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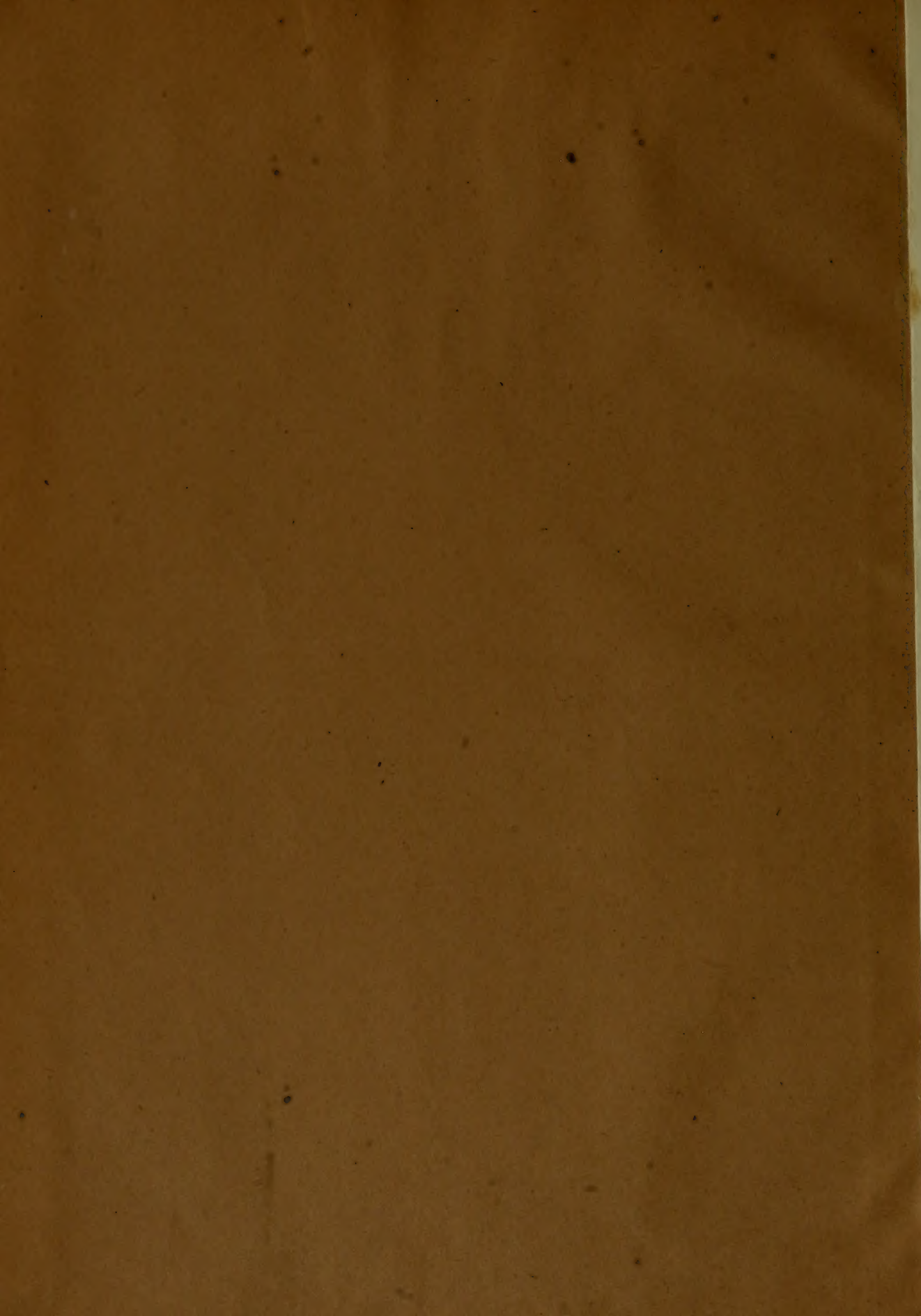
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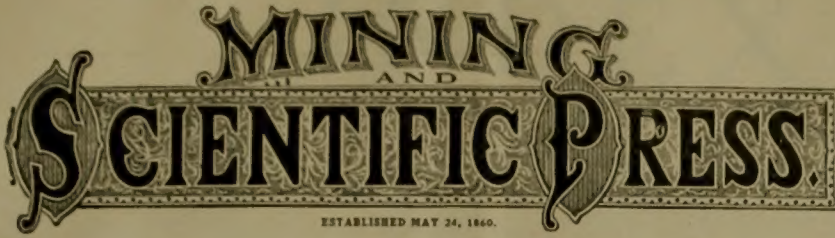
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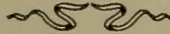
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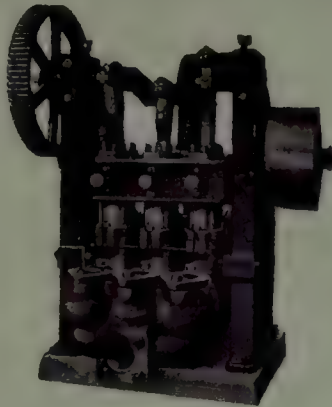
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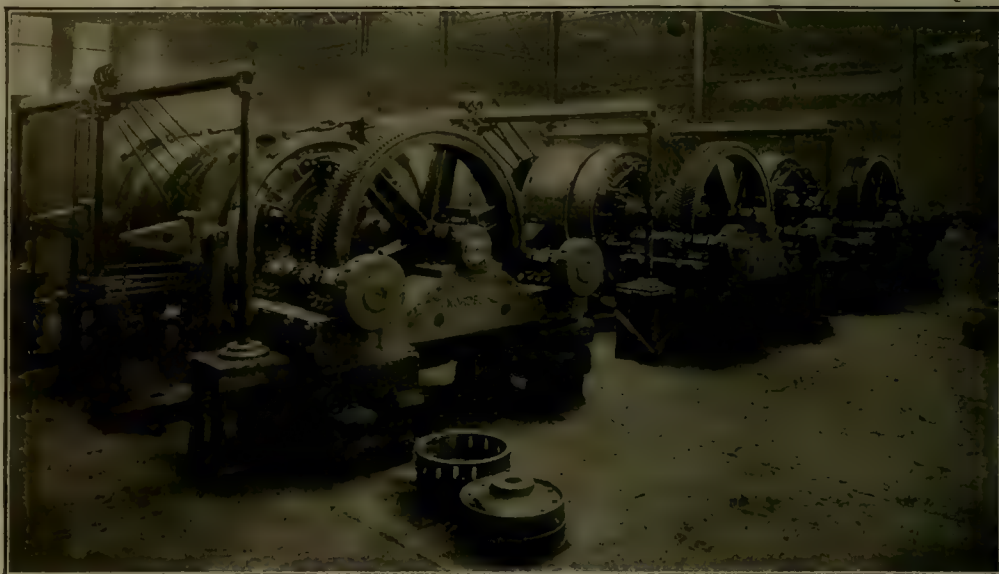
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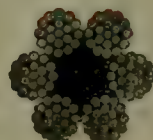
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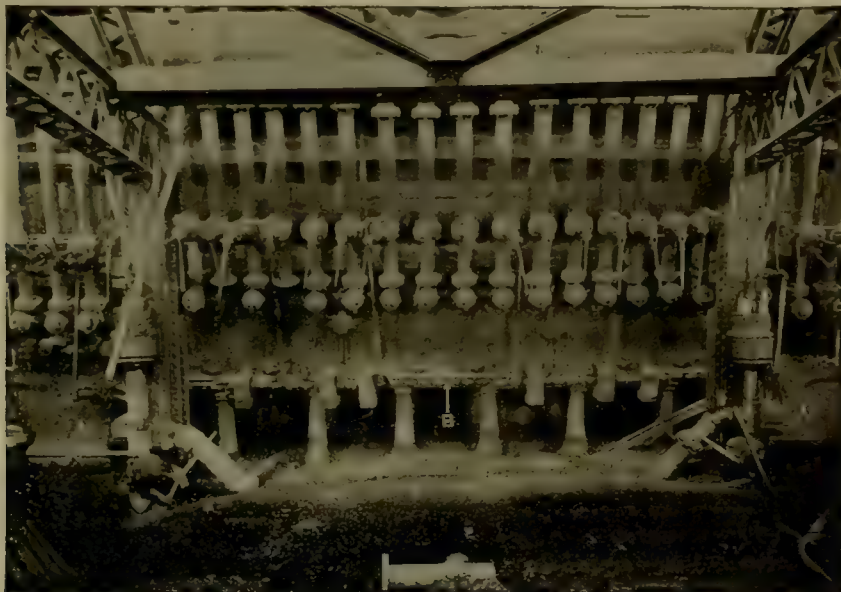
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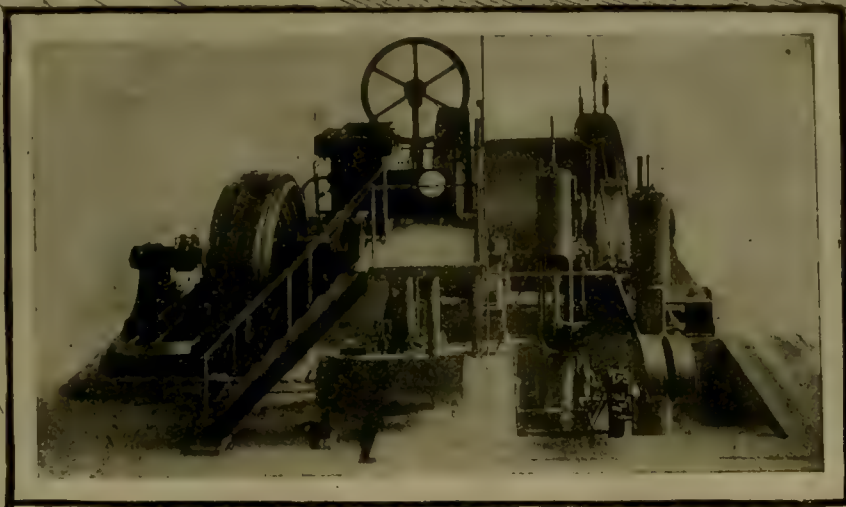
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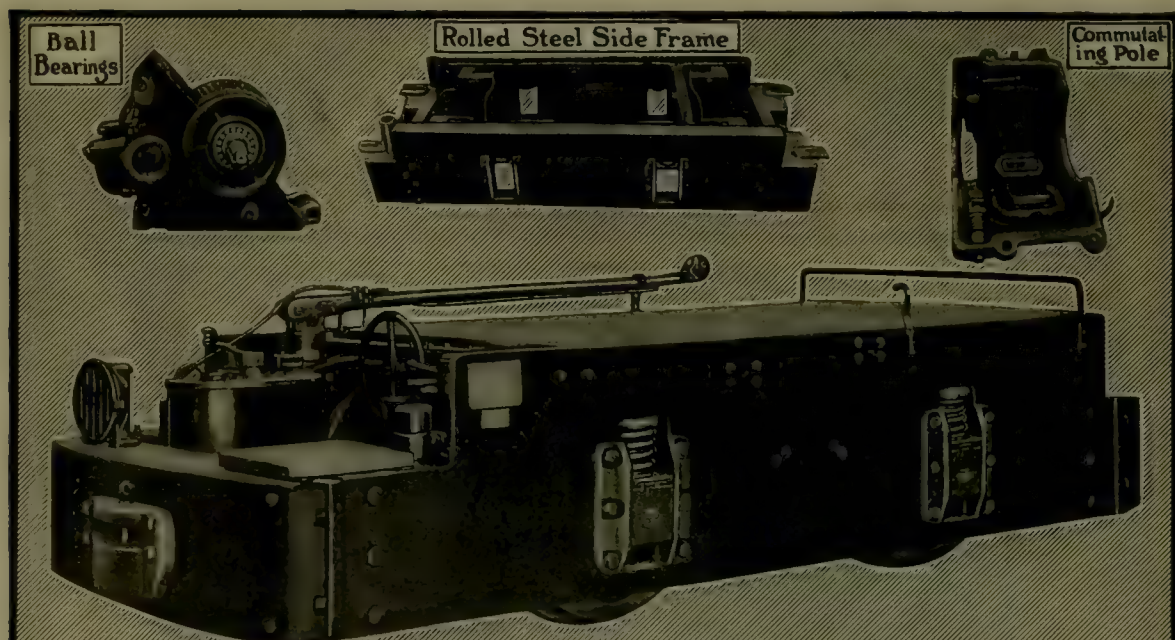
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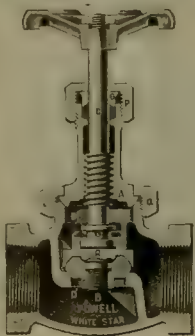
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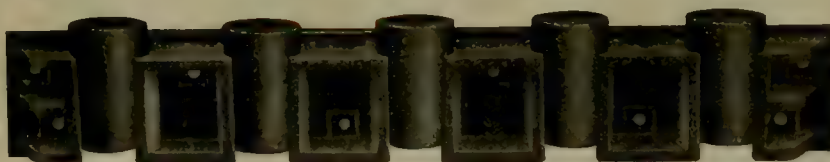
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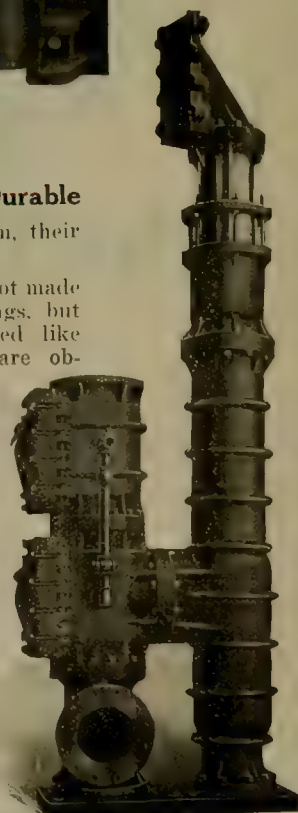
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Does this justify a motor truck?

Suppose you are crushing one hundred tons per day with your stamps, and everything is moving along like clockwork. Your daily average gross revenue is about \$600. The mill is twenty odd miles of hard haul from the railroad. Fine!

One day one of the cam shafts breaks without warning. A new one is ordered to come by express. Half the mill must lie idle until the new shaft is delivered and installed. Ten idle stamps result in a loss of \$12.50 per hour.

It will take the mine team twenty-four hours to make the round trip to the railroad.



A MORELAND DISTILLATE MOTOR TRUCK

sent from the mill can deliver the shaft in less than five hours.

Here is an emergency of frequent occurrence, in which the truck can save at least \$240. This justifies a motor truck.

A mine need not be so remotely situated or the conditions so severe as at this mine to prove a motor truck a profit maker. The truck can do the same amount of work as performed by from three to six horses. It lowers labor expense now required to care for the horses (or mules). The truck can operate regardless of weather conditions which incapacitate or kill horses. (Experience shows that a horse wears out in five years.)

If both cam shafts should break, the mill would be forced into complete idleness, but the truck will require no feed,

bedding or attendance while not working. It can deliver new shafts or other machinery promptly, and when the mill is working again, the truck will haul two or three shifts per day as long as necessary. It will carry overload if the emergency demands. This justifies a motor truck.

A MORELAND DISTILLATE Motor Truck operates with a fuel saving of at least fifty per cent over any gasoline truck. Distillate contains approximately twenty per cent more power per gallon than does gasoline. Does this justify a MORELAND DISTILLATE Motor Truck? We have proved it to many men in whose business heavy hauling is an important factor.

Write for free information, blue prints, etc., stating your road conditions, length of haul, grades, nature of product to be hauled, etc., and allow us the privilege of submitting you an intelligent proposition for your special requirements.

MORELAND MOTOR TRUCK COMPANY

LOS ANGELES, CAL.

Branches:

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Fresno, San Diego

Factory, General Offices, Salesrooms:
1701-1751 No. Main St., Los Angeles, Cal.



PUMPING PROBLEMS SOLVED

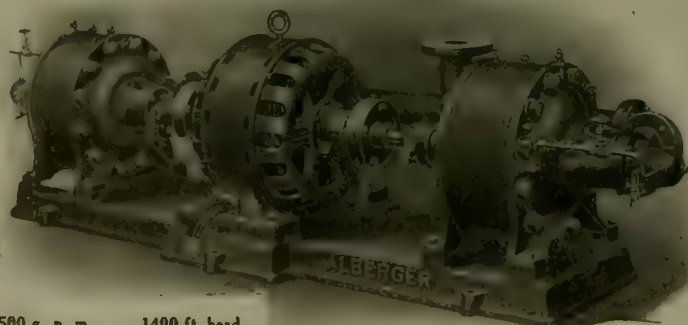
If there is a way to meet them properly with
CENTRIFUGAL PUMPS,

the ALBERGER staff will find that way.

To insure the ultimate possibilities for success and economy in your installation, wouldn't you be glad to place your problem in the hands of highly trained and experienced engineers?

The ALBERGER staff will supply exactly that kind of service.

Alberger Centrifugal Pumps



580 g. p. m. 1400 ft. head
1750 r. p. m. 72% efficiency

5 inch ten-stage Motor Driven Turbine Pump.

ALBERGER CENTRIFUGAL PUMPS being designed on correct principles are the most successful in meeting the rapidly increasing application of CENTRIFUGAL PUMPS to MINE PUMPING SERVICE.

Let us send you our Catalog D-10.

ALBERGER PUMP & CONDENSER COMPANY

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ROOT SPIRAL RIVETED PIPE

For Hydraulic Mining, Water Supply, Compressed Air, Exhaust Steam, Etc.

Lighter, stronger, more rigid and can be installed for lower cost than any other pipe of equal capacity. Galvanized or asphalted, with bolted or flanged joints.

A Standard For Over Forty Years



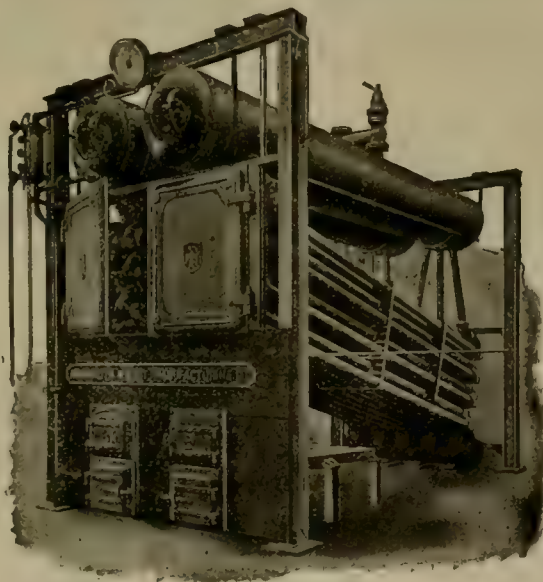
ROOT IMPROVED WATER TUBE BOILERS

In Units from 10 to 400 H.P.

Made sectional, if desired, for mule-back transportation. Strong in construction, with low cost for operation and maintenance.

Heavy Steel
Plate Cyanide
and Agitation
Tanks

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Machine Work

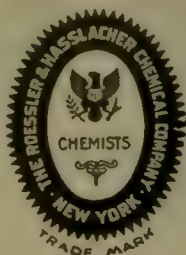


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Your
Requirements
For
Prices

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SALES OFFICES: 50 Church St., New York, N. Y.



THE
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NEW YORK

WORKS: PERTH AMBOY, N. J.

Cyanide

98-99%

(Old Standard)

39-40% Cyanogen

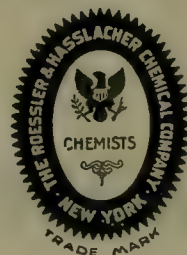
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ALL OTHER CHEMICALS
FOR MINING PURPOSES



MARION ELEVATOR DREDGES



*There are Three 16 Cubic Foot Marion Elevator Dredges
in the Bonanza Basin near Dawson.*

UP IN THE YUKON AND ALASKA

where work can be done only during a few favorable months, the demands on Gold Dredging Equipment are most exacting. During these few working months men and machinery are keyed to their highest pitch. **Output—big output** must be had. That's why **Marion Elevator Dredges** are used—they stand up under the test—they take the peak load and walk away with it. Marion Dredges are designed right—they are built right.

Our Engineers are at your service

THE MARION STEAM SHOVEL CO.

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CHICAGO: 1442 Monadnock Block

NEW YORK: 50 Church Street

ATLANTA: 1411 Candler Bldg.

Vancouver, Seattle, Spokane, Tacoma, Portland, San Francisco: E. P. Jamison & Co.

International Engineering Congress, 1915

San Francisco, Sept. 20-25

in connection with the

Panama-Pacific Exposition

There will be held in San Francisco in 1915 a general international engineering congress under the auspices of the following five national engineering societies:

American Society of Civil Engineers
American Institute of Mining Engineers
The American Society of Mechanical Engineers
American Institute of Electrical Engineers
The Society of Naval Architects and Marine Engineers

The sessions will be held in 10 sections and the proceedings will be published in 10 volumes of about 500 pp. each, with a somewhat smaller volume containing all general proceedings and an index digest of all papers.

The subdivision into sections with titles of volumes of transactions are as follows:

- Vol. I The Panama Canal
- Vol. II Waterways and Irrigation
- Vol. III Municipal Engineering
- Vol. IV Railways & Railway Engineering
- Vol. V Materials of Engineering Construction
- Vol. VI Mechanical Engineering
- Vol. VII Electrical and Mechanical Engineering
- Vol. VIII Mining Engineering and Metallurgy
- Vol. IX Naval Architecture & Marine Engineering
- Vol. X Military Engineering

Engineers throughout the world are invited to become members whether or not they may be able to attend the Congress.

The membership fee of \$5.00 will entitle holder to the volume of general proceedings and index digest and to any other single volume according to choice. Other volumes may be subscribed for according to a sliding scale depending upon the number of volumes taken.

Circulars giving full information accompanied by form of application for membership will be forwarded on request.

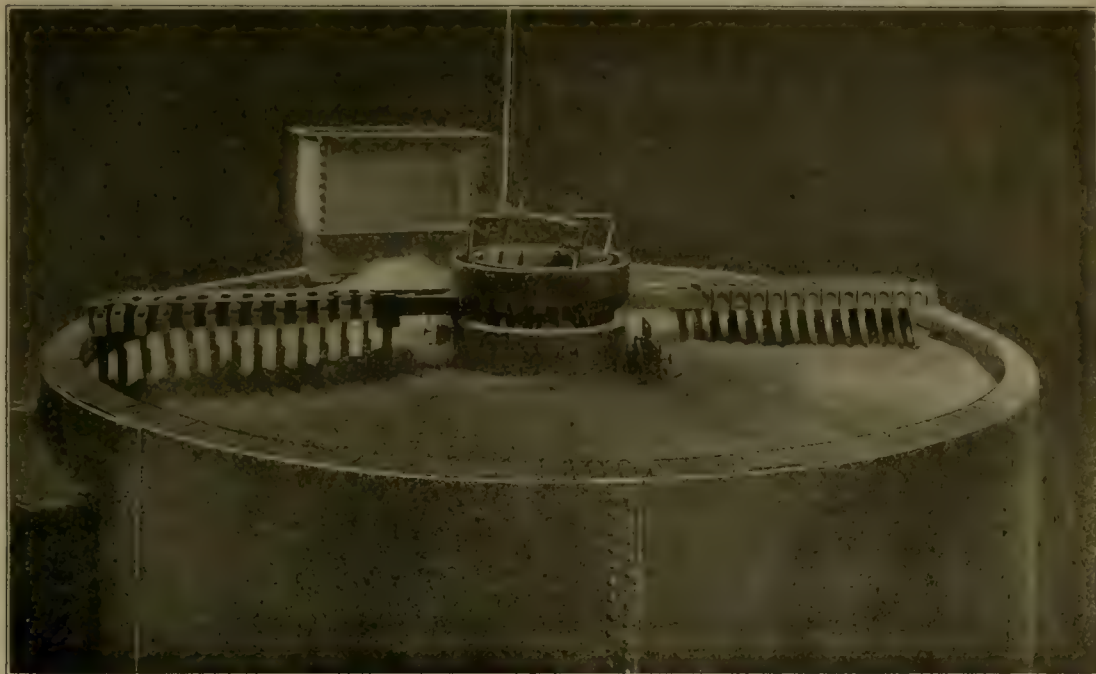
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W. A. CATTELL, Secretary

Foxcroft Building,
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The Wedge Mechanical Furnace

PATENTED



Conservation of Heat

Multiple hearth Wedge Roasting Furnaces conserve heat, for the following reasons :

The central shaft need not be cooled by air or water. It is protected from the roaster gases by special fire brick.

Each arm having its independent air or water connection, the cooling of the arms may be regulated accordingly.

The top of the furnace is used as a dryer hearth. Heat otherwise lost through the top arch is absorbed by the ore fed to the furnace, expelling moisture and bringing the temperature of ore, when entering the first roasting hearth, closer to the required roasting temperature.

Write us, stating analysis of ore, concentrates, mixture or material you desire to roast, characteristics and physical condition of same, number of tons to be treated per twenty-four hours, and results desired in the calcine.

Wedge Mechanical Furnace Company

115 CHESTNUT ST., PHILADELPHIA

International Smelting & Refining Company

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———— PURCHASERS OF ————

Gold, Silver, Copper and Lead Ores

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The Economy of This Sinker Must Appeal to You

It is the most economical type of a sinker pump and it's so designed that it can be hoisted in a few seconds out of the way of workmen or for blasting.

You obtain a pump occupying smallest space for a given delivery, so designed that it is least liable to get out of order, with only the discharge pipe in the shaft and balanced so that it can be placed in any position in the shaft in the

"American" Turbine Sinker Pump

It is balanced by having a divided discharge pipe by the frame to the discharge pipe which extends up from the center of the frame.

The pump is suspended by cables and sheaves from a hoisting drum at the surface so that it can be quickly raised or lowered.

It is so designed that it will not overload the motor under variable head, which is an important feature in a centrifugal pump.

It is provided with grit-proof bearings above and below the impellers so that it is impossible for grit to get into the main bearings.

It is made in any number of stages, the six stage, as illustrated, being adapted to operate against any head to 200 feet.

And it combines all of these economic features with none of the valve troubles incident to old style plunger pumps—there's nothing about it to get out of order—just the rotating impellers keyed onto the main shaft operating in grit-proof chambers.

Write for the complete story. The most complete centrifugal pump catalogs ever issued, Nos. 117 and 124, for the asking if you only say you want them.

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LAP WELDED STEEL PIPE



Large Diameter Lap Welded Pipe

Sizes 12 to 72 inches. Thickness $\frac{1}{8}$ to $1\frac{1}{4}$ inches. Lengths up to 40 feet.
Coated with the highest grade Mineral Rubber Asphalt Coating. Each length subjected to Hydraulic Test 50% greater than specified working pressure.

**Specially Suited for HIGH PRESSURE WATER LINES, GAS, VACUUM
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*Our Prices and Prompt Deliveries will interest you
LAP WELDED PIPE CATALOG sent on request*

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**SPIRAL RIVETED PIPE, LAP WELDED STEEL PIPE, FORGED STEEL PIPE
FLANGES, EXHAUST STEAM AND HYDRAULIC SUPPLIES**



Lower Costs and Better Results

Both Advocate Strongly the Use of

Justrite Half-shift Carbide Lamps

in Your Mine

Look at the new lever feed: Simply moving the lever to right or left increases or decreases the flow of water to just the amount necessary. This permits a strong, steady light always and no waste of carbide.

Look at the capacity: When the miner starts down into the shaft with his Justrite, he has enough water and carbide in the lamp to burn $4\frac{1}{2}$ hours, a full half shift. You know the time that saves.

Look at the feed valve perfectly protected from clogging. No shaking necessary.

Look at the simple self-lighting attachment. No matches necessary.

Look at the adjustable and detachable holder made of strong steel wire. The miner can stick his lamp into the timbering just as he would a candle, and then turn it so as to focus the light on his work.

Do You Know—
that lighting your mine with candles or oil costs you two to three times as much as it costs with carbide lamps?

Look at the polished brass reflector that is part of the substantial seamless drawn brass body. Look at the notched plate that prevents the feed regulator shifting. Look at the weight—only 12 ounces when fully loaded. Look at the strength of the construction by which all parts are securely riveted not soldered.

Then, remembering that this lamp costs you no more than other carbide lamps, answer this question:—

"Can you with justice to your miners and yourself neglect investigating the lower costs and better results of Justrite Half-shift Carbide Lamps?"

Your inquiry will be promptly answered. **Write.**

We manufacture a complete line of carbide lamps, lanterns, and supplies for Engineers, Superintendents, Inspectors, Shift Bosses, etc., as well as for miners.

Get our catalog.

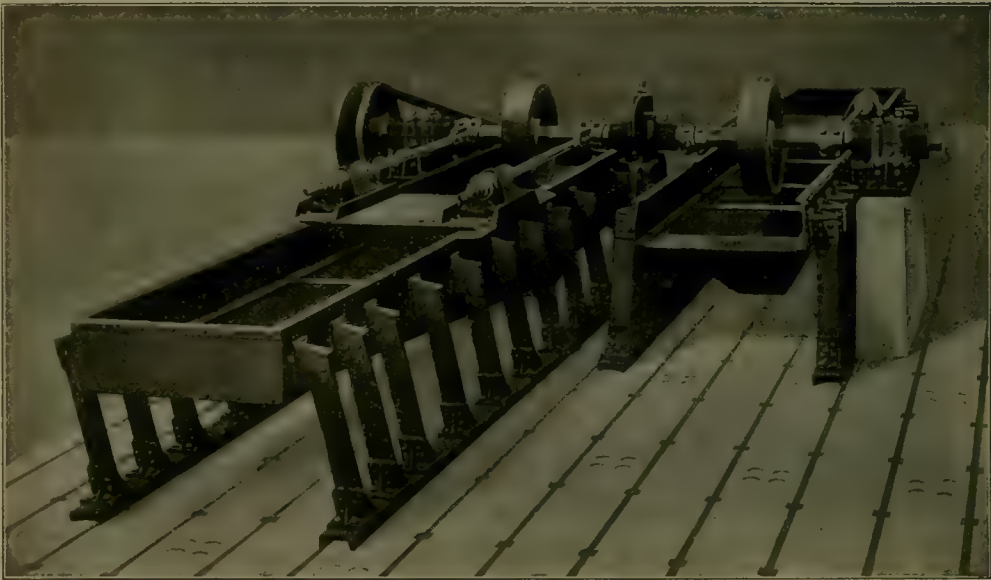
Justrite Manufacturing Co.

546 VAN BUREN ST., CHICAGO, ILLINOIS

DODGE

Dodge-Zimmer Conveying System

The Short Direct Way to Convey
Raw, Finished and Waste Materials



Dodge-Zimmer Conveyor Under Test in the Dodge Machine Shops at Mishawaka, Ind.

THE economical transportation of material is the greatest problem in the mining field, and notwithstanding the perplexity of the individual case, there is one underlying thought always dominant—the upkeep cost.

First cost has its proper consideration, as does the power cost, but the bugaboos of rapid wear and tear, early and frequent replacement, shut-downs, etc., most deeply concern the operator. In the Dodge-Zimmer conveyor we have evolved a system that comes nearer keeping down the cost and overcoming the defects of conveying machinery generally than anything yet placed on the market. The keynote of our new conveyor is simplicity—the short, direct way to efficiency and economy in conveying raw, finished, and waste materials.

No conveying system is today offering such desirable features and advantages covering a wide range of uses, so completely fulfilling the needs of all conveying processes, nor at low cost of investment, requirements of power or low cost maintenance per unit of measure and distance traversed, than the Dodge-Zimmer.

As a means of getting it before the trade, we have issued a handsome pamphlet carrying illustrations in halftone and line effects, with details on the general make-up. To the mining operator or engineer it is a message of importance well worth asking for. A request will bring it to you in the next mail, with any other information you desire.

Dodge Manufacturing Company

Elevating and Conveying Engineers
Mishawaka, Ind.

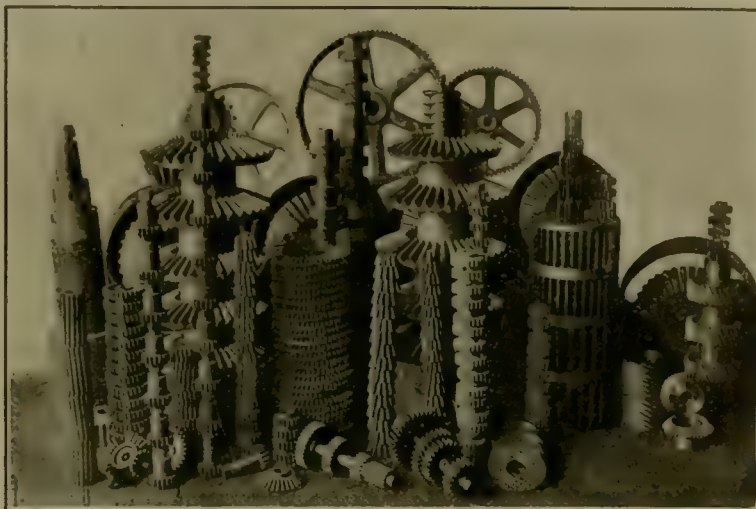
Dodge Manufacturing Co., 14th and Lovejoy Sts., Portland, Ore.
Harron, Rickard & McCone, San Francisco and Los Angeles

Hendrie & Bolthoff Mfg. & Supply Co., Denver
Mine & Smelter Supply Co., Salt Lake City and Denver

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Put your gear problems up to Us

You must realize that twenty-five years experience and the largest gear cutting plant on the Pacific Coast, render us most competent to advise to your best interests and to produce gears embodying every essential of service satisfaction.

We are ready to quote on one or a thousand gears for any mining requirement. A first order will convince you that our product is RIGHT in every way.

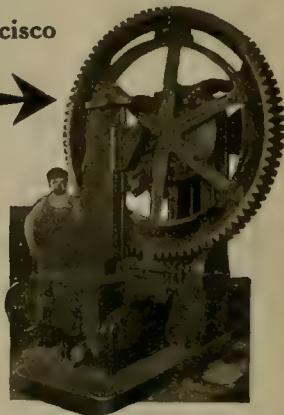
Put your gear problems up to Us. Ask for Bulletin

Pacific Gear & Tool Co.

1035 Folsom Street

San Francisco

This illustration shows cutting the largest gear cut in the West. It was an emergency gear required by the Pacific Gas & Electric Co. of San Francisco. We saved them fully three weeks time, and delivered this 92-inch diam., 8-inch face gear. That was eight months ago, and it is doing regular duty.



"EMPIRE" PLACER MACHINERY

ASSURES MAXIMUM PROFITS IN PLACER OPERATIONS



An "Empire" Drill in Korea

"EMPIRE" GOLD DREDGES

When it comes to working a placer ground, profits depend upon the dredge equipment. "Empire" Dredges have made records for low operating cost, durability, and large yardage wherever used. The "Empire" Dredge pictured here has handled 130,000 cubic yards per month at a cost of 2.4 cents per yard.

"EMPIRE" PROSPECTING DRILLS

In the beginning of a placer proposition, accurate data as to the mineral content of the ground is the first essential. This the "Empire" Drill gives — with greater accuracy, in less time, at less cost, with a smaller initial outlay, than any other means of placer testing. The "Empire" here illustrated is one of two which drilled 4112 feet of hole in 127 days at an average cost of 8.7 cents per foot.



An "Empire" Dredge in The Philippines.

"EMPIRE" SERVICE

We are the only concern in the world devoted exclusively to the building of placer mining machinery. To our unequaled facilities for manufacture and quick delivery we add an engineering skill and practical experience in placer work which is the basis of "Empire" Service. We will study your individual problem and advise you with authority not only on the best equipment but also on the best methods of procedure.

Send For The "Empire" Books.

New York Engineering Company
Dredge Engineers

2 Rector Street

New York

THE IMPERIAL DRILL SHARPENER

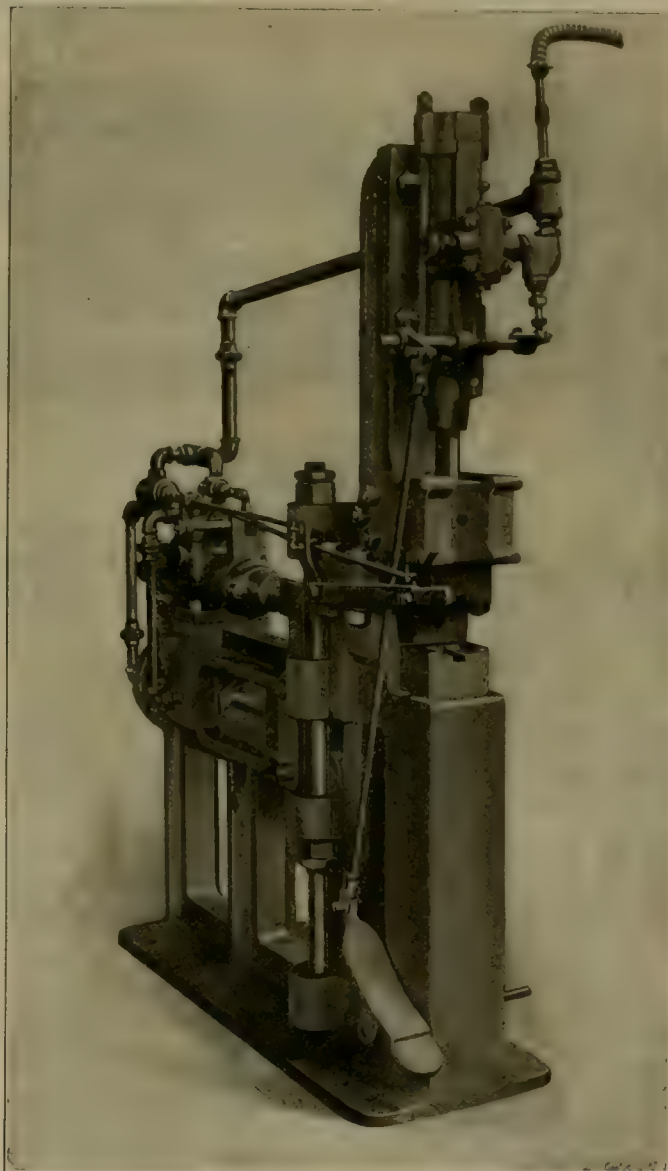
Will make
and
sharpen
Drill Bits
up to
3 in. wide.

Every bit
made to
the exact
gauge.

Using less
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50 feet
of air.

Simple
and easy
to operate.

Weight
2500 lbs.



Is guaran-
teed
against
breakage
for one
year.

Is strong
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durable,
there are
no springs
or delicate
parts
to break.

Requires
only
18"x48"
of space.

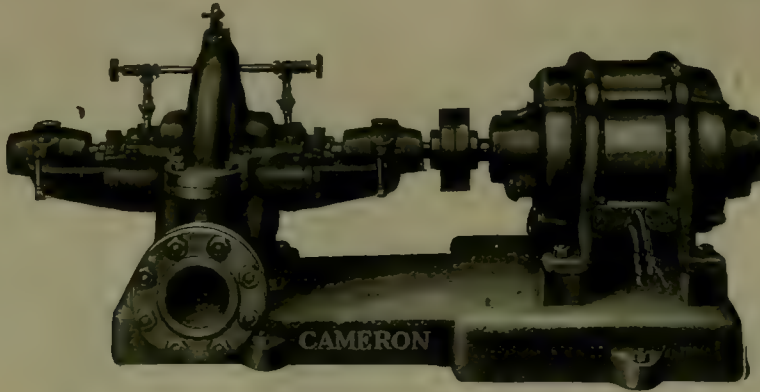
**Price complete with all necessary Dies and Dollies F.O.B.
Denver, Colorado, \$800.00**

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The Slogan of the Cameron—"Character: The Grandest Thing."

In Close Quarters Underground



You will find Cameron Centrifugals

the most convenient, and ultimately by far the most economical pumps for keeping the mine dry.

Compactness

Cameron Centrifugals are compact, so that they can be set in the frequently-contracted space available for pumping stations underground.

Accessibility

Every part of these pumps is readily accessible. Note the horizontally-split casing. By merely lifting the upper section the whole interior is exposed to view.

Efficiency

Their efficiencies are high. This "CAMERON" advantage is realized to the full in mine pumping, where the pulls are long and very seldom interrupted.

Up-Keep

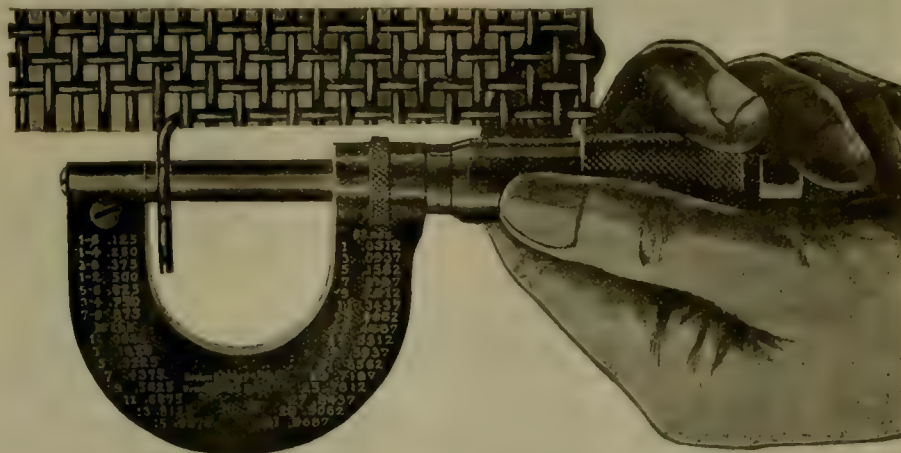
Exact care in manufacture and great simplicity of design renders the up-keep of "CAMERON" Centrifugal Pumps very low.

**Bulletin S-D-68 tells the full
Cameron story. Write for a Copy.**

A. S. CAMERON STEAM PUMP WORKS
11 Broadway, New York

The Precision of a Micrometer

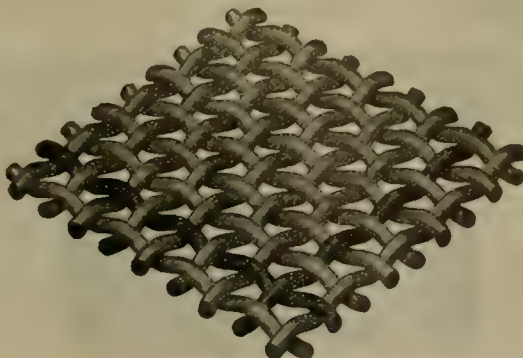
IS REQUIRED IN THE CONSTRUCTION OF



Ludlow-Saylor Double Crimped Mining Screen

The precision of a micrometer is required to detect variation in the screened product that it handles, due to the DOUBLE CRIMP that is put into the wire before it is woven, preventing the wires from shifting or "giving" under the strains imposed, and insuring a uniformity and permanency of mesh that has made LUDLOW-SAYLOR a synonym for satisfaction in mining screen.

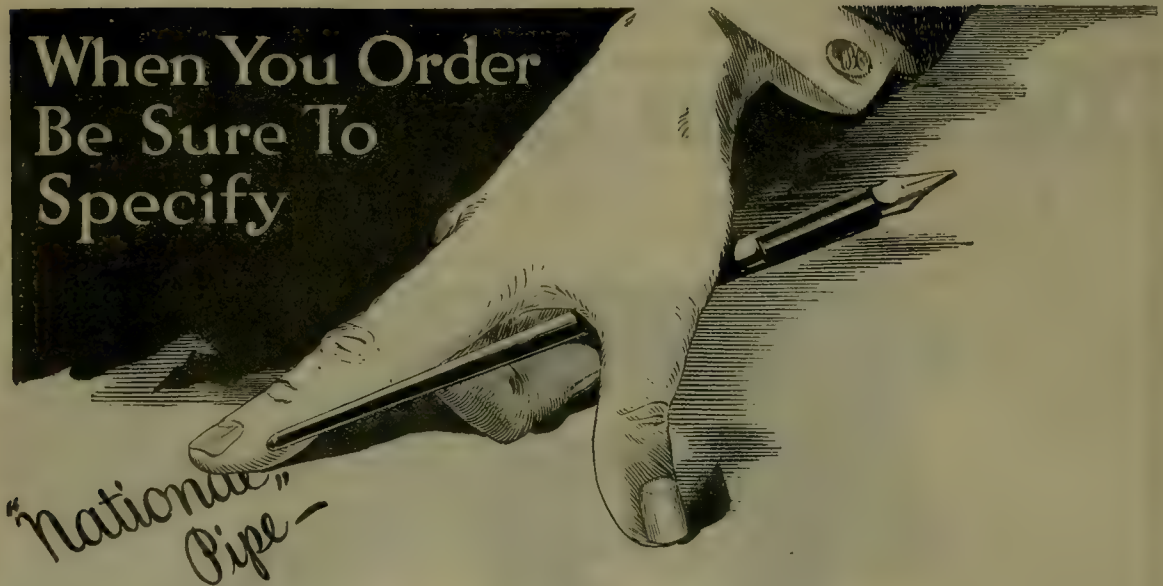
The conditions under which mining screen is used are variable but severe, and the best wire made has a limited lease of life. But LUDLOW-SAYLOR Screens, due to the rigidity with which they hold their mesh and preserve their accuracy of alignment, reduce the process of wear and confine it to the abrasive effects of the sand, ore or other material as it passes through the meshes of the screen.



The precision of the micrometer suggests the care that is taken to make LUDLOW-SAYLOR DOUBLE CRIMPED MINING SCREEN a necessity where absolutely uniform results are required and where "screen insurance" is desired in its simplest, surest form.

Our catalogue, No. 45, is a compendium of information on screens for all purposes and explains in detail the virtues of the DOUBLE CRIMP.

Ludlow-Saylor Wire Co. St. Louis, Mo.



¶ An order which simply says "pipe" is not complete.

¶ "Pipe" may mean any pipe—and there is about as much difference in pipe as there is in men.

¶ All pipe should be the standard—tested—known brand—"NATIONAL"—if you wish your pipe lines to be permanent and ultimately most economical.

¶ The following paragraph would be a good one to cut out and paste down where you and every one else would see it when ordering pipe:

¶ "All pipe to be 'NATIONAL' Pipe as manufactured by National Tube Company, sizes 3-4 inch and larger to have the name 'NATIONAL' rolled in raised letters on every few feet of length, and on the smaller butt-weld sizes the name 'NATIONAL' to appear on the metal tag attached to each bundle of pipe."

Ask for N. T. C. Bulletin No. 12A—this bulletin has recently been enlarged and revised and contains a summary of information about "NATIONAL" Pipe—When you read it you will keep it on file for permanent use—It's free.

¶ To readily identify "NATIONAL" material and as protection to manufacturer and consumer alike, the practice of National Tube Company is to roll in raised letters of good size on each few feet of every length of welded pipe the name "NATIONAL" (except on the smaller butt-weld sizes, on which this is not mechanically feasible; on these smaller butt-weld sizes the name "NATIONAL" appears on the metal tag attached to each bundle of pipe).

MARKING



Name Rolled in Raised Letters on National Tube Company Pipe

¶ When writing specifications or ordering tubular goods, always specify "NATIONAL" Pipe and identify as indicated.

¶ In addition, all sizes of "NATIONAL" welded pipe below four or five inches are subjected to a roll-knobbling process known as Spellerizing to lessen the tendency to corrosion, especially in the form of pitting. This Spellerizing process is peculiar to "NATIONAL" pipe, to which process National Tube Company has exclusive rights.

NATIONAL TUBE COMPANY, GENERAL SALES OFFICES Frick Building, Pittsburgh, Pa.

District Sales Offices: Atlanta, Boston, Chicago, Denver, Kansas City, New Orleans, New York, Philadelphia, Pittsburgh, St. Louis, St. Paul, Salt Lake City
 Pacific Coast Representatives: U. S. STEEL PRODUCTS CO., San Francisco, Los Angeles, Portland, Seattle
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YUBA GOLD DREDGES

Suction Dredges

Centrifugal Pumps

Yuba "Ball Tread" Tractors



Yuba No. 14. Ready to Operate, December 18th, 1913.

Yuba No. 14, now in operation, is equipped with buckets of 16 cu. ft. capacity each, and was designed and built by The Yuba Construction Company for the Yuba Consolidated Gold Fields. This dredge is capable of digging 70 feet below water level. This is the sixth dredge of 15 cu. ft. capacity, or larger, that we have built. Yuba No. 14 has a steel hull, steel housing and steel gold saving tables, and is the fifth ALL STEEL dredge we have built to date.

THE FIVE ALL STEEL DREDGES

- A 9-cubic foot dredge for the Oroville Dredging Co., Ltd., Colombo, S. A.
- Natoma No. 7—A 9-cubic foot dredge for Natomas Consolidated of California
- Natoma No. 8—A 15-cubic foot dredge for Natomas Consolidated of California
- Natoma No. 10—A 15-cubic foot dredge for Natomas Consolidated of California
- Yuba No. 14—A 16-cubic foot dredge for Yuba Consolidated Gold Fields

In addition, we have had a wide experience in designing and building dredges for tropical countries as well as for properties where inaccessibility demands smaller and lighter dredges.

We are prepared to design and construct gold dredges with either steel or wooden hulls, equipped with buckets of from 1½ cu. ft. to 16 cu. ft. capacity each.

We represent the Bucyrus Company on the Pacific Coast and in Alaska and the Orient for Placer Dredge Machinery.

The Yuba Construction Company

Works : Marysville
California

Main Office : 433 California Street
San Francisco, Cal.

18,000 Wilfley Concentrating Tables Now In Service

Ten Times More Than All
Other Makes Combined



The Wilfley Table is so widely known and so universally preferred that there is not the slightest chance for you to be misled in the selection of a Wilfley. It has attained its pre-eminence in the mining industry only because it has been the most successful.

Ask the users—any of them, anywhere. Go to some of the plants in your vicinity and see the Wilfleys at work.

Then you will know why there are over 18,000 in service—then you will be sure to specify Wilfleys for your plant.

Write us for Bulletin No. 25 and further particulars.

The Mine and Smelter Supply Company

Denver Salt Lake City El Paso Mexico City

New York Office, 42 Broadway

Sole Owners and Manufacturers of the Wilfley Concentrator.

Also Sales Agents in Utah, Nevada, Idaho, Montana for Hardinge Mills.

OVOCA CLASSIFIER

Moisture in Tailings Reduced to 15 Per Cent

Unwatering Tailings

In sluicing tailings out from a mill, 75 to 80 per cent of the sluicing water may be recovered with this Classifier, for use again in the mill system—an important feature where water is scarce.

At the mill of the Ozark Smelting & Mining Company, Magdalena, New Mexico, the Ovoca Classifier is used to unwater the mill tailings for final stacking and re-use of mill water. The tailings are delivered to the Ovoca Classifier with about seven of water to one of ore by weight.



UNWATERED TAILINGS—OZARK MILL

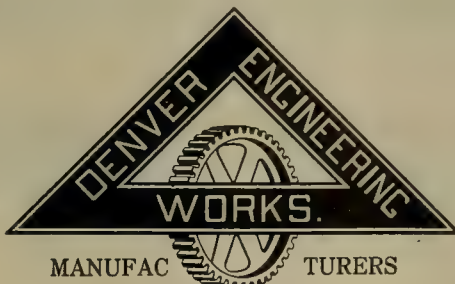
The Classifiers were able to reduce the water in the tailings to 15 per cent, but the material piled up too steep and the moisture in the delivered tailings was therefore increased to 20 per cent, which permits the tailing to move in thick turgid streams down the tailings stack. See Fig. 0261.

The angle of the slope of the tailings stack is 55°, showing how completely the tailings may be unwatered and at the same time recover a large proportion of the mill water.

ASK FOR BULLETIN 10622

D E N V E R,

Mining and Milling Machinery
Electric Hoists
Richards Pulsator Jigs
Richards Pulsator Classifiers
Ore Crushers



MANUFACTURERS

Crushing Rolls
Mine Cages
Stamp Mills
Tube Mills

COLO., U. S. A.

Mine Timber Framing Machinery
Revolving Screens and Grizzlies
Automatic Samplers
Sample Grinders
Ore Buckets



THE UNITED STATES OF AMERICA

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Patents obtained and Trademarks registered in every Country in the World.

Write for our Handbook to Inventors containing over 100 Mechanical Movements. Sent free on request.

Attention is called to the Notices of Patents obtained through Us, which appear each Week in the MINING AND SCIENTIFIC PRESS. These notices are inserted without Expense to Patentees.

THE PARRAL TANK SYSTEM OF SLIME AGITATION

(Patented)

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Modus Operandi

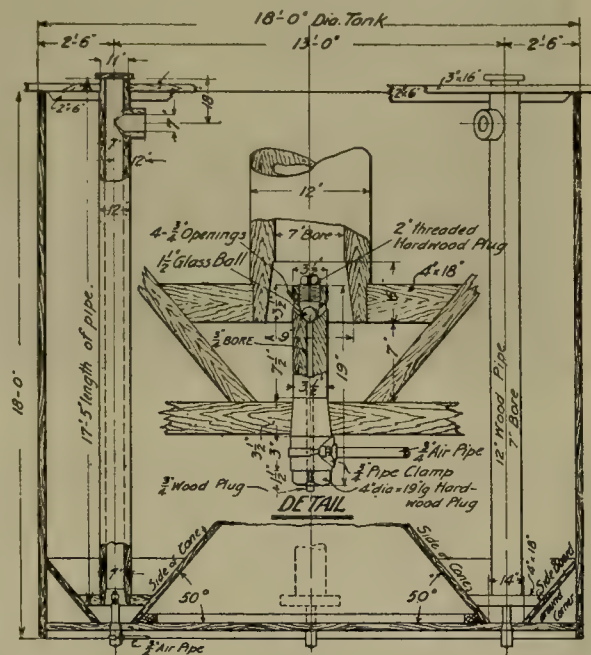
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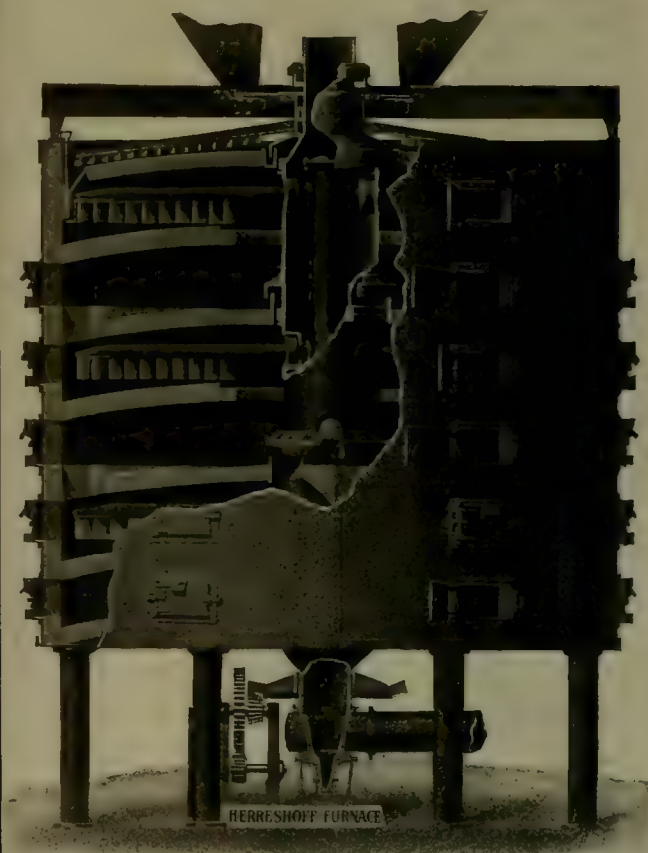


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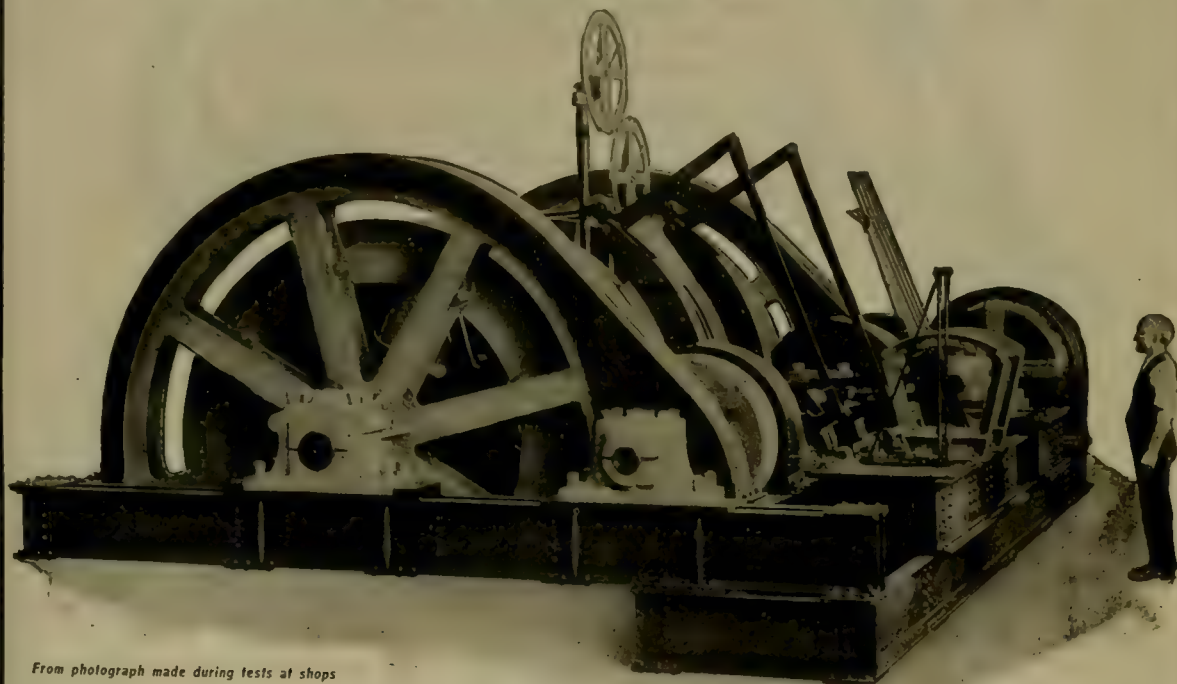
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Double-Drum Electric Hoist For 2000-Foot Double Compartment Shaft

DATA

Drums, each, Dia. 84", Face 50", Brake Flange 96". Hold 2000 ft. 1" Rope. Drum Gear, Dia. 9' 9½", Face 9". Cast Steel. Pinions, Dia., 18½". Gearing throughout, double Herring-Bone Cut teeth. Post Brakes, V-shaped woods. Dial indicators for 2,000 ft. of Rope. Gear Reduction 16.06 to 1. Motor ITC 5017, 300 H.P., 575 R.P.M. Current, 3-Phase, 60 Cycles, 2200 Volts. Bed, extreme length 15' 9½", extreme width 26' 3½". Extreme height 13' 6". Height from top of I-Beams to top of Indicators 9'. Duty 9000 lbs. 800 R.P.M. Weight of hoist 72,000 lbs. Structural steel bed to be set in concrete up to tops of I-Beams.

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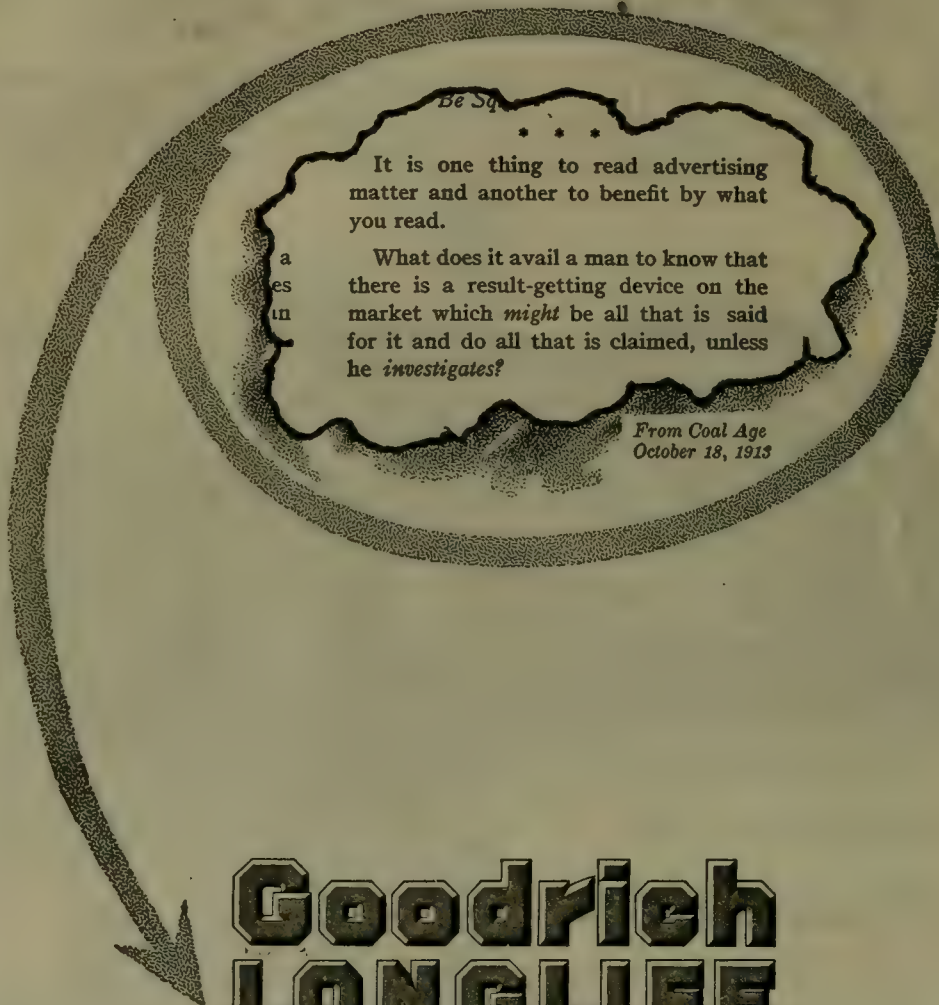
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October 18, 1913

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The Risdon Johnston Concentrator has found its way in all of the mining camps of the world.

The Utah Copper Co. has 1184 machines in one plant—

The Boston Consolidated Mining Co., 234.

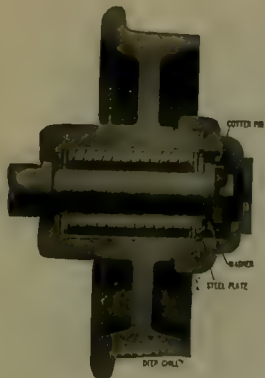
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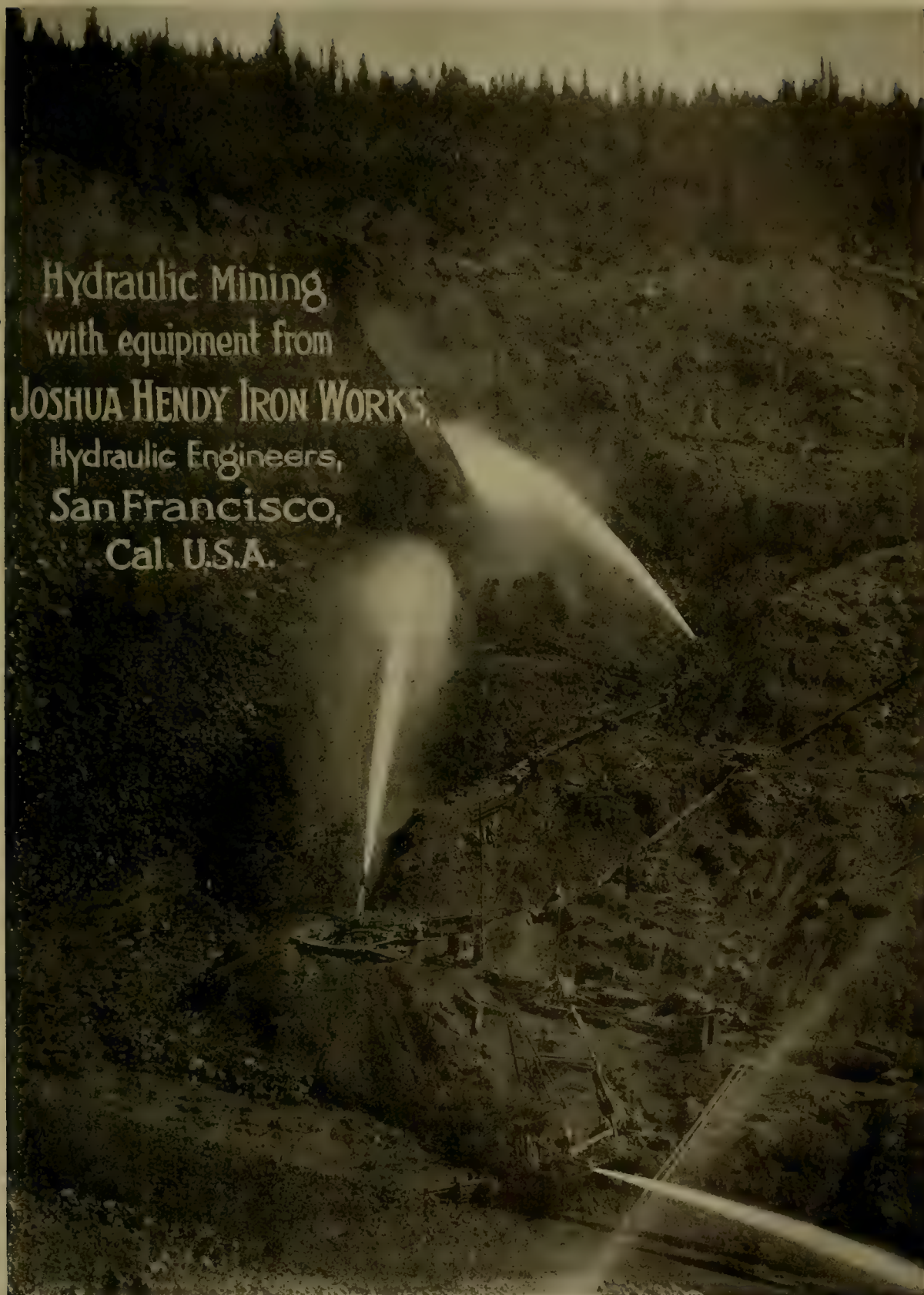
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By reason of demands of the Trustees of estates holding claims against the Glasgow & Western Exploration Co. Limited, that company has been put into liquidation in Scotland, and Mr. William Lamont of 33 Renfield St., Glasgow, has been appointed liquidator.

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To facilitate a realisation of these properties a comprehensive report has been prepared, and correspondence is solicited from substantial mining interests.

Communications should be directed to

JOSEPH RALPH, Assoc. Inst. M. M.,
Attorney-in-Fact for the Liquidator,
The Glasgow & Western Exploration Co. Limited,
416 Walker Bank Building,
Salt Lake City, Utah.

MINING AND SCIENTIFIC PRESS

"Science has no enemy save the ignorant."

Whole No. 2789

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SAN FRANCISCO, JANUARY 3, 1914

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ESTABLISHED MAY 24, 1860

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EDITORIAL

Greeting

It is the Editor's privilege once a year to write directly to his readers, contributors, and advertisers a word of thanks for their support, and it is a pleasant privilege and a valued one. There is a bond between reader and Editor that grows with the years, and in the case of the *Mining and Scientific Press* it is pleasant to know that the tie is close. Despite the admittedly bad year and the disturbed conditions in Mexico which have forced economies in the budgets of many mining men, 'stops' have been less than had been anticipated, and the total number of paid subscribers to the *Press* has been steadily increasing since April.

If less immediately profitable than some of its predecessors, 1913 has been an unusually interesting one to members of the editorial staff. Early in the year it was found possible to carry out long-cherished

plans for opening an editorial office in New York, and Mr. Read, hastily packing his dictionary and thesaurus, left for the city on the Hudson. The move has proved a wise one in that it has made possible a marked improvement in the paper. To take Mr. Read's place in San Francisco, Mr. E. H. Leslie came up from Mexico, where he had been doing excellent work on the staff of our interesting southern contemporary, the *Mexican Mining Journal*. About the same time Mr. Gelasio Caetani joined our staff of Special Contributors and began to furnish those delightful essays in which sound technical knowledge is so mingled with homely common sense, that there have been many calls for more. Late in the year Mr. Frederick H. Morley came down from the mountains of Colorado to give to the readers of the *Press* from his store of experience and observations.

Attentive readers will have noted the large space devoted this year to flotation and copper metallurgy. Both subjects have been big with interest, and both promise much for the future. It will be the effort of the Editors to continue to print the most accurate information on these subjects and to give to the *Press* the same peculiar standing on these lines that it already enjoys in matters of cyanidation and dredging, to mention only two of what may be called *Press* 'specialties.' In this and all our work we shall strive to continue to win and to hold the confidence of readers, contributors, and advertisers. Service is the keynote of success in journalism as in other industries, and service has ever been the purpose of the *Mining and Scientific Press*.

Gentlemen, on behalf of my associates as well as myself, we thank you for your support and wish you all a happy and prosperous new year.

H. FOSTER BAIN.

January 1, 1914.

LEAD, nickel, and tin smelting have shown few changes in the year, and little of technical importance has transpired. In the Sudbury district the Moud Nickel Company began smelting at its excellent new plant, and is experimenting with Dwight-Lloyd sintering machines. The Canadian Copper Company is achieving excellent success in using powdered coal for fuel and in other lines. At the Tooele plant of the International Smelting & Refining Company, in Utah, a curious accident resulted in an explosion which destroyed the dust-chamber. It seems that when wet ore high in sulphur is put through the sintering machines, there is a reaction not unlike that which is counted on to make the Hall process of fume treatment a success—that is, a part of the sulphur comes down uncombined in the solid state. This being carried over into the dust-chamber, led to an explosion, and has also caused serious loss by fire in the bag-house. At Murray there have been murmurs of discontent and a renewal of agitation over fume trouble, and a determined effort was being made during the

year to reorganize the farmers for further action against the smelters.

DIAMONDS form one sort of an index of trade conditions, and it is interesting to read in recent correspondence from South Africa that slackness is chiefly felt in the market for small stones, indicating the effect of fluctuating demands of fashion rather than a lack of buying power the world over. The same correspondent discloses the fact that diamond dealers have a jargon all their own, as the following illuminating remarks will show: "Kimberley was freely sold this week by the Syndicate, New York buying all the closed goods. Wesselton is announced to be shown on Monday; applications for sights are numerous."

MANY of our readers may not know of the existence of the American Museum of Safety in the Engineers' building, which houses the American Institute of Mining Engineers, since its publications are not numerous and do not reach a wide field. The influence of the Museum is widespread, however, and we recently referred to the First International Congress of Safety and Sanitation, held under its auspices. Scarcely less important is the First International Exposition of Safety and Sanitation now in progress in the Grand Central Palace, New York. Not only the makers of safety appliances have displayed their wares, but the large industrial corporations have made impressive exhibits of what they are doing to conserve the safety, health, and mental well-being of their employees.

Annual Reviews and Statisticians

In presenting this number of the *Mining and Scientific Press*, a word or two of explanation may be permitted. The change in the size of the page has been made, in part to conform to what is rapidly becoming the standard size for technical journals, and in part to permit a better use of space in connection with illustrations. Incidentally, improvements have been made in dress and style, and others are in contemplation. It will be noted that in this review much less space has been devoted to statistics than has been customary, and that there are no summaries of developments by states and districts. It is felt that this is in line with the general purpose of the *Mining and Scientific Press*, which is, to print the best technical journal of mining. The news of the mines is printed week by week. To rehash this for an annual summary is a thankless job of doubtful utility. For those far countries where periodical reviews are more appropriate as also more feasible than a steady stream of news letters, we shall continue, as in the past, to print general résumés as opportunity serves. In our Special Correspondence last week we published such letters concerning mining in 1913 in New Zealand and Rhodesia, and we expect to print, when the data are

available, another of those excellent general reviews of the progress of mining in the Belgian Congo, of which Mr. S. H. Ball has already furnished three. To be truly valuable, such summaries must be written by the right man, and when the right material has been assembled. To attempt a complete review of the world of mining at the end of an artificial period, leads but to a dreary sea of words. News of development is only news when fresh, and from eight to nine pages is set aside in each weekly issue of the *Press* for printing of significant news while it is news.

Technological developments take place regardless of calendar years. At times the progress is rapid, again it is slow. In the year that has just closed, there has been intense interest in copper smelting, and many improvements have been made or proposed; lead smelting has seen few changes. In the following pages, therefore, will be found an elaborate review of copper smelting, and only a paragraph on lead smelting. Next year, possibly, the conditions will be reversed. This illustrates the controlling motive in the selection of the material in this, as we believe, our best Review Number. Why take ten pages to say that nothing happened?

As for statistics, we print those which are available and authoritative, and will print more as they become available. A little statistical knowledge, however, is a dangerous thing. Since the fall of Adam there have been statisticians in the world, and yet even now there is no agreement as to when that interesting event transpired. A baby when born weighs perhaps eight pounds and at the end of the year possibly three times as much. At the same ratio he should weigh a trifle less than a ton at the age of five—but he doesn't.

Our Contributors

It is always a pleasure to be in good company, and the members of the editorial staff feel especially honored by those who have given of time and effort to make this number of the *Mining and Scientific Press* interesting and valuable. It is a rare pleasure to come into contact with significant men, and it is even more of a privilege to have their help. To the symposium upon the condition and needs of prospecting, of which we print a part this week, men of the widest experience and of well proved ability have contributed. Messrs. W. H. Aldridge, Philip Argall, F. W. Bradley, P. R. Bradley, D. W. Brunton, Albert Burch, George E. Collins, David Fasken, Charles Hayden, D. C. Jackling, Hennen Jennings, B. B. Lawrence, E. J. Longyear, J. H. Mackenzie, H. C. Perkins, M. L. Requa, Arthur Thacher, B. B. Thayer—and these form but a part of the list—are men who know; and what such men say may not be disregarded.

They, and those who have written the special articles in this issue, are too well known to require introduction to mining engineers, but for the benefit of the young men, and those to whom the *Press* comes

for the first time, we may say that Mr. Archibald Douglas is a busy attorney in New York who still finds time for public service of the sort with which his name is so closely associated through the activities of Dr. James Douglas. Of the presidents of the three great mining engineering societies who write for us, Mr. Rand is also president of the Spanish American Iron Company and has been active in the development of the resources of that island, as he has been in Institute affairs through the whole of his notably successful year as president: Mr. Chance, a Philadelphia mining engineer widely experienced in the problems of coal and iron, was, as much as anyone, the founder of the Society of which he writes; Mr. Scholz is engineer for, and president of, the various Rock Island coal companies, and a man who has given much time and thought to the organization of the bituminous coal operators. Mr. Rickard, who reviews the whole world of mining from the London viewpoint, finds time for the *Press* despite his duties as editor of *The Mining Magazine*. Mr. Burton is mining editor of *The Analyst* in New York, and former New York correspondent for the *Mining and Scientific Press*. Mr. Garrison is a Philadelphia engineer well known to our regular readers as one of our special contributors. Mr. De Wolf is director of the State Geological Survey of Illinois and secretary of the Association of State Geologists, of whose work he writes. Mr. Hall is a 'Teck' man who looks after the interests of the United Zinc & Chemical Company and knows the zinc business from many angles. Mr. Janin is the worthy successor to the great name among mining engineers built up by his father, brother, and uncles. Mr. Stoughton is the versatile secretary of the American Institute of Mining Engineers, who always does three men's work and then finds time to help anyone who needs help. Mr. Leslie is assistant editor of the *Press*. Mr. Denny is one of the two famous brothers who saw so far and so truly into the future of the Rand that they became unpopular there, and more recently in Mexico, London, and elsewhere have enjoyed seeing others coming to their own conclusions. Mr. Read is New York editor of the *Press*. Mr. Roush is associate editor of that very excellent journal, *Metallurgical and Chemical Engineering*, and has done us the rare favor of contributing generously to a contemporary. Mr. von Bernewitz is assistant editor of the *Press* and has brought to the study of American problems in milling several years' active experience at Waihi and Kalgoorlie. Mr. James is the London metallurgist whose worldwide interests keep him especially well informed, and whose keen comment always stimulates discussion. Mr. Peele is professor of mining at Columbia University. Mr. Austin, formerly professor of metallurgy at Michigan College of Mines, is now in general practice at Salt Lake City. Mr. Walker is our London correspondent. Mr. Searls is assistant city attorney of San Francisco and obtained his knowledge of mining law through service in Judge Lindley's

office. Mr. Dennis is a California mining engineer who has developed and managed quicksilver properties in Texas and Nevada. The writer of our New York Metal Review is a professional correspondent who devotes his whole time to watching the metal market but who prefers to remain anonymous. Even this does not entirely complete the list, since in arranging for the papers printed, and in revising and criticizing them after submitted, the members of the regular staff have had invaluable assistance from many other members of the profession.

The Mexican Crisis

The past year in Mexico has been one marked by political turmoil and general depression and one in which the mining industry has suffered keenly. As it closed, the situation showed no signs of improvement, and the immediate future holds little of promise. The Huerta administration, which when inaugurated gave promise of a solution of Mexico's difficulties, has degenerated into a military despotism. It has been accepted by but a small part of the population and its orders carry but little weight outside of the Federal District.

The period which Mexico is passing through today, and the problems and difficulties which confront the Mexican people, are those inherent in reconstruction, and as it is a long step from Porfirian despotism to democracy, those who have interests within the confines of Mexico can but abide the time when a renaissance of political and social standards will result in that longed for peace and stability of government without which no country can prosper. With Mexico, reconstruction, because of the character and status of the population, without outside assistance must be necessarily slow. Of the 15,000,000 inhabitants 80 per cent are Indians or belong to the peon class; a population which in the past has been herded, driven, and exploited by the upper class with which it has no bond of sympathy. The peon has had no opportunity to acquire property, to better his condition, or to improve his surroundings. It is to the peon, who is awakening to a realization that he is a part of the nation, that the present upheaval is due. It has been estimated that in this vast country comprising 767,000 square miles, an area equal to 17 Pennsylvanias, all of the arable land is held by 7000 families. One single landlord holds 16,000,000 acres, an area one-third the size of Great Britain, and this has been assessed for taxes at \$200,000. While a good part of those who are at present bearing arms on the revolutionary side of the struggle should be classed as bandits rather than patriots, their present position in the ranks of the revolutionists is largely due to an unhealthy political atmosphere and its direct results upon their manner of existence.

The past year has seen the overthrow of Francisco Madero, a man of undoubtedly high political ideals, but one who lacked those attributes of leadership and

organization which are prerequisite at this time. In the usurpation of power by Victoriano Huerta, it was hoped that the substitution of a rigorous policy backed by the support of the army would restore peace and put a quietus upon the disturbing element. This also has failed, and the results of another attempt at despotism has been revolution, federal bankruptcy, brigandage, general depression, and little semblance of authority. There are some who hold that with adequate funds, Huerta's policy would succeed, but in the light of his conduct of office during the past few months, this may be doubted. In fact, the estrangement between federal and revolutionary factions has increased and the resultant loss of confidence in Huerta by his previous supporters and foreign nations, augurs poorly for any solution at his hands. Mexico will not again submit to a dictatorship like that of ex-President Diaz or the present incumbent Huerta, and he who succeeds must learn as Porfirio Diaz, realizing his own shortcomings, recently stated, "that to govern Mexico, there is only one course to take and that is to act for the people and through the people." While the bestowal of an effective political franchise upon those who are not fitted to receive it is not essential, those rudiments of justice and republican government which have found so little place in Mexico to date, must receive consideration in the solution of the present situation. It is to be noted that the two important revolutionary movements, headed by Madero and Carranza have had their origin in the north; in that part of Mexico adjacent to the United States where the Mexican people have had opportunity to see the results of true democracy. It may be objected that the restlessness and ignorance of a large percentage of the people make the situation hopeless and that the form of government is of a very secondary importance; but even granting this, there is only hope for peace in a government which has been legally constituted and is identified with the majority. Only such a government can find favor with and command the respect and support of the nations.

The mining industry in Mexico has had a bad year, due largely to the interruption of railway communications and disturbed conditions which have made impossible the operation of a large number of the properties. Railway communication between the interior and the American border was interrupted early in the year and attempts to reestablish it have been futile. With the fuel oil supply from the Tampico fields intercepted, there is little hope of an early resumption of railway traffic. The coal supply has also been curtailed by the dynamiting of a number of mines by the 'revolutionists' in the state of Coahuila and interruption of railway communication.

Most of the larger silver districts, however, have kept up and in some cases increased their production. Among these may be mentioned El Oro, Pachuca, Guanajuato, and Hostotipaquillo. The returns reported for the last fiscal year ended in July show the exportation of gold to have decreased \$10,313,687; and ex-

clusive of coined silver there was a decrease in silver exports of over \$7,000,000. Copper has not fared so badly. The Cananea mines have been in practically continuous operation, as have those at Boleo and Aire Libre; the Moctezuma company reports the best year in its history. The copper exports for the fiscal year totaled \$36,522,115, which is an increase of \$3,020,242 over the preceding year. Lead showed a decrease of \$1,111,811 and the zinc exports have dwindled to \$536,094. The importance of the petroleum industry is increasing as is the output. The production for the year was estimated at 3,955,228 tons, an increase of 1,435,218 tons over that of the preceding year. The total investment in the oilfields is now estimated at \$700,000,000. Taking oil into account, the value of the mineral exports for the year showed an increase of \$3,441,807. This figure includes the silver coin exported, which was valued at \$9,806,402.

The figures presented, while showing a material decline, are evidence that mining is still being profitably conducted regardless of revolutionists and increased taxes. It is universally regretted that this wonderful country, which Cecil Rhodes has called "the treasure house of the world," should be so burdened with internal strife, and it can only be hoped that with the coming elections on July 5, a new administration may come in which will give birth to a new era of political quiet and industrial prosperity.

Aluminum

Not many years have passed since, following the discovery of a process by which aluminum can be produced from its ore comparatively cheaply, the columns of the pseudo-technical journals were filled with articles describing aluminum as the metal of the future and predicting that, because of its strength as compared with its weight, it was destined to displace many of the metals now in general industrial use. The claims made by irresponsible people were so extravagant and absurd that the general public soon came to realize that they could never be attained, and consequently discounted every statement made concerning aluminum. As a result the metal, from enjoying high regard, fell almost into disrepute and public interest in it declined. But as a matter of fact, the general features of the statements first made are essentially correct, minor factors having intervened to prevent them from being realized as quickly as expected. Though the cost of the metal was greatly decreased, it was not reduced to a point where the sum total of advantages plus cost was sufficient to cause manufacturers to change their practice, which, in many cases would have necessitated 'scrapping' valuable machinery and abandoning the manufacture of products for which a reputation had been built up through many years of work.

Other factors than mere cost must always be considered. Thus as a conductor for electricity, aluminum at 20 cents per pound is on a par, from the

standpoint of cost, with copper at 12 to 13 cents. During 1912 aluminum ranged between 18 and 26 cents per pound while copper ranged between 14 and 17½; in other words, sometimes copper was the cheaper and sometimes aluminum, but the latter showed a range of 8 cents against 3½ for the former. The manufacturer and consumer of electrical conductors, therefore, had comparatively little incentive to commit themselves to the use of aluminum, the more so as the supply of the metal was comparatively limited and a few large purchases might send it skyrocketing. This is not all the story, however, for aluminum is comparatively weak in its tensile strength, while the larger cross-section of the equivalent conductor made the wind load and ice and snow load on wires much greater than is the case with copper. To support the wires would require more poles or towers, and what was saved at one pocket was lost out of the other. This difficulty has now been overcome by the use of a composite cable of several aluminum wires about a steel wire, and the transmission line of the Los Angeles power project uses such a cable for its 275 miles of length. There is another difficulty: aluminum, in spite of the early claims made for it, is much more subject to corrosion than is copper, and the same is true of steel. We understand that a means has at last been found of overcoming this drawback, and that henceforth the item of relative cost will practically be the determining one. Assuming that 14 to 15 cents is the normal price for copper, it seems probable that aluminum will henceforth be a keen competitor with it when selling for 20 cents per pound.

It must not be assumed from this that increase in the output of aluminum will be followed by a corresponding decrease in the consumption of copper, for there is almost an infinite variety of uses for aluminum which can absorb much greater stocks of the metal. Its use in the manufacture of cooking utensils, competing with enameled ironware, is known to everyone, and the consumption in this way will certainly increase greatly when the selling price of the finished article is brought closer to the cost of the metal, and the latter is also reduced. In this case its use for the larger-scale cooking utensils employed by the makers of preserved food, liquors, and the various products of chemical engineering is also likely to increase. Another large field is in the manufacture of automobiles, aeroplanes, and other machinery where lightness combined with strength is advantageous. A large increase in the supply, together with a steady moderate selling price is likely to greatly increase consumption in this field. Another field, yet unexploited, is the use of the metal for interiors, supplanting woodwork. In the modern business office almost the only articles still made of wood are the desks and chairs, and it is quite possible that these will soon be supplanted by metal, yielding to the demand for fireproof construction. Painted sheet steel is now the favorite material for all metal construction, but unpainted aluminum would be much more satisfactory from the standpoint of illu-

mination, since it quickly acquires a gray 'mat' surface which diffuses light without creating a glare. The cost of aluminum is now too high to compete with steel in this way, but what the future position of the two will be must be left for the future to show.

Much aluminum is used in ways which are not impressive but which consume a large amount of the metal. Aluminum 'novelties' have become so common that they have lost their novelty, but have proved so convenient that their use is likely to increase rather than decrease. Aluminum foil is now being used, displacing, to some degree, the tinfoil so familiar to our fathers as the containers for 'fine-cut chewin'' and to our sons as the wrapper for expensive cigars. The powdered metal, known as aluminum bronze powder, is used in painting, lithographing, printing, and as a constituent of explosives and a patented source of heat. The early difficulties in working the metal have now been largely overcome, and the manufacture of aluminum tubing, for example, is rapidly increasing. It is not remarkable, therefore, that the consumption in this country increased from 46,000,000 pounds in 1911 to 65,000,000 in 1912, coincidentally with a steady increase in the price from 18 cents in January 1912 to 26 cents in December. It is important to note, however, that even this amount was only 71.2% of the copper consumption during the same period.

No review of the outlook for aluminum would be complete without some reference to the sources of the supply of the metal. The Aluminum Industry Aktiengesellschaft is the largest producer, its plants in Switzerland, Germany, and Austria having a capacity of 32,000,000 pounds per year. This is closely followed by the Aluminum Company of America, with plants at Niagara Falls and Massena, New York. The British Aluminium Company, with two plants in Scotland, is a good third, and there are numerous other plants in France, Germany, Switzerland, Norway, and Italy, which contribute to the total output. The Northern Aluminium Company at Shawenegan Falls, Canada, is the only other plant now producing the metal on the North American continent. However, the Southern Aluminium Company has under construction near Whitney, North Carolina, a plant which will nearly double the present American output when it is in operation. The power supply is to be obtained from Yadkin river, and the technical work is under the direction of French metallurgists. The Aluminum Company of America is also building a new plant at Marysville, Tennessee, and is said to have contracted for 20,000 electrical horsepower from January 1. However, the power company found it necessary to rebuild the dam and these two plants in the south are both likely to begin operations toward the end of the year. Perhaps the most important effect of this will be to give to manufacturers more than one domestic source of supply, and manufacturers who have heretofore been deterred by this fact from committing themselves to the use of a product in which there is now no open market will be encouraged to begin or increase their

use of aluminum. The tremendous increase thus made in the domestic output of aluminum is certain to have a marked effect on the uses and applications of the metal, and it will be interesting to observe whether the increased consumption will take care of the increased yield, or whether a recession in the price will be the result.

Production of Gold in 1913

Since the days of Jason, the quest of the 'Golden Fleece' has absorbed the attention of a large part of the people of all countries. On account of its use and value, gold is the metal of paramount importance in the world, being now the standard of the monetary systems of most of the important nations. From the time of the oldest known civilization, it has been recognized as the most valuable of metals because of its color, lustre, and malleability, as well as its rarity. The Egyptians and Assyrians held gold in high esteem, as is evidenced by the ornaments and jewelry which have been found among the relics in the most ancient tombs, and it seems quite probable that the early Egyptians used gold as a medium of exchange. With regard to its production, there appears to be no statistics earlier than the time of Solomon, although the Egyptian hieroglyphics give the amounts of the tribute paid to the Pharaohs. We are told that the weight of gold which came annually to Solomon was 666 talents, an amount which would be worth today anywhere from thirteen to twenty-six million dollars, according to different authorities. Evidently the gold industry was flourishing as far back as 1000 B.C. and the statisticians were already busy.

Accurate statistics of the world's production of gold are never available, but the annual estimates are close enough for all practical purposes. Exact figures are of no particular use in any event, for the principal value of statistics lies in the indication of general tendencies. Last year we noted that the rate of increase in gold production was steadily declining, and this year we find that the rate of increase has not only been brought to a halt, but that the total output has actually diminished very materially. The table showing the world's production of gold for several years past is of interest, for it shows the great variations in production and the obvious tendency toward a gradual diminution. Our estimate for the year 1913 is based upon official data and accurate figures as far as these are obtainable. The figures for Africa and Australia are official for the first ten or eleven months, December being estimated, and our data for the United States, Canada, and India are based upon estimates furnished by government officers. The Mexican government publishes the figures for the exports of gold for the fiscal year ending June 30, so the estimate of the gold production is based upon incomplete data, although this is fairly accurate.

Official statistics for Russia are seldom published until two or three years have elapsed, but the esti-

mates furnished by our London representative are probably as close as can be secured. It will, therefore, be observed that fully 90 per cent of the world's production of gold can be estimated with a high degree of accuracy, although we deem it foolish to attempt to give anything more than approximate figures. The remaining 10 per cent is contributed by countries from which accurate statistics are rarely, if ever, available. During the year, detailed figures will be published by the governments of Japan, Korea, and the East Indies, but the production of gold from the Central and South American countries is only obtainable by computing the amounts of the importations into other countries during the year. From countries such as China no reliable data can be procured. The production from 'other countries' includes that from Austria, France, Germany, Great Britain, Italy, Servia, China, the East Indies, and many minor producers. The estimates given must be regarded as mere approximations.

WORLD'S GOLD PRODUCTION BY YEARS

1893	\$157,494,000	1908	\$442,477,000
1903	327,702,000	1909	454,059,000
1904	347,377,000	1910	455,260,000
1905	380,288,000	1911	461,542,000
1906	402,503,000	1912	475,000,000*
1907	412,966,000	1913	457,928,000†

*Partly estimated. †Estimated.

The notable increase in gold production during the year 1912 was due principally to the Transvaal. In 1913 the production of the Transvaal declined about \$6,000,000, while that of Rhodesia and West Africa showed slight increases, so that the total output of Africa for the year will be less than that of the preceding year by more than \$4,000,000 worth of gold. This decrease is due in part to strikes and riots in the Transvaal last summer and the great scarcity of labor, and also to the fact that the average value of the Rand ores is diminishing, as is pointed out by Mr. T. A. Rickard and Mr. H. S. Denny elsewhere in this issue. In the United States there has been a steady decline in gold production for some time, and this will probably become increasingly noticeable unless some new goldfield is discovered within the next few years. It is a fact that the richest placers and lodes in the country have already been found and exhausted, with the result that our gold production in the future must come from the large bodies of low-grade ore. The rapidly diminishing production of one mine alone, the Goldfield Consolidated, accounts in a large measure for this decreased gold production of the country, but there have also been important declines in other fields. Alaska, for instance, shows a decrease of about \$1,700,000, which is largely due to the exhaustion of the bonanza gravels of the Fairbanks districts, and to an unusually dry season.

Mexico's condition of unrest and revolution has caused the suspension of mining in many districts in that country, with a corresponding decrease in the gold output, although in the larger camps work has been continued with only slight interruption. The ap-

proaching exhaustion of some of the principal ore-bodies is already having its effect, while the cessation of prospecting on account of the disturbed condition of the country augurs ill for the future gold supply. India is one of the few countries which shows a steady and consistent increase in gold production.

GOLD PRODUCTION OF THE WORLD.

	1911.	1912.	1913.
Africa	\$187,738,000	\$208,795,000	\$204,343,000
United States	96,890,000	93,451,000	88,391,000
Australasia	59,107,000	53,557,000	50,680,000
Russia	32,151,000	27,702,000	25,000,000
Mexico	24,880,000	24,750,000	19,500,000
India	10,449,000	12,088,000	12,164,000
South America	12,340,000	11,500,000	12,000,000
Canada	9,762,000	12,500,000	15,350,000
Japan and Korea....	6,890,000	7,000,000	7,000,000
East Indies	4,726,000	4,980,000	5,000,000
Central America	3,360,000	3,600,000	3,500,000
Other countries	13,249,000	15,077,000	15,000,000
Totals	\$461,542,000	\$475,000,000	\$457,928,000

During 1914 and the years to come, the production of gold will probably decrease gradually, unless new goldfields of importance are discovered. Improvements in metallurgy will undoubtedly continue to be made, permitting of the working of lower-grade ores, but this science has already advanced so far that future betterments will probably make progress slowly. Much may be expected, however, from the successful mining and milling of the huge bodies of low-grade ore which are known to exist. The operation of the Alaska-Treadwell and the experiments conducted by the Alaska Gastineau and Alaska Juneau companies have proved that ore containing \$1.50 to \$2 per ton in gold can yield a profit where extensive deposits are mined on a huge scale. By the end of this year the last two companies mentioned should be recovering about \$5,000,000 worth of gold annually, and this production will in time be doubled. Increased transportation facilities will greatly aid mining of the lower-grade gold gravels and the vein deposits in the difficultly accessible regions of Alaska. The same is true of Siberia, where vast areas of alluvial deposits lie undeveloped on account of lack of transportation. The consensus of opinion is that the more accessible parts of the world have been so thoroughly prospected that there is now slight probability of discovering goldfields of richness or importance in the regions which are now known. In the future the prospector will be forced to confine his efforts largely to parts of Canada and Alaska, South America, China, and elsewhere, for it is evidently a fact that almost all of the easily mined placer deposits and the outcropping bodies of rich ore have been found, mined, and largely exhausted. The discovery of new fields will depend upon the exploration of distant inaccessible territory, and upon scientific prospecting by means of our vastly increased knowledge of the geology of ore deposits. The mining and treatment of large bodies of low-grade ore will also add greatly to the future production.

Gold and Silver Production of the United States

Estimates for the calendar year of 1913, by the Bureau of the Mint and the United States Geological Survey, with final figures for 1912: printed through the courtesy of George E. Roberts, Director of the Mint.

GOLD			SILVER (Fine Ounces)		
State or territory.	1912.	1913.	State or territory.	1912.	1913.
Alabama	\$ 16,724	\$ 8,062	Alabama	168	84
Alaska	17,145,951	14,782,512	Alaska	515,186	379,575
Arizona	3,762,210	3,098,046	Arizona	3,490,387	3,380,703
California	19,713,478	20,105,447	California	1,300,136	1,527,026
Colorado	18,588,562	18,420,031	Colorado	8,212,070	9,159,367
Georgia	14,360	9,881	Georgia	77	84
Idaho	1,381,214	1,366,605	Idaho	8,294,745	9,573,328
Illinois			Illinois	4,731	3,659
Michigan			Michigan	528,453	429,014
Missouri			Missouri	35,438	33,763
Montana	3,625,235	3,078,202	Montana	12,731,638	13,035,841
Nevada	13,456,180	12,279,131	Nevada	14,369,063	15,092,190
New Mexico	784,446	844,086	New Mexico	1,536,701	1,525,133
North Carolina	166,014	111,442	North Carolina	4,854	2,268
Oregon	770,041	1,379,087	Oregon	57,081	158,594
*Philippines	400,248	787,039	*Philippines	5,650	9,974
*Porto Rico		1,116	*Porto Rico	100	9
South Carolina	16,915	1,985	South Carolina	47	13
South Dakota	7,891,370	7,197,498	South Dakota	206,460	168,231
Tennessee	8,265	7,711	Tennessee	89,893	124,009
Texas	63	120	Texas	406,067	428,490
Utah	4,265,851	3,400,103	Utah	13,835,903	12,269,088
Virginia	218	3,514	Virginia	982	23,706
Washington	680,964	692,021	Washington	413,538	263,090
Wyoming	22,235	30,491	Wyoming	265	3,729
Totals	\$93,451,500	\$88,301,023	Totals	63,766,800	67,601,011

*Estimates, 1912.

United States Mineral Output in 1913

Below are given figures of production for 1912, as collected by the United States Geological Survey, and estimates for 1913, for coal and the leading metals, furnished by the courtesy of George Otis Smith, Director, except as noted.

Coal:	1912.	1913.
Bituminous, short tons.	450,104,982	476,000,000*
Anthracite, long tons..	75,322,855	79,800,000*
Pig iron, long tons.....	30,180,969	30,500,000†
Copper, pounds	1,243,268,720	1,223,700,000*
Gold, fine ounces.....	4,520,717	4,276,300‡
Silver, fine ounces.....	63,766,800	67,601,111‡
Lead, short tons	415,395	466,843*
Spelter, short tons.....	323,907	345,575*
Quicksilver, flasks	25,064	23,000*

*U. S. Geological Survey estimates.

†U. S. Geological Survey and Bureau of Mint estimates.

‡Iron Age figures for 11 months; December estimated.

*Estimated by C. G. Dennis.

Copper production in the United States in 1913 is estimated by the United States Geological Survey as totaling 1,223,700,000 lb., worth \$187,200,000. These figures may be compared with 1,243,268,720 lb. in 1912, worth \$205,139,338.

Lead production is estimated by the United States Geological Survey as follows:

Total refined lead from domestic and foreign ores, 466,843 tons, value \$41,082,184; the corresponding production for 1912 was 467,342 tons.

Antimonial lead, 1913, 16,338 tons; 1912, 13,552.

Imports (ore, bullion, and refined lead), 1913, 56,717; 1912, 83,560 tons.

Lead content of the ores mined in 1913, 460,512 tons; 1912, 457,355.

Spelter production is estimated by the United States Geological Survey as having amounted to 345,575 tons of primary spelter from foreign and domestic ores in 1913, worth \$39,395,550. The corresponding figures for 1912 were 323,907 tons, \$44,699,166. The recoverable zinc content of ores mined in the United States in 1913 is placed at 414,151 tons.

Canadian Gold and Silver Production

*Canadian gold production in 1913 is estimated by the Mines Branch of the Department of Mines of Canada at \$15,350,000, as compared with \$12,559,443 in 1912. Silver production is similarly estimated at 33,500,000 oz., which may be compared with 31,931,710 in 1912.

*Printed through the courtesy of R. W. Brock and John McLeish.

What is the Matter With Prospecting?

A SYMPOSIUM

Having in mind the statement often made that mines are not being found as rapidly as is necessary in order to keep up the growing rate of mineral production—in short, that a few years will bring us face to face with a metal famine—and the other wide complaint that prospectors can no longer obtain grubstakes for finding and developing new deposits, nor can they sell claims undeveloped, we recently asked a number of prominent engineers and mine owners to aid us in getting at the facts by answering briefly the following questions:

1. *Is it true that money is no longer available in adequate amounts for finding and developing prospects?*
2. *How can additional money be made available?*
3. *Do you believe in government aid to prospecting and prospectors, and, if so, in what way should this aid be given?*
4. *Can prospecting methods or conditions be so improved as to make the available funds adequate?*
5. *How can a better market for undeveloped mineral lands be created?*

The response has been most generous, and from the large number of interesting letters received we have selected a few from which brief abstracts are presented below. We regret that the necessity for condensation makes necessary the omitting of introductory statements and reparagraphing, but we feel sure that our friends and readers will pardon this in view of the significance of the subject-matter. Our own summary and comment will be withheld until more of the letters shall have been presented.—EDITOR.

Walter H. Aldridge:—There is plenty of money available for investigating new properties which give promise of large tonnages of low-grade commercial ore. There are not many large concerns willing to grubstake prospectors or, in fact, to risk much money in attempting to develop prospects. The developing of the prospect is more the province of the prospector and his associates or small local syndicates. The reason that a large amount of money is not available for prospects is probably due to the fact that the many companies which have had large and varied experiences in exploration work have found the chances of developing good mines from the ordinary prospect are not sufficiently good to justify the many losses incurred in working prospects which do not develop into mines. I do not believe in government aid to prospecting or prospectors, as I doubt whether it would do any good, and there would unquestionably be an immense amount of money wasted if such a plan should be adopted. I do not know how present prospecting methods can be materially improved. The Western prospector will still continue to hunt up good surface showings. If he is successful he will usually interest some of his associates in his claim or claims,

or else get a small local syndicate to back him to a limited extent. If this work is encouraging, the small syndicate usually interests a larger syndicate of greater means. Ample funds can, therefore, be secured so long as the prospect in the first instance is a reasonably good one, and the work subsequently performed gives justification for the first good impressions formed by the prospector. I can not make any suggestions how a better market for undeveloped mineral lands can be created, as the marketability of mineral lands is entirely dependent upon the surface showings, geological conditions, etc., and where these are favorable there is always keen competition to secure them.

Philip Argall:—In reply to your letter of December 5: I find it extremely difficult to interest capitalists in prospects. It is very difficult to find a means. The Denver Chamber of Commerce organized a prospecting company last year, and with all the influence of that commercial body, backed by competent mining engineers and a first-class directorate of leading business men, capital was not available, the company had to be liquidated, and money returned in full to subscribers. Clean business methods were the ideals of the company, and after the great innings of the wildcatters, I now believe the change was too great. Though I regret to say it, visions of high profits are necessary to sell prospecting stock, hence those that "see visions" have their place in mining. I have never known successful issues along the line of government aid. Prospecting combines at once the greatest risks with the greatest profits usually obtained in mining. I am frank to say that it is only the Government clerks in the Forest Service that can at once determine if the budding prospect will develop into a great mine or an expensive hole in the coppice. Those who have spent many years in developing mines are not dissatisfied with one good mine from ten selected prospects. It is a matter of judgment and judgments aided by experience. By forming prospecting syndicates to deal systematically with selected prospects, and by prospectors being more liberal in their terms, giving an interest in the property against development and not demanding payment for the privilege of developing more or less meritorious uncertainties, the market may be broadened.

F. W. Bradley:—Money is just as available in adequate amounts for finding and developing prospects as it ever has been. The prospects may not make as many bonanza mines as formerly, but the development of less wasteful methods and inventive genius will probably keep pace with the world's growing metal requirements. Additional money could be made

available by having the postoffice and other authorities go after the big people in the mining stock swindling game as hard as they go after the small people who sell mining stocks on false representations. No, I do not believe in government aid as a subsidy to the prospectors; but I do believe in the present existing government aid to prospecting, which present aid will probably continue to grow in the same ratio as present government aid to agriculture grows. Available funds are just as adequate for all legitimate mining work as they are adequate for any other kind of legitimate work. A better market for undeveloped mineral lands could be created by stopping the swindling games conducted in the name of mining.

P. B. Bradley:—I think money seeking legitimate mining ventures exceeds the opportunities to risk it where there is a reasonable mining chance for success. Additional funds can be made available by protecting the timid operator against fraud. More publicity should be given to the possibilities in favorable areas. For example, a large English operator recently had trouble in securing data on the output of the Mother Lode area in this state. His idea was that with this data in hand he would have less difficulty in interesting his friends in that territory. I believe in government aid to prospectors only indirectly; that is, by stimulating and assisting the mining industry through the Bureau of Mines so that there will be a broader field of work for the prospector. Improvement in prospecting conditions might be brought about by the assistance of the Bureau of Mines, say by the establishment of district offices, each in the charge of a competent officer whose duty is to study his district with a view to encouraging not only the development of new properties, but also the rehabilitation of old mines where modern practice and new methods may result in their success. A better market can be made by protecting the investor against fraud, and by giving ample publicity to new methods and the demand for minerals not now commonly mined, but which from time to time are sought by new industries.

D. W. Brunton:—It is only too true that prospectors do not now receive the same backing and support from business men that they did ten years ago. In Colorado, this is due principally to the fact that no new mining districts of any importance have been discovered during the past twenty years. Nearly every winter, when the snow is deep and the mountains inaccessible, fairy stories of important discoveries appear in the newspapers, but the next spring, as soon as the districts are accessible, the values vanish. Funds and support can only be obtained by making mining more profitable and by preventing the organization of wild-cat promotions and other fraudulent methods of imposing on the public, through which legitimate enterprises are made to suffer. If, by government aid, you mean the subsidizing of prospecting and mining operations, I would say no, as we have altogether too much paternalism now. The U. S. Geo-

logical Survey and the Bureau of Mines are now doing much more for the industry than any direct grant of funds, and if the appropriations for these two branches could be increased, there is no doubt the industry would be immensely benefited thereby. Improvements in prospecting methods can only be brought about by greater knowledge and skill on the part of the prospectors. Where prospecting has to be carried on in the forest reserves, more common sense and less 'red tape' on the part of the forestry officials would be extremely desirable and decidedly beneficial, not only to the prospectors, but to the forest service as well. An undeveloped prospect is a good deal like a lottery ticket, and, like the latter, will not be a very desirable acquisition unless the prizes are not only large but sufficiently numerous to justify the risk. To this end the complete revision of our present mining laws is extremely desirable, so that, should a man be lucky enough to open a valuable orebody, he would have a reasonable chance of retaining its ownership.

Albert Burch:—I do not believe in government aid to prospectors, but I do believe that the United States should take steps to scientifically prospect and classify its own mineral lands; and, in doing so, should employ the services of both technically trained geologists and mineralogists and practically trained prospectors, on such a basis of compensation as would attract the best men of both classes to the service. I know of a prospecting venture about to be started, in which two men, one of them a good mineralogist and the other a veteran prospector, are to start out as partners, under a grubstake agreement with a capitalist. If young school of mines graduates, with a little mining experience and a fair amount of training in field geology, would seek alliances such as this, instead of positions as assayers, surveyors, and assistants around operating mines, the standard of prospecting efficiency would undoubtedly be raised, and the demand for competent prospectors increased. A young man of this class, with few family responsibilities, could well afford to devote a few years to this kind of work; because, even though not financially successful, the experience would be very valuable to him in his subsequent mining work. Not the least valuable of the lessons which such a life would teach him, would be self-reliance.

George E. Collins:—I have no recent personal experience of raising money for prospects, but from what I hear, I am satisfied that it has become very difficult, excepting from individuals who have exceptional personal confidence in the man who endeavors to raise it. I do not know of any way in which this condition can be changed, excepting as a result of increased public confidence in the business of mining; and this, in my opinion, can only be secured by increased dependence in professional mining engineers, based on a higher standard of principle and honor among them, and enforced by legislation requiring their employment. I do not believe that direct gov-

ernment aid to prospectors is practicable or desirable, excepting as to the dissemination of information. But I believe there might wisely be a system of public money rewards to prospectors who discover mineral deposits of substantial value, but which under existing conditions cannot be profitably worked. I venture to suggest that the federal government, acting through the Bureau of Mines, might purchase such discoveries from prospectors. Prospecting methods will always depend on the individual prospector. Until something is found, and some *prima facie* evidence is secured of the presence of valuable minerals, I fear that organization and technical skill are helpless, and that we must depend for the original discovery of mining prospects on rather haphazard methods. The only way I can see in which to help the prospector is through the technical and semi-technical journals, which can disseminate accurate knowledge about minerals, and the conditions under which they are likely to be found, so as eventually to reach the class from which prospectors are drawn. Speaking generally, the root of the trouble, in my opinion, is a decadence of the adventurous pioneer spirit. Prospectors are fewer than they were, in many other lines besides mining. I do not hear of experienced prospectors of good character being unable to secure grubstakes.

D. Fasken:—I can only speak from experience of the province of Ontario, and reliable prospectors have no difficulty in finding parties ready to grubstake them, but the capitalists are more careful than they were a few years ago as to whom they shall employ. There is a scarcity of men who should go out as prospectors. They have not the technical knowledge. Farmers' sons and all sorts of laborers have gone out without any idea when they are examining rock as to whether they could expect mineral to be found or not. With regard to raising money for developing purposes, I would say that money in Ontario at the present time is scarce, but where a property has merit there are plenty of people prepared to undertake the development. I do not believe in a government aiding prospecting or prospectors. I would not think such a scheme feasible. I think what a government ought to do, and what they are trying to do in Ontario, is to protect a prospector once he has made a discovery, and let him operate as cheaply as possible.

Charles Hayden:—Money is just as available now as it has been in the past, if not more so. It is not the place of a banking house, however, to go into the business of prospecting—that is the business of individuals. I see no necessity for additional money being made available. I do not believe in government aid to prospecting and prospectors, other than the rights and protection which they now have. I do not see in what way prospecting methods can be improved. I do not believe there should be any better market for undeveloped mineral lands created. I

think by good hard work and labor people should develop those privately before asking outsiders to become interested in them.

D. C. Jackling:—In my opinion the apparent lack of interest in prospecting is due more to the lack of fertile fields for such exploratory work than to indifference on the part of anybody to the discovery of new mineral deposits. In other words, the mineral-bearing areas of the United States have been pretty well covered by investigations and developments to varying extent. There is scarcely an area anywhere in the country that has not been investigated by engineers either for the government or through the activities of private individuals or corporations; and, furthermore, the business of mining has taken on in the last few years much more of a scientific character than applied to it in earlier days. In fact, it is becoming a business conducted in a general way, at least, along lines of fairly definite principles, whereas in the days of active prospecting in unexplored areas the general idea of mining investigations and operations partook in some degree at least of the spirit of adventure. I believe there is just as much money available as there ever was for the investigation and development of mineral resources; but, on the other hand, I believe the days of the old time prospector are gone, and with them the time when money can be secured as it used to be for the support of prospecting expeditions. The modern way is to send an engineer to places that are reported through various channels to indicate promise of mineral deposits. Instead of the prospector spending months traveling by wagon or afoot, the engineer goes to a point near his destination by train, and in all probability travels the balance of the distance by automobile, and if the indications justify it, he reports in a definite way, and the result is development on a practical scale: the whole thing requiring weeks or months where it used to require months or years. On the whole, I think, however noble the prospector's vocation, the time is past when it can be either a popular or profitable one; and still I believe that, taking into consideration the possibility of finding new mineralized areas, or new deposits in known mineralized areas, the development and commercialization of the country's resources is going ahead at a more rapid rate today than it ever has at any previous time. There are variations in this activity, of course, depending on industrial conditions, the price of metals, etc.; but considering periods of time long enough to cover such variations from maximum to minimum, I believe what I have said is true, and I think the statistics and history of the mining industry in the United States for the last five to ten years will substantially bear out this view.

Hennen Jennings:—As I have been so little connected with actual mining in this country of late years, I do not care to go on record in attempt to, in detail, answer your questions. I do not think it ad-

visible to invoke any government aid unless it might be in connection with pushing and upholding the report of the committee on general revision of the mining laws of the American Mining Congress. It would seem that our stupid apex law, which was supposed to be so beneficial to the prospector and the poor man, has really been a boomerang and struck back at them, for now people with money are fearful in the initial stage of a mining venture that they may be buying lawsuits rather than ore deposits, and they would prefer paying more money at a later date when the venture had its legal and prospect values better established. The busy and greedy promoter has also overdone things and has had a tendency to frighten honest investors away. At the present time only laws upholding the poor man and discouraging the rich seem in favor with our legislators, and in the end most of them will be found to serve the poor man about as well as the apex and be a detriment rather than a betterment to him.

Benj. B. Lawrence:—The opportunities offered to the prospector in the early days of the development of this country no longer exist. Given new territory, you will have plenty of prospectors. The decrease in the production of the minerals in the state of Colorado, for instance, I believe to be due to the very rapid exhaustion of the mineral deposits heretofore discovered in that state, and the failure to replace the worked-out mines by new ones is simply due to the fact that such mines are no longer easy to find. The citizens of Colorado made an effort through one of the newspapers in Denver to stimulate prospecting and by various measures through the Chamber of Commerce there, but as far as I know, the inducements which were offered to prospectors to 'get busy' have been productive of no results. I believe that there is money available for finding and developing prospects, and that there are men to find them, the difficulty being that the prospects are hard to find. I do not believe in government aid to prospecting or prospectors. I do not think it would accomplish anything, and it would help to develop a very substantial breed of loafers. The prospector was a product of his environment and cannot be reproduced, as existing conditions will not develop the type of man who has been responsible for the discovery of the mineral wealth of this country. That scientific methods of prospecting by expert geologists will ultimately be productive of some good, I do not doubt. In this respect, economic geology has taken great strides, and I am hopeful that as a result of the study of geologists some new mineral deposits will be discovered. Capital will be eager to develop mineral deposits if they really have promise. The trouble is that the undeveloped mineral lands of which we have knowledge are rejections from which have been chosen the properties which are operating and have been operated in the past, and what remains, under existing conditions are not sufficiently attractive to allure capital.

E. J. Longyear:—It is a fact that moneyed men are not as ready to back the prospector as they were in the past. Additional money may be made available by reestablishing public confidence and a reasonable attitude of the government toward mineral development. The government, through its Geological Survey, can be of great assistance to the prospector. I do not favor direct financial aid by the government. There is undoubtedly room for improvement in prospecting methods, but I would not expect such improvement to have much influence in making money more available until other conditions have changed. There is a strong feeling among the people today that no individual or group of individuals should expect to derive from a business venture any more profit than a moderate percentage on his investment. This sentiment is being more or less reflected in recent government actions, and investors hesitate to risk spending money where there is an uncertainty as to whether they are going to be permitted to retain the results of their investments. The inducement that leads the prospector to endure the hardship of the desert, and the capitalist to back him, is the possibility of 'striking it rich.' If they can be assured that their property will not be confiscated, even though the profits may be large, we shall see plenty of money available for developing mineral lands.

John H. Mackenzie:—My judgment is that there is plenty of money still available for developing good prospects, but good prospects are very difficult to find, as there is little territory that has not been 'combed' over in the last ten years. Whenever a new find is made that is really good, there will be plenty of additional money spent in searching for new mines. You remember the boom in prospecting when Tonopah and Goldfield were struck. You also probably know that not over 10% of the money that was poured into Nevada for prospecting and developing purposes went into the ground and that 90% was spent in gambling and riotous living. I do not believe in government aid to the prospector, as I do not think it would be possible to bring the prospector under proper control. As a rule, they are an irresponsible lot. It might be that after a prospector found an outcropping that promised well, government aid could be furnished to develop the prospect; but, on the other hand, if a prospector found a really good looking outcrop, there is plenty of private capital available to help him develop it. I think there is a good market now for undeveloped mineral lands that promise well—the trouble is to find the promising mineral land.

H. C. Perkins:—It is not true that money is no longer available in adequate amounts for finding and developing prospects. I do not believe in government aid except by making titles secure and preventing mining swindles. There are ample funds for clean, honest business. In some localities where dishonest or foolish mining promoters have cost the public heavily, confidence must be reestablished.

M. L. Requa:—It is not true that money is no longer available for developing prospects. Probably at no time in the history of mining has there been a keener competition for meritorious prospects to develop. The great trouble is the lack of satisfactory prospects. I think it is highly probable that there is greater difficulty being experienced now than ever in finding grubstakes, for the reason that experience has proved that it is very difficult in these days for the ordinary prospector to find something sticking out of the ground. I think it has become more and more evident that the mines of the future must largely be developed in territory that shows certain geological conditions, but where ore-shoots are not outcropping upon the surface. The percentage of successes will probably be relatively small. I do not believe in government aid to prospecting or prospectors. If the government is going into the business, it had better do the whole thing—the prospecting and the developing—and reap the rewards. Prospecting methods and conditions do not need improvement. It resolves itself into two great divisions: prospecting in the effort to find something that is sticking out of the ground, and prospecting in the effort to find an orebody that is indicated by certain surface conditions. No great improvement is demanded in prospecting for deposits that show upon the surface; possibly there may be improvements for prospecting for hidden deposits. There is an ample and voracious market awaiting the development of mineral lands that show any value. Boiled down to a few words, the facts are that so far as the United States is concerned, the surface showings have been pretty well found, at least I believe they have. In the future, development work must be done with the hope of finding orebodies that do not crop on the surface. This is expensive and probably will not be a popular form of mining and will be done only by a few concerns. In the meantime, the prospector must seek other fields. I believe that there are still many areas in the world that afford the possibility of finding orebodies showing upon the surface, but I doubt that they exist in any great quantity in the United States.

Arthur Thacher:—There is one point to which I would strongly object, and that is any government aid in prospecting or to prospectors. There are a great many reasons why I think this would be very undesirable. The whole matter, in fact, had best be left to private enterprise. The government can do as it has done in the past; that is, give information and maps, and possibly this branch might be improved or added to, but as for direct aid or undertaking any direct help for prospecting, I think this would be a decided mistake. I know some others might have a different view, but I think the danger in all our government work is that they do not draw the line carefully enough between what is properly government work and what should be left for individual effort. A great deal can be done by the government in general direc-

tions, but when it encroaches on the private enterprises I think it is a decided mistake and will lead to disaster and throw discredit on all the government work.

Benjamin B. Thayer: I do not agree with what you state seems to be a prevailing opinion, namely, "that mines are not being found as rapidly as is necessary in order to keep up the growing rate of mineral production"; or, "that a few years will bring us face to face with a metal famine." It is my opinion that the old type of prospector is becoming somewhat extinct; I mean by this the individual who went into the mountains alone with his pack-animals, his expenses being generally borne by one or two individuals. In addition to this, the possible prospecting area has become more and more limited, as many sections of the United States have been pretty well run over. The best evidence that prospecting is still going on is in the discoveries in Alaska, where, in my opinion, up to the present time, on account of the inaccessibility of the country and the difficulty of transporting supplies for extensive mining, nearly all of the attention of the prospector has been given to placer mining and not to quartz mining at all points beyond the tidewater districts. I think that as this country is opened up—by this I mean transportation made more feasible—more attention will be paid to the quartz deposits of Alaska, and that doubtless many important mines will be opened up. Again, I think the prospector of today is too prone to place his holdings in the hands of the 'get-rich-quick' promoter instead of relying upon the miner to take the metals out of the ground—a slower but surer process. I do not think it a practicable scheme for the government to attempt to aid the prospectors financially, but I do think the spirit of conservation can be overdone, and the government, by the withdrawal of lands, can seriously hamper the work of the prospector and retard the growth of a district. There is plenty of market at the present time for promising prospects, if, as I have stated before, the prospector will endeavor to reach the capital he needs through the proper channels. It must be borne in mind that the greatest increase in the copper-metal output in this country of late years has been due to the application of new reduction methods to properties whose existence in some instances had been known for over a quarter of a century, and also to the refinement of methods previously in use. To sum the matter up, I would state that in my judgment there is no dearth of market for the wares of the prospector, and many mining men of authority still believe that "it is cheaper and safer to buy your eggs and hatch them, than it is to buy full-grown hens."

Accidents in metal mines of the United States, according to the Bureau of Mines, in 1912 resulted in the death of 661 men. In addition 4502 were seriously and 26,232 slightly injured out of 169,199 employed.

The International Engineering Congress

By H. FOSTER BAIN •

Among the important events now being planned for next year, the Engineering Congress which is to assemble in San Francisco, September 20, 1915, easily takes front rank. Held under the patronage of the five national societies, the American Society of Civil Engineers, American Institute of Mining Engineers, American Society of Mechanical Engineers, American Institute of Electrical Engineers, and the Society of Naval Architects and Marine Engineers, and with a total guarantee fund of \$37,500, the Congress is already assured of success. Membership is open to anyone upon payment of a small fee, and it is hoped that the total enrollment will at least approximate 10,000. More than 70 engineering societies in America and abroad have signified their acceptance of the invitation to take part. While anyone may belong and may obtain such volumes of the proceedings as he may care to pay for, participation in the program will be by invitation only.

The Congress is under the management of a board consisting of 28 representatives of the five societies named. The president and secretary of each society is *ex officio* among the number, and the ten so selected constitute the 'Committee on Participation' which has its headquarters in New York. It is through this committee that all invitations to take part in the Congress are issued; and it is to this committee that Colonel George W. Goethals has signified his acceptance of the presidency. Active direction of affairs is in the hands of a Board of Management composed of 18 representatives of the five societies, resident in San Francisco, and of which W. F. Durand, of Stanford University, a delegate from the Society of Mechanical Engineers, is chairman, and W. A. Cattell, of the Society of Civil Engineers, is secretary. The representatives of the Institute of Mining Engineers are Edward H. Benjamin, Newton Cleveland, W. S. Noyes, and H. Foster Bain. The board holds monthly meetings and acts through an executive committee and sub-committees on finance, papers, publicity, and local affairs. The latter will have charge of quarters, transportation, entertainments, and excursions. Mr. Benjamin, its chairman, is at the same time a member of the executive committee.

The papers committee has been busy outlining a program and tentatively making up lists of names as a basis for invitations to prepare the papers and discussions of the Congress. It is planned to publish the latter in 10 full volumes and one half-volume, the latter to include the proceedings of the opening session and those papers that deal especially with the Panama canal. Space in the other volumes is to be allotted so as to permit covering the widest possible range in engineering. It is proposed that they shall collectively constitute a virtual encyclopedia of present-day practice, so far as main outlines are concerned.

It is desired that the papers shall be of the 'Recent Progress and Present Status' type, and that instead of dealing in a restrictive way with particular problems or describing particular constructions, they shall summarize important lines of progress in each branch during the last decade and note the present practice and probable future trend.

Metallurgical Papers

To mining and metallurgy a total of 750 pages has been allotted, though many closely related subjects will be discussed in the volumes devoted to civil, electrical, and mechanical engineering. With the active coöperation especially of T. T. Read, Bradley Stoughton, and C. W. Merrill, the following general outline for the metallurgical volume has been prepared. It is proposed that the volume shall constitute what may be termed a cross-section through the metallurgical industry in 1915. The larger topics will each be under the general supervision of a special editor who will have charge of collating and arranging the papers by individual authors. It is not intended to exclude the citation of special instances to illustrate the general treatment of a subject, but such citations should preferably consist of references to the bibliography of the subject which will serve to supply the reader with measurably full indication of the sources where important original papers may be found. In particular, it may be noted that within the extent of space available, it is not expected that the treatment can be to any marked degree detailed in character. It is desired rather that it shall be broad, comprehensive, and suggestive. The general subject will be considered under 11 heads with sub-topics indicated:

1. Iron and steel—Metallurgy of cast steel, including founding; manufacture of steel and wrought iron; properties, uses, and manufacture of alloy steels; metallography of iron and steel; corrosion of iron and steel.

2. Copper—Copper smelting practice; hydrometallurgy of copper; copper refining; copper alloys; physical properties and metallography of copper.

3. Cyanide practice—Preliminary crushing; re-grinding; solution of gold; filtration; precipitation.

4. Metallurgy of zinc and cadmium.

5. Lead smelting and refining.

6. Metallurgy of aluminum.

7. Minor metals—Nickel and cobalt, mercury, tin, arsenic, antimony, and others.

8. Metallography and technology of non-ferrous alloys.

9. Electrometallurgy—Iron and steel; aluminum; zinc; copper.

10. Utilization of fuels—Pulverized coal; liquid; gaseous.

11. Ore dressing—Crushing and sorting; wet-con-

centration; magnetic work; flotation.

The volume on mining engineering has been planned with the special assistance of H. C. Hoover, F. W. Bradley, M. L. Requa, D. C. Jackling, and incidental help from other members of the Institute. In it a slightly different point of view has been adopted. It has been thought that the most serviceable volume that could be produced would be one in which should be summarized the best engineering practice as relates to distinctively mining problems. With this in view, it has been proposed to leave to the other sections of the Congress the handling of subjects that are only incidentally mining and to bring together a group of papers that would afford a concrete picture of mining methods in 1915. It is thought that best results will be obtained by collections of somewhat detailed descriptions and analyses of the different mining methods as exemplified by type examples and supplementing these by very brief bibliographies and carefully planned discussion rather than by a general résumé of the literature of each topic. The purpose is, as far as may be, to have each subject handled by a practicing engineer who has himself employed the method described. The following list of papers is proposed:

Papers on Mining Methods

1. Placer mining, including: (a) the testing and valuing of placer ground; (b) hydraulicking (briefly); (c) dredging, the latter to be discussed in detail and to form the main part of the paper. In this and subsequent papers named, the object should be to describe the methods, efficiency, and limitations of the process. The recent use of dredges for stripping iron ores may well be taken up in the discussion of the main paper.

2. Steam-shovel mining: (a) the methods on flat lands with heavy cover, as in the Lake Superior iron district; (b) modified methods on steep slopes, as in the Western copper mines, with consideration of the methods of preparing and blasting the ground; (c) substitution of drag-line scrapers, as in the Cuban iron-ore mines; (d) mill-hole work.

3. Caving systems in mining: (a) methods as employed in the Lake Superior iron mines; (b) modified methods used in Western copper mines.

4. Method used at the De Beers diamond mine. This was developed from a coal-mining method in wide use and shows relations both to caving and narrow stoping.

5. Stoping as used in the Lake Superior copper mines with great depths and low angles of dip.

6. Mining methods on the Rand, as an example of stoping at great depth in persistent orebodies and where large-scale operations are possible.

7. The cross-stoping method in use at Broken Hill, New South Wales.

8. The rill and fill system at Kalgoorlie.

9. Methods of filling. These methods have been worked out especially in European coal mines and are beginning to be employed at Scranton, Cripple Creek,

and other points in the United States. They must ultimately be used even more widely, and the topic is therefore especially important.

10. Underground transportation. These methods have been developed most largely in coal mines, and the metal miners have much to learn in this particular. Grades, curves, track, motive power, cars, signals, and dispatching are some of the subdivisions to be considered.

11. Hoisting from depths, with Butte as the type example. Butte is chosen because of the fact that the engineers there have passed through the stage of direct steam, and in the district may be seen both electric hoisting and a peculiar method of using compressed air; a comparison and a study of limitations of these systems would be especially important.

12. Preparatory work and experimental mining and milling. Now that mines are worked upon such a scale that millions must be invested in preliminary work and in plant equipment, it becomes important to know what are the most economical methods and what the wise limits of expenditure. Test-pitting, drilling, underground exploration, sampling, estimating, testing, the building and operation of pilot-plants, should all receive attention. The ratio of preliminary expenditure to total investment is one to be carefully studied.

13. Underground costs and efficiencies. This should be a general paper treating the subject in a broad way, not a mere compilation of unrelated costs. So far as possible figures should be reduced to a basis of tons per man per shift, and the relative economy of different types of labor and of labor as against machines, studied in detail.

14. Oil production, with especial emphasis on oil-well drilling. This involves engineering of a high degree of skill where many conditions must always remain unknown. Oil is now an important part of the mineral output, significant from many points of view.

Supplementary Meetings

In addition to the Engineering Congress proper, several similar meetings will be held about the same time. The Electrical Engineers plan a separate world's congress for the week preceding the Engineering Congress, and about the same time the American Association for the Advancement of Science, and its affiliated societies, will be meeting. In the week following the meeting of the engineers, an International Petroleum Congress is to be held, and at some convenient date the American Institute of Mining Engineers and the Mining and Metallurgical Society are also to meet. Following the meeting of the Sixth International Congress of Mining, Metallurgy, Applied Mechanics, and Practical Geology, which is to assemble in London in June under the auspices of the Institution of Mining and Metallurgy, an excursion through Canada is planned under the patronage of the Canadian Mining Institute with a visit to San Francisco and a return through the United States to be arranged by the engineers of the latter country.

The National Radium Institute

By ARCHIBALD DOUGLAS

Through the investigations of the U. S. Bureau of Mines, it became evident in the latter months of 1912 that valuable radium ores were being shipped abroad to be manufactured into radium which was being sold back to this country at prices entirely incommensurate with those paid for the ores themselves. But worse than this, it was discovered that at least twice as much uranium oxide and its accompanying radium was being wasted in the low-grade ores that were thrown on the dump and the fine carnotite dust was being swept away by the winds and rain. Knowing the excellent work being accomplished by the Austrian Radium Institute and the Radium Institute of London, Charles L. Parsons, chief of the division of mineral technology, of the Bureau of Mines, proposed to Dr. Howard A. Kelly of Baltimore and Dr. James Douglas of New York—both of whom he knew to be deeply interested in securing radium for use in two hospitals with which they were closely connected—that they form a Radium Institute and endeavor to work up some of our American ores and keep the radium in this country for use among such of our own people as could be reached by such quantities as were secured.

It was agreed, if the ores could be procured, that the Radium Institute would be founded and necessary funds furnished to work up the raw material. Mr. Parsons went with Dr. Kelly to the Paradox valley in Colorado and inspected the mines there. On their return a conference was held with the officers of the Crucible Steel Mining & Milling Co. who owned 27 claims in Montrose county, Colorado, which it had been holding pending such time as it would pay to extract the vanadium and uranium therefrom. The officers of the Crucible Steel Mining & Milling Co., appreciating the immense good that the radium in these ores might accomplish, consented to have these claims worked on a royalty basis under an agreement covering the return of the uranium and vanadium content of the ore to them. Further conferences were then held with Doctors Kelly and Douglas, and the National Radium Institute was incorporated as announced in the paper given by Mr. Parsons before the American Mining Congress, at Philadelphia, October 24.

For some months the Denver office of the Bureau of Mines had been carrying on laboratory experiments and investigations in the field with reference to the uranium ores, and a bulletin covering these investigations has just been published by the Bureau. Knowing of the work of the Bureau of Mines, the National Radium Institute proposed a coöperative agreement with the Bureau of Mines whereby the Bureau was offered an opportunity for scientific and technologic study of the mining and concentration of the carnotite ores in the claims secured by the National Radium Institute; and for studying in the plant of the Institute the most efficient methods of obtaining radium, vanadium, and

uranium therefrom, with a view to increased efficiency of production and the prevention of waste. The legality of the agreement was carefully looked into and full approval given by the government officials, it being found that there were many precedents in similar coöperative work, especially between the Department of Agriculture and the farmers of the country.

In the agreement with the Bureau of Mines, the technologic management of the mines and mills was to be guided by the scientific staff of the Bureau, and Mr. Parsons has been designated by the Director to have charge of the investigation. He will be assisted by R. B. Moore, physical chemist in charge of the Denver laboratory who will have direct management of the plant, and by Karl L. Kithil, mineral technologist of the Bureau who will be in charge of the mining and concentration. Plans have been completed and contracts let for the experimental plant to be erected at Denver; land for the plant has been leased; over 100 tons of carnotite has already been obtained; and the larger part of the apparatus has been ordered.

In connection with the production of radium, the separation of uranium and vanadium will also be studied, and all processes, details of apparatus and plant, and general information gained will be published for the benefit of the people. As a result of these experiments it is hoped that other plants will be erected and that our carnotite ores will be worked up at home and the radium kept in this country. The Institute was formed for the special purpose of procuring enough radium to conduct extensive experiments in radium therapy, with special reference to the curing of cancer. It is also expected to investigate the physical characteristics and chemical effects of radium rays.

The radium produced will not be for distribution, as the work of Dr. Kelly has distinctly shown that to get real results in the treatment of cancer and other malignant diseases a high concentration of gamma rays is essential, and this at the present time can only be obtained from a comparatively large amount of material. Accordingly, to distribute the radium among many hospitals or physicians would render it practically ineffective for this purpose. Some hospitals at both New York and Baltimore are already partly supplied, and while it will be some time before a sufficient quantity of radium is produced from these ores to add greatly to the present usefulness of these hospitals, it is sincerely hoped that the work of the Institute will be of real benefit to many by assisting or possibly in controlling cancer, the most malignant of diseases.

Besides being of benefit to the general public, the activities of the Institute are sure to assist the prospector and miner by providing a greater demand for his already rare ore and by assisting to conserve the large waste which is now taking place; also to the plant operator by developing methods and by creating a larger market for his products. The radium produced is intended for the Institute's own use and is not for sale or distribution.

Work of the National Societies

American Institute of Mining Engineers

By CHARLES F. RAND

The American Institute of Mining Engineers, the second of the four largest national engineering societies, was founded on May 16, 1871. Its membership has grown during its 42 years of life until, at the present time (November 1, 1913), there are 4509 members on the rolls. This is the largest in its history. The growth is shown in the following figures:

1871	284
1881	1035
1891	2082
1901	2799
1911	4210
1913	4509

Of the 4509 members, 3228 reside in the United States, 181 in Canada, 254 in Mexico, and 846 in other countries, including almost every corner of the globe.

Founded in a time when the profession of mining engineering practically included that of metallurgy, the name American Institute of Mining Engineers was sufficiently comprehensive to describe its scope, even though its activities have been concerned more with metallurgy than they have with mining and geology. A recent attempt to change the name to American Institute of Mining and Metallurgy, was dropped because of sentiment as well as the pressure of other matters which were at the time deemed to be of greater importance.

It is the will of the members that Institute membership shall be democratic in character, and any person who is actively engaged in mining, metallurgy, geology, or chemistry is eligible to full membership, regardless of technical education or length of experience. Associate members are those persons who are interested in the activities of the Institute; junior members are students in good standing in undergraduate courses of engineering schools. While following the will of the members in admitting all eligible persons upon a democratic basis, the present Committee on Membership gives the strictest scrutiny to all applications, and demands convincing evidence of applicants' standing and eligibility before recommending them for election.

Publications

The chief activities of the Institute are devoted to the distribution of information on mining, metallurgy, and geology by the presentation and discussion of technical papers at general meetings of the Institute and at meetings of the local sections, and by the publication of the best of these papers in the monthly *Bulletin* and annual volume of *Transactions*. The volume of publication has grown so large that, notwithstanding the rejection of a large percentage of papers received in 1913, the first

ten monthly *Bulletins* of that year contained 2604 pages, and, for the first time in the history of the Institute, it will be necessary to issue three volumes of *Transactions* to contain all of the valuable papers and discussions that have been accepted and presented at meetings. The money paid for printing and distributing the publications of 1913, not including editorial expense, was equal to the total amount received from members in dues. The several thousand dollars required for editorial and office expense, contributions for local sections, technical committees, etc., had to be secured from other sources of income. It is thus evident that in the *Bulletin* and *Transactions* alone the members receive more than the full value of their annual dues. In 1913 the Institute also published the Emmons volume on 'Ore Deposits,' which is a continuation of the previous Posepny volume.

The first local section of the Institute was established, after two preliminary meetings for the reading of papers, in May, 1911, with headquarters at New York City. Since that time, nine local sections have been established, in several cities, and steps are being taken for the organization of others in this, and in one foreign, country. The purpose of these local sections is to extend the benefit of the Institute by more frequent meetings of the members in each locality, for reading and discussion of papers, and for social intercourse and acquaintance.

Technical Committees

Because of the wide diversity of subjects included in the Institute's field of activity, and the necessity of specializing in order adequately to take care of these several interests, the Board of Directors has established a number of technical committees, which shall have charge of the interests of the Institute in their respective fields. Although the desirability of such action was suggested by William B. Potter in his Presidential address to the Institute in 1889, in the following words: "It is hardly to be expected, perhaps, in an organization grown to such proportions as the Institute has assumed in the number of members and variety of interests represented, that a very efficient discharge of all its duties could be accomplished without the assistance of the systematic methods which a more definite organization would supply. In the scientific associations of wide and general range, the several interests are usually classified into groups and sections more or less fully organized and equipped for independent work; and it has already been suggested that it might be well for the Institute to adopt a similar course. As a suggestion for such a grouping at the start, the following might serve: I. Iron and Steel; II. The Precious and Base Metals; III. Geology and Mining; IV. Chemistry;" the first such committee—the Iron and Steel Committee—was not established until April, 1912. This committee was successful in securing for the Institute a large number of important

papers and discussions on the subject of iron and steel, and its activities have been so important that in October, 1913, it conducted a general meeting of the Institute under its own auspices, for the presentation and discussion of papers. The second committee to be formed was that on Precious and Base Metals. This committee secured for the Institute a series of papers of very great value, which were presented and discussed at the Montana meeting of the Institute and will be published in Volume XLVI of the *Transactions*, to be known as the Montana Volume. There are now eight Technical Committees in all: The Iron and Steel Committee, chairman, Albert Sauveur; Precious and Base Metals, chairman, Charles W. Goodale; Mining Geology, chairman, James F. Kemp; Mining Methods, chairman, David W. Brunton; Use of Electricity in Mines, chairman, William Kelly; Mining Law, chairman, Horace V. Winchell; Petroleum and Gas, chairman, Anthony F. Lucas; Non-Metallic Minerals, chairman, Heinrich Ries.

The Institute can best carry on its work when all desirable, eligible men are on its membership rolls, and one of the functions of these technical committees is to secure the membership of desirable men within their fields of activity. More than one hundred members were added during its first year by the Iron and Steel Committee.

The formation of the technical committee has been one means of bringing to the attention of the Institute management the large number of men who should be interested in the Institute's activities, but who are not members. For the purpose of securing the coöperation of all such desirable, eligible persons, a Committee on Increase of Membership was formed and through their efforts a number of new members have been secured.

Library and Office Activities

Upon moving into the United Engineering Society's Building in the year 1906, the Institute's library was merged with those of the American Society of Mechanical Engineers and the American Institute of Electrical Engineers, and placed under joint management. This combined library contains now over 55,000 volumes and regularly receives about 700 technical periodicals. The members have been slow to learn of the services which the library can perform to those who are not able to visit it; namely, by furnishing lists of references, abstracts, translations, copies, by lending books through the mail, etc.; but, notwithstanding this, the library is rapidly increasing its activities for members residing at a distance.

Mainly through the efforts of Dr. James Douglas, the land debt of the Institute, which was originally \$180,000, will be entirely paid off at the time of the annual meeting on February 17, 1914. This wiping out of the debt will not only relieve the Institute funds of the payment of interest, but will give the Institute an unencumbered ownership of one-third of the United Engineering Societies Building, and the land on which it stands, worth altogether about \$1,750,000.

The Institute has recently established an Employment

Department with the object of bringing employer and employee together. Although the work of this department has naturally been handicapped at first by lack of knowledge on the part of the members of the services which it can perform, it has been able to fill a number of positions during the past three months and its activities are rapidly increasing. The Employment Department not only publishes a list in the bulletin of 'Positions Vacant' and the 'Engineers Available,' but is in frequent communication by mail and wire with those whom it can serve. As soon as the members of the Institute who are employers of engineers realize that the Employment Department is in a position to secure for them very promptly efficient men well suited to their requirements, this department can expect a great increase in its activities. The Institute maintains in New York a Members' Writing Room.

The policy which the directors have favored this year has been that of encouraging participation in Institute affairs, through the committees, of as large a number of influential men as convenient. The result should be that the management will become impersonal and the Institute's welfare at no time be dependent on any one man.

The Mining and Metallurgical Society

By H. M. CHANCE

The Mining and Metallurgical Society of America is just completing the sixth year of its existence, a year in which its activities have broadened and its functions have expanded. I believe that the consensus of opinion among its members is that the year has brought about a better understanding of the aims and objects of the Society, fuller appreciation of its value to its members and to the profession at large, and a truer understanding of its position as an association which requires and maintains a certain standard of attainments—in experience, professional standing, achievements, or knowledge—as a qualification for membership, but which is in practice an essentially democratic body.

Its members have understood from the outset that the Society was organized to perform functions heretofore neglected or but partly performed, and to provide a representative body by or through which the profession might speak on matters of professional or public interest, but whether it should also undertake work in other directions was not fully determined, and for this reason it has been moving slowly and deliberately, learning by experience, but at the same time it has been working steadily and successfully to carry out the objects of its organization. Its success in this direction has largely been through the efficient and painstaking work of its committees. The steadfast loyalty and unity of purpose shown by its members during the past year have strengthened and rapidly matured the Society, conferring upon it, while still young, individuality and character in keeping with its tenets.

In addition to the publication of matters relating to

its current business affairs, the *Bulletin* of the Society has included matters brought before the Society for action, a number of technical papers, contributions, and communications upon geological and mining subjects, the discussion of some sociological problems and reports from its committees on Mining Law, Standardization, and on Rules for the Award of the Gold Medal of the Society. During the year the Society has passed resolutions memorializing the Congress of the United States to pass legislation providing for: (1) a new building for the United States Bureau of Mines; (2) a new building for the United States Geological Survey; and (3) the creation of a Patent Commission to recommend to the congress of the United States any legislation that may be deemed necessary or expedient. As already announced in the *Bulletin* for November, the gold medal of the Society has been awarded to Herbert C. Hoover and Lou Henry Hoover for distinguished contributions to the literature of mining. The medal will be presented on January 13, 1914, at an evening session of the Annual Meeting of the Society which is to be held in New York City on that date. The Society will close the year in prosperous condition. It has an income larger than its expenditures, no debts, and a satisfactory surplus in its treasury.

As the Society is too young to have a past by which its future activities may be forecast, the interest of its members is centred upon its present and future, upon what it is doing and can do for its members, and upon what it is doing and may do for the profession at large. I shall not attempt to discuss the many useful functions of the Society, but will mention only those that, in my opinion, are of dominating importance.

Many of our members believe that the greatest service the Society can perform for its members is the promotion of engineering fellowship and friendship by drawing together in close association those who are interested in like work and who are actuated by like motives, and I think this belief is well founded because such association enables them to coöperate (within the Society) in advancing the interests of the profession. For precisely similar reasons it seems to me that the greatest service the Society can render the profession at large is to assist in bringing about a more thorough realization of the community of professional interests—in promoting professional solidarity—a matter of profound importance to the profession. Within the Society, professional solidarity has made rapid progress. It is the force that now directs the activities of the Society and is one that must always be an important factor in controlling its destiny. How the influence of a like force can be extended to the profession at large may well occupy the future attention of the Society and of other kindred engineering organizations. These are some of the larger issues with which the Society will be expected to deal. They open fields of work in which the activities of the Society may expand indefinitely.

Perhaps this résumé would not be complete without some reference to the work of the local sections. Those members of the Society who are able to attend the

local section meetings, find pleasure and profit in the discussions of technical matters, especially in the free expression of personal views and recital of personal experiences which the informal character of these meetings permits. To enable a larger number of its members to enjoy these privileges, one of the future objects of the Society will be to establish local sections at a number of places convenient to the location of its members.

The American Mining Congress

By CARL SCHOLZ

The aim of the American Mining Congress has been, and will continue to be, the furtherance of any movement which will be of benefit to the mining industry, with special reference to the wishes of the greater number. The correct solution of the problems which will be of help to the majority with the least injury to the remainder is a task requiring due consideration and support from all quarters.

Perhaps the most important work rendered by the Mining Congress has been its work in assisting in obtaining, first, the establishment and, later, the necessary appropriations for the maintenance of the United States Bureau of Mines. There can be no division of opinion that the first duty of mine owners is to safeguard the lives of the employees. That the Bureau of Mines has more than justified its existence does not require any further affirmation, but we believe its power and influence should be extended, and there is additional work for the American Mining Congress in this cause.

Aside from matters of safety and economy in operating, general economic conditions are becoming more important to mines in this era of expansion when the growth of the industry increases by leaps and bounds; and decided changes in business methods become not only advisable but imperative. Within a half century the early mine operator who aided in the mining of his product was his own superintendent, engineer, and salesman, has developed into the head of operations whose daily output is many times greater than his former annual tonnage. Like changes have taken place in the methods of buyers, and laws have come to life regulating or endeavoring to regulate the industry. The old state of interests of the community is giving away to community of interests, and with the great number of vexing problems, no single individual or even a state organization can satisfactorily maintain its position.

The purpose of the American Mining Congress is to bring together the mine owners scattered throughout this vast country, and by concerted action endeavor to improve the conditions of the industry in a dignified and broad minded manner; to this end the coöperation of all mining men is invited, and it is believed that their moral and financial aid will be amply justified by results which can only be accomplished by united action.

The London Market

By T. A. RICKARD

Introductory.—The year 1913 has been so full of trouble to the mining market in London that those who are superstitious may be forgiven for referring to the second half of its name. It began under a cloud of anxiety created by the first Balkan war, and before the early summer had seen that settled, the complications over Scutari threatened an embroilment of the Great Powers. Then just when the spectre of a vast conflict was vanishing in the Near East, the bourses of Europe were agitated by the internecine strife between the Balkan allies, the conclusion of which brought further burdens in the shape of an insistent demand for loans on the part of the exhausted combatants.

Meanwhile, the trouble in Mexico had been simmering, with occasional explosive outbursts of anarchy, as when the Madero government went down, early in the year, and Huerta advanced through assassination and riot to the presidential chair. During the summer the hope was insistent among those interested in Mexico that the latest military adventurer to rise to supreme power would prove an effective despot, and that order would be brought out of chaos, so that mines and railways could be operated without molestation. But the unruly element masquerading under a new name continued to devastate the country, and caused the cessation of industry over large areas. In the closing months of the year the diplomatic intervention of the United States has threatened, from day to day, to find a sequel in an armed incursion that could only end in a big and costly war. These events, of course, have had a dire effect. Mines have closed-down, many have been looted, others are crippled by the breakdown of railway transport. The railways have been dynamited or used for military purposes until the conduits of commerce throughout Mexico have been put out of use. As many of them have been financed in London, the present loss and the probability of greater damage to investors have contributed to the general dismay.

Besides these events, the mining industry of South Africa has received a body blow from the effects of which it is still staggering. A strike of white miners at the end of June led early in July to a sanguinary riot in the streets of Johannesburg. The cessation of work at many mines was bad enough, but the intimidation of the natives by the wild acts of their bosses was worse, for it led to an exodus of black labor from the Rand.

Thus war, insurrection, and riot have loomed large during the year, freezing the currents of speculation, and causing a shrinkage of quotations that, as we shall see, is astounding. Indeed, the absence of defaults and bankruptcies, entailing a panic, is a striking feature of the position, even if it brings but a lugubrious satis-

faction. The organization of modern business was never exemplified to better advantage than in the ability of the financial interests to withstand a strain so long, so severe, and so aggravating. The fact that the strain has been withstood warrants the expectation that it will be overcome finally. But so long as war between the United States and Mexico looms in the foreground, it is not likely that any market recovery will be recorded.

Among the shocks to public confidence, such as are due partly to the risk implicit in mining and the frailty inherent in joint-stock finance, are the disappointments or fiascos associated with the Orsk, Eldorado, Esperanza, Santa Gertrudis, Mount Elliott, Bwana M'Kubwa, and Great Cobar mining companies. On the other hand, gratifying developments highly encouraging to shareholders have been recorded during the year in connection with the Mount Morgan, Golden Horse-Shoe, Oroville Dredging, Nundydroog, Kyshtim, Tomboy, Naraguta, Renong, and Burma mines. Owing to the general shrinkage of quotations, the improved prospects of many other mines have not been reflected in market valuations, but the number of them is considerable.

Transvaal.—The output of gold, on account of labor troubles, will scarcely exceed that of 1912, which was £38,757,560 or \$188,749,317. The mining industry of the Rand has passed its zenith, as is indicated by the diminution in dividends, compared with the gross output and so-called 'profits,' the last being a purely fictitious statistical statement of a highly misleading character.

	Gross.	Profit.	Dividends.
1910	£30,703,912	£11,567,099	£8,887,185
1911	33,543,479	11,415,861	7,763,086
1912	37,182,795	12,678,095	7,952,994
1913	37,000,000	11,350,000	6,500,000

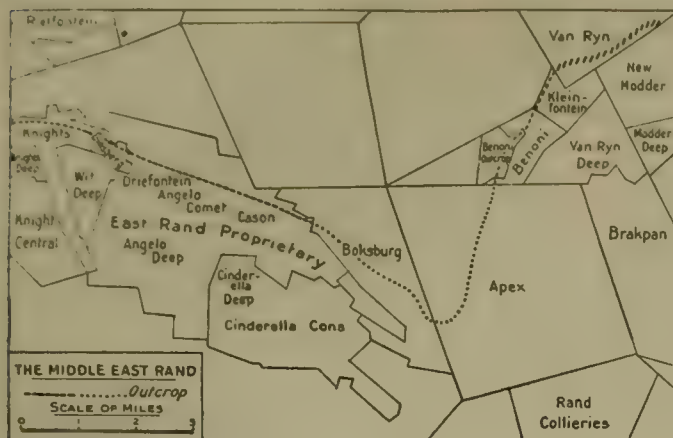
These figures, be it noted, apply to the Witwatersrand district only and do not include the 'outside' districts of the Transvaal. The totals for 1913 are, of course, estimated.

Reference has already been made to the strike and riots in July. These have exposed the fact that the normal complement of 25,000 white men does not consist of manual laborers, but of overseers in charge of the 200,000 Kaffirs. The native is bossed by the white man, who receives from \$135 per month at surface to \$375 per month on contract underground. Against this the colored worker is paid 50c. per shift, and is housed and fed in a compound. He costs the companies about \$20 per month. Owing to incitement by labor agitators from Australia and America, the white worker has become increasingly assertive. For this he has some excuse, but not much reason. The excuse is the prevalence of phthisis, which itself is largely due

to the workman's unwillingness to adopt palliatives, such as respirators and water-sprays. On the part of the companies, the deficiencies in ventilation may be cited, and the lack of effective control, due to the centralization of management at the head-offices of the financial groups, whereby the manager has lost prestige and influence with his white employees.

Engineering & Mining Journal in May, 1903, in which I deprecated the suggestion that the blanket lodes of the Rand had the uniformity and persistence of coal seams. The conglomerate persists, but the gold decreases, in depth. When a blanket ceases to be profitably gold-bearing it loses its economic characteristic and becomes the plain 'pudding-stone' of early Victorian geology.

Last year at this time I was able to instance the development of the Far Eastern portion of the Rand as an outstanding feature of the year. During 1913 the progress of work has been highly satisfactory in the case of the Van Ryn, the New Modderfontein, the Modderfontein B, and the Modderfontein Deep, but results from the Brakpan, Government Mining Areas, and Geduld have been disappointing. The Brakpan has had a bad time owing to a caving of the hanging wall and the poor returns from new workings. The drop in the quotation has been lamentable. The following list of quotations exhibits the fall in market appraisals of the leading mining companies operating on the Rand:



Dissatisfaction, some of it real and some of it merely vicious, has thrown the local industry out of gear, and on the top of that the violent quarrel among his bosses of the dominant race has caused the Kaffir to become unruly in some cases and intimidated in others. Hence the unwillingness to renew contracts on the part of time-expired natives. The recruiting for colored labor had been vigorous and far-reaching; finally, in March, the total supply was augmented to 231,700, but even that did not suffice for the needs of the mines. Then came the strike and the cessation of recruiting, with rapid withdrawals to the kraals, until in October the total supply had shrunk to 170,000, the lowest since the early part of 1910.

This shrinkage has been hardest on the low-grade mines, which, to earn a profit, must be operated on the full scale. As the low-grade mines are also, for the most part, the deep-level properties, it is not surprising that several of them are defunct. Among the mines that have closed down are the Apex, Benoni, Cloverfield, Cinderella Consolidated, Jupiter, French Rand, Van Dyk, Simmer & Jack East, Rand Klip, Lancaster West, Rand Collieries, Volgelstruis, Treasury, and Jumpers. The last two are outcrop mines with a good record, but now exhausted. Among the mines on which operations have been discontinued are two of the deepest on the Rand. This may be noted in connection with the statement of H. H. Webb, in his report for the Consolidated Gold Fields of South Africa, that the mines of that group show undoubted signs of impoverishment in depth. In this respect the Gold Fields properties are not unique. The recognition of this basic fact of non-persistence of ore is interesting, but belated. Some of my readers will remember an article entitled 'Even Methuselah Died,' written by me in the

	Dec. 1, 1912.	Dec. 1, 1913.
Rand Mines	£6½	£5½
Central Mining	9¾	7½
Con. Gold Fields	3¾	2
General Mining	1	½
Crown Mines	7 "	6½
East Rand Proprietary	2 ¹¹ / ₁₀	2
Brakpan	4	2¾
City Deep	3	2¾
Con. Langlaagte	1½	1½
Randfontein Central	1¾	1½
Village Deep	2½	1¾
New Modderfontein	12¾	11¼
Van Ryn	3¾	3¼

As I said last year, the space given in this review to the Transvaal emphasizes the dominance of the Kaffir market, as is called that department of the Stock Exchange devoted to Rand securities. The gloom at Johannesburg is bound to affect the whole mining market. Liquidation has been on a big scale, as quotations show, but it has not, I believe, gone too far, in most cases. The market valuation of mines is preposterous in boom times, it is exaggerated in ordinary times, and it only comes down to realities in periods of excessive depression. A rebound may be expected, but it is likely only to afford the insiders a chance to unload on the public.

Rhodesia.—The annual output of gold, estimated at £2,900,000, shows an increase; but it is small, and in no proportion to the discounting of the future that has marked Rhodesian finance. I confess to a prejudice against this part of Africa, for it has been the scene of the most unblushing stock-jobbery, highly injurious to the business of mining. During the year the notorious Amalgamated Properties has gone to the wall, with reconstruction; the Giant has gone 'scat,' as the Cornish-

man says; the Eldorado and Lonely Reef have had some of their inflation reduced; the Falcon has been the subject of an unpleasant episode; and the Shamva has shrunk in valuation to something nearer its merits. This mine was bought for £65,000 and transferred for £400,000; as soon as the Company was formed, the 500,000 shares were kited to £5½, on optimistic reports and market juggling, to drop to £1¾ now that the mill is about ready to start. The Globe & Phoenix is still the largest producer, yielding 10,500 oz. gold per month, but it has been rendered ridiculous by a fight over directors' fees and by the squabbles among cliques and coteries of shareholders. At the end of 1913 there is talk of a revival in Rhodesian mining, meaning a renewed outburst of speculation, by reason of the proximate beginning of profitable production at the Shamva, Cam & Motor, Antelope, Falcon, and Eileen Alannah mines. Of these the Cam & Motor is much the most promising; whether the others will justify the expectations now entertained, we doubt. However, the increased yield of gold from these properties will be a stimulant to the market in 1914.

The downward trend of quotations is seen by the following list, of which it can be said now that not one depreciates the true merits of the mines:

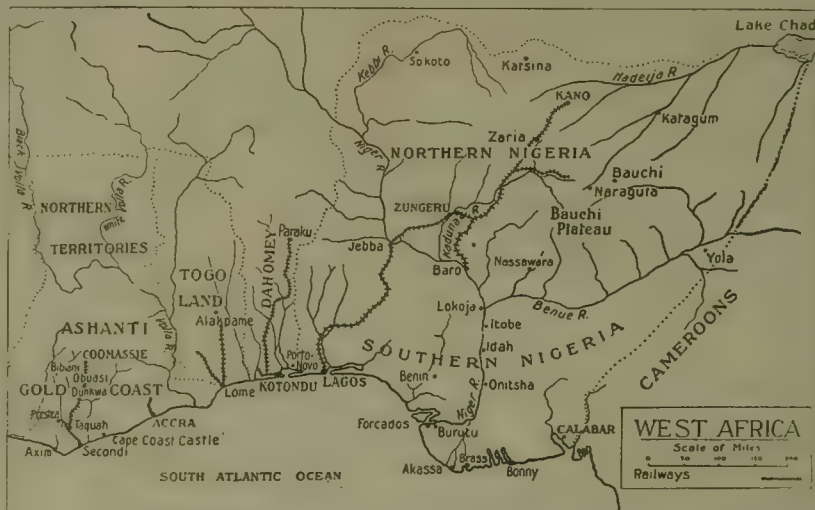
	Dec. 1, 1912.	Dec. 1, 1913.
Cam & Motor.....	37s.	28½s.
Shamva	3¾	1¾
Globe & Phoenix.....	1½	1¼
Falcon	1¼	¾
Eldorado	1¾	¾
Lonely Reef	3	2¼
Giant	1½	5s
Chartered	26½s.	19s.
Tanganyika	2½	1¾

Of the two chief copper enterprises, the Bwana M'Kubwa was the victim of a fiasco, due to an erroneous assumption of the specific gravity of the ore, and still has to face sundry metallurgical uncertainties, while the more famous Tanganyika Concessions has two blast-furnaces in operation at Katanga, producing about 900 tons of copper per month. Fine ore is being briquetted, and the Company is making its own coke at Wankie. However, the performance seems small enough after the big promises of four years ago.

One of the events of the year has been the effort made by the British South Africa, usually called the Chartered company, to develop the agricultural resources of Rhodesia, by encouraging immigration and settlement on the land. This promises to help many of the land companies, and some of the mining companies that own land. It is a commendable departure,

and ought to prove generally beneficial to industry in Rhodesia. Unfortunately the proposed alienation of the land to newcomers is meeting with opposition on the part of the resident white population, and threatens to make trouble for the Chartered company.

West Africa.—This part of the world, from the miner's standpoint, is now divisible into the Gold



Coast and Northern Nigeria. All the enthusiasm of early exploration has died out of the Jungle market, as the West African gold mining department is called. The annual output of gold, estimated at £1,630,000, shows a small increase, but it has become realized with regrettable tardiness that the cost of operations under conditions so adverse to white men has been underestimated all along. A good example is afforded by the Prestea, a splendid gold-quartz vein, where the yield was estimated repeatedly at 40s., as against a cost of 20s., per ton. After several years of disappointment it is clear now that the yield is 33s. per ton, while the cost is 26s., so that the net resultant profit is about 7s. as against the roseate predictions of 20s. per ton. The Ashanti Goldfields is doing well, both as to output and dividends, but here also expectations are now on a lower and less flamboyant plane. The Broomassie is doing better, but far below the promises of its prospectus. The Bibiani has joined the Cinnamon Bippo, Effuenta, Fanti, and other 'has beens' of the insalubrious jungle. Of the mines on the blanket, once supposed to give the promise of a second Rand, the Taquah and the Aboisso are both creditable enterprises, but the margin of profit is small. The Abbontiakoon, which resumed crushing in the second half of 1912, has steadily increased its output, but the inability to reduce the cost is a severe handicap. Two dredging companies, on the Offin and Ancobra rivers, respectively, manage to make a profit, but this is done under difficult conditions, both as to submerged timber and unfavorable climate. No new enterprises of any consequence are coming forward, so that an expansion of the gold min-

ing industry in West Africa is unlikely. A few comparative quotations are appended:

	Dec. 1, 1912.	Dec. 1, 1913.
Ashanti	21s.	17s.
Prestea	17½s.	13s.
Abbotiakoon	6½s.	6s.
Taquaah	13s.	14s.
Abosso	20s.	18s.
Broomassie	5½s.	5½s.
Ofta River	5½s.	4½s.
Fanti Consolidated	8s.	5s.

Tin mining in Northern Nigeria is making progress, as is indicated by an increase of production and the more systematic exploitation of the alluvial deposits. As yet no veins or lodes of any importance have been uncovered. The output is the yield mainly from 'calabashing,' or panning, of rich patches of gravel by native workers, who are paid from 1 to 6 pence per pound for the tin concentrate. Ditches and pipe-lines are under construction by several companies, notably the Naraguta, Naraguta Extended, Rayfield, Bisichi, Ropp,

machinery. Most of the tin so far exported has been carried on the backs of natives. The construction of railways is being pushed with commendable zeal. The present railway runs from Lagos to Kano; the branch line to Rahama is being continued to the Bauchi plateau (which is the tin region), leaving the main line at Zaria and terminating at Bukuru. In addition, the Government proposes to construct a more direct line from the mouth of the Bonny river, where deep water is available, through the Udi coalfield, across the Benue river, along the edge of the Bauchi plateau, to Kaduna, where it will join the existing railway. This line will be 530 miles long and will shorten the distance from the mines to the coast by fully 160 miles.

The following quotations indicate a fairly vigorous market in Nigerian tin shares:

	Dec. 1, 1912.	Dec. 1, 1913.
Rayfield	16s.	11s.
Naraguta	13½	13½
Naraguta Extended	11s.	13s.
Ropp	3¼	6¼
Kaduna	1¼	7½
Bisichi	1¼	11/16
Jos	6s.	7s.
Champion	7s.	8s.



CLEANING THE TIN IN NIGERIA.

and Kaduna, while two companies, the Jos and the Benue, have just begun to work with dredges. If the latter are successful, it will be an important advance, but I am not hopeful as to the correctness of the procedure, because the clay, irregular bedrock, and patchiness of the alluvium all militate against effective dredging operations.

The output in 1912 was 2532 tons of concentrate, averaging about 70% metallic tin; for 1913 it is probable that the production will be 5000 tons of a similar product. The largest producer is the Naraguta, which ships from 60 to 75 tons of concentrate monthly to England. The Rayfield sends from 40 to 50 tons, the Naraguta Extended from 25 to 40, and the Bisichi from 25 to 36 tons per month. A good deal of this concentrate goes to the smelter at Bootle, near Liverpool, erected by Richard Pearce and his son, Frank Pearce, formerly at Denver, Colorado.

Scarcity of labor, as yet, has not become a discouraging factor, but the competition between the companies, with offers of higher wages, may render the position acute unless restraint is exercised. Lack of cheap transport, of course, has hindered the introduction of

America.—This part of the London share-market includes Canadian, Mexican, and South American mines. It is nothing like so important as it used to be before the Rand and Western Australia came into prominence, and in the days when the Exploration Company was so active in the Rocky Mountain region. The Treadwell group, in Alaska, has an agency with the Exploration Company, and the three mines on Douglas island continue to do particularly well, but share-dealings are small, as is apt to be the case with mining of this consistently satisfactory character. The Granville company, formed in 1911 to exploit large alluvial areas along the Klondyke valley, in the Yukon, has undergone re-organization, the interests formerly controlled by A. N. C. Treadgold and J. W. Boyle being respectively incorporated under the names of the North West Corporation and the Canadian Klondyke company. Both the former controllers remain as general managers, and active dredging operations have been under way during the past season, with results considered quite satisfactory. Another dredging company, the Oroville, which started as a Californian enterprise, has gained renewed life by the acquisition of an alluvial area at Pato, in Colombia, where a dredge has been at work since March with highly satisfactory results, the digging of 315,000 cubic yards during the past 8 months having yielded \$205,000 worth of gold. So far, the digging has done considerably better than the drill-holes.

Another enterprise, involving dredging together with land reclamation is the Natomas Consolidated, the bonds of which, to the amount of \$15,000,000 were issued in 1910. After three years it has been acknowledged that more working capital is required and a reconstruction for that purpose is imminent. The

yield from dredging has fallen short of the \$5,000,000 estimated by \$2,000,000. In the land business also excessive liabilities have been incurred. However, the fiasco is more surprising than conclusive, for the resources of the Company are enormous and only require a little less flamboyancy in administration.

In Colorado the Independence, at Cripple Creek, is now near an end, the profit coming entirely from the milling of the old dump; in the same way the Camp Bird, after a fine career, is known to be finally exhausted, the Company owning it having transferred its energies to the Santa Gertrudis, a silver mine in Mexico, and the Messina, a copper mine in the Transvaal. A further deal involving the Bonanza and Siempre Viva mines, in Nicaragua, is being incubated in the interest of the Camp Bird, which is now practically a holding company for blocks of shares in various mines. The Tomboy, also in Colorado, is doing well, and has added another chapter to a record of wise management and honorable administration. The Tomboy itself, and then the Argentine, were acquired and worked out; now the Company is operating the Revenue or Montana claims, in the same district, and is making a profit of \$275,000 per annum from a property that cost \$400,000 only.

As regards Mexico, the El Oro district is the most important to the London market. There, the parent mine, the El Oro Mining & Railway Co., continues productive on a diminishing scale, without any prospect in depth. The Esperanza and the Mexico, the two adjacent mines on the same vein system, have depreciated greatly in value, despite sundry discoveries underground that seemed to postpone the day of exhaustion. The Dos Estrellas, on the other side of the hill, has gone the way of most mines that are boomed on the Paris bourse. At Pachuca, the Santa Gertrudis also has had a bad time, aggravated by the belated manner in which information was given to the shareholders. Below the 18th level the lode is distinctly poorer, and the 20th level, now being extended, is yielding results indicating further impoverishment. Meanwhile cross-cuts on the upper levels are finding branch veins, and parallel orebodies of considerable promise, so that lateral development in this mine, as in others, may lead to the development of fresh resources of decided importance. The Buena Tierra, Avino, Mazapil Copper, Palmarejo, Barranca, La Fé, and other mines operated by British capital have been shut down owing to the condition of anarchy in which Mexico has been passing during the past year. New issues have been few. The Reforma mine at Campo Morado was examined for the Camp Bird people, but, for sundry reasons, one of which was the political unrest, it was dropped. A new company, financed by a prominent South African operator, Hans Sauer, was formed to take options on various properties at Pachuca and in Oaxaca, but nothing important has resulted as yet. As soon as the country is quieted, I expect to see a notable stimulus to British participation in Mexican mining, but quiet is a word that ill

consorts with Mexican affairs at the present time. The trend of quotations is shown herewith:

	Dec. 1, 1912.	Dec. 1, 1913.
Alaska Treadwell	87½	8
El Oro	17s.	14s.
Esperanza	2½	1
Mexico Mines	7½	5
Camp Bird	23s.	14½s.
Santa Gertrudis	1½	¾
Oroville Dredging	5s.	11½s.
Tomboy	1½	1¾
Granville	14½s.	10s.
Casey Cobalt	2½	2½
Cobalt Townsite	3½	2½

Several Cobalt issues have been prominent in the share-market, notably the Cobalt Townsite, Casey Cobalt, Cobalt Lake, and City of Cobalt. The last mentioned is a wild project. The first two are controlled by Rose & Van Cutsem, London brokers of good repute. Their mining operations in the new year are to be guided, I hear, by D'Arcy Weatherbe. When the Townsite was taken over, it was thought at Cobalt that British speculators had been 'handed a lemon,' but events have proved quite otherwise, the exploratory work carried out by the manager, A. C. Bailey, having been highly successful. While these calcite stringers, full of native silver, are not well adapted to joint-stock operations, it must be confessed that the public, so far, has not done badly out of Cobalt; but the danger of fallacious expectation is ever present in the case of deposits of such a character. Incidentally, it may be noted that the Associated Gold Mines of Western Australia has an option on the Keeley mine, in South Lorrain, and this option is likely to be exercised, the exploratory work conducted under the direction of J. Mackintosh Bell having been remarkably successful. More recently the same Company has taken an option on the North Thompson property, at Porcupine. This adjoins the Hollinger and the Crown Porcupine. The Hollinger itself had had a small hold on British interest, which has been rewarded, but participation in the development of Porcupine has been scant, owing to untoward happenings three years ago. However, several English companies have scouts in Northern Ontario, and the Kirkland Lake developments are likely to stimulate organized prospecting in the Canadian Northwest.

Australasia.—This part of the world has been prominent on the Stock Exchange by reason of the activity in Broken Hill shares. The great Barrier district in New South Wales, famous for its silver, is now one of the leading sources of zinc and lead supplies. Flotation processes of concentration have enabled ores formerly regarded as inextricably refractory to be separated into their constituent metallic sulphides in the form of various marketable concentrates. During the past year a selective method of flotation has further facilitated profitable treatment. Meanwhile, the big orebodies give signs of continuity. The parent mine, the Broken Hill Proprietary, has an ore reserve still

over 2,000,000 tons, besides about 1,000,000 tons of zinc tailing yet to be treated. An issue of 240,000 shares at £2 each was made by this Company early in the year for the establishment of an iron and steel industry, based on immense deposits of ore at Iron Knob, on Spencer's Gulf. The Zinc Corporation, in addition to its large milling plant, operated on accumulations of tailing, acquired the South Blocks mine in 1910, and



MINING CLAIMS AT BROKEN HILL.

has opened up on the 8th level ore 50 to 80 ft. wide of normal contents, namely, 14% lead, 10% zinc, and 2½ oz. silver per ton. A new lode, west of the main Broken Hill lode, has been developed on five levels; it represents a mineralized zone of great importance, for it may prove a new asset to several other mines, namely, the South, the Block 10, and the Proprietary. This west lode is characterized by an excess of zinc, which can now be extracted profitably. In the South mine this lode has been tested by drilling, which has proved 31 ft. of ore assaying 16% lead, 10% zinc, and 4 oz. silver; and it has been traced from the 825-ft. level to the 1070, enlarging at the lower horizon. Both the North and South companies are prospering, and have increased their dividends. In October the main lode in the North mine was cut on the 1400-ft. level, exposing 112 ft. of ore averaging 17½% lead, 15% zinc, and 10 oz. silver. This is an improvement in grade, and augurs well for the future. In the British and Block 10 mines also there have been disclosures of fresh ore of a promising character in the western ground. The Sulphide Corporation, owning the old Central, has struck the western lode at 1300 feet.

West Australian mines are less prominent, owing to the decline of the big producers at Kalgoorlie. But it must be admitted that they are dying hard, and are being managed with a care unknown in the bonanza days. The Golden Horse-Shoe, Ivanhoe, Great Boulder, Lake View & Star, and Kalgurli are still very much 'on the map,' and in the outside districts the Sons of Gwalia and Great Fingall evince signs of vitality. The discovery of a rich but erratic orebody in the Victorious mine at Ora Banda created some excitement for holders of shares in the controlling company, the Associated Northern Blocks, and the beginning of milling operations in the Bullfinch Proprietary, the sole survivor of a wicked boom, has been another cheerful incident.

Among other noteworthy incidents in other parts of the island continent I may mention the passing of control in the famous Mt. Morgan from the estates of the Hall brothers to W. K. D'Arey and the firm of Lionel Robinson, Clark & Co. A block of 350,000 shares was involved in this transaction, which is the first step to a complete re-organization, under the resident management of Benjamin Magnus, who succeeds G. A. Richard, so long associated with the success of the mine, which is now an important producer of copper, as well as gold. In Queensland also are the Mount Elliott, Great Fitzroy, and Hampden Cloncurry—all copper mines. The former is now deeper than the rich orebody to which it owed a brief prominence, the second is still struggling with the application of flotation to a low-grade complex ore, while the third has suffered from labor troubles and a fire. Another copper mine, the Mount Oxide, has been registered as an English company and is likely to do some good, having rich orebodies and an energetic management. The London control, however, is market-wise and not one to inspire public confidence.

The leading quotations reflect the local situation:

	Dec. 1, 1912.	Dec. 1, 1913.
Broken Hill Proprietary	45s.	34s.
Broken Hill South	8½	7½
Broken Hill North	7½	*2½
Zinc Corporation	18s.	17½s.
Golden Horse-Shoe	2½	2½
Ivanhoe	3½	2¾
Great Boulder	13s.	14s.
Bullfinch Proprietary	9s.	11½s.
Sons of Gwalia	1½	1½
Great Fingall	8s.	13s.
Waihi	1½	2½
Great Cobar	4½	17½s.
Mount Elliott	7½	4
Mount Morgan	3¼	3¼
Hampden Cloncurry	2½	1½

*Capital increased from £200,000 to £600,000 during the year.

Three promising mines have been shut down owing to metallurgical difficulties, namely, the Gwalia Consolidated, Lancefield, and Yuanmi. The first of these yielded gold to the value of £400,000 down to 100 ft. in depth, when the ore became refractory, owing to arsenic, with graphite. The orebody is said to be 3500 ft. long, and at 500 ft. (according to several bore-holes) it assays 11 dwt. per ton for a width of 36 ft. The Lancefield vein is higher grade, but not so wide. Arsenic and more graphite are here the trouble. At the Yuanmi antimony is the obstacle. These three properties offer a big chance to metallurgical ingenuity.

The worst episode of the year in Australian mining has been the debacle of the Great Cobar. The £5 shares once quoted at £12 (making the valuation £2,238,504) are now at 18 shillings, and they are not worth that. It is an old story. The purchase price of the mine was much too high, the promotion loot was too big, the working capital was entirely inadequate. Seven years of toil and trouble, varied by one dividend that ought

not to have been paid, have now ended in a recognition of some of the facts, with a debenture debt of £725,000, and a mine that looks feeble on the bottom levels. A fine property has been irretrievably despoiled. The Waihi, which furnished the sensation of 1911, shows no real signs of recovery. Labor troubles have hindered deeper exploration, which so far has yielded no results of importance, only assays that have caused the quotation to rise to an unwarrantable extent.

Russia.—Anglo-American enterprise continues to be both prominent and successful in Siberia, notably in copper mining. The Kyshtim, with which Leslie Urquhart, H. C. Hoover, and A. C. Beatty are prominently identified, has developed into a big property. R. Gilman Brown is the consulting engineer. According to his latest report, the total reserves in October amounted to 2,054,000 tons of assured ore and 397,000 tons of probable extensions. The average copper content of the ore being smelted, at the rate of 600 tons per month, is 3%. The output for 1914 is estimated at from 9000 to 10,000 tons of blister copper. Drilling has been a prime factor in discovering and exploring the various orebodies, of which there are four groups, constituting as many mines. The smelting plant includes the most up-to-date equipment, including an electrolytic refinery. The Hoover-Beatty interest in Atbasar has passed to the Spassky, which is administered by Ehrlich & Co., and includes a French interest headed by E. Carnot and F. Robellaz. E. T. McCarthy is the consulting engineer. The mine has just been deepened to 630 ft., where a cross-cut has penetrated the lode, exposing ore averaging 12% copper. The main orebody of the mine is 250 ft. long and 30 ft. wide, while the smaller orebody is 30 ft. wide for a length ranging from 80 to 120 ft. The average output runs 20% copper, chiefly in bornite, but the second-class ore, averaging 8%, is being accumulated, pending the completion of the concentrating plant. Dividends of 35% have been paid on a capital of £595,330, increased by the absorption of the Atbasar to £950,000. The production of copper is from 400 to 450 tons per month. So far 21,000 tons has been produced. At the Atbasar the previous exploration by boring is being fully verified by systematic development. The ore is a sandstone impregnated with bornite, yielding an ore averaging 8% in copper. The workings are shallow—only down to 250 ft.—owing to the fact that the deposit conforms with the dip of the strata. The erection of a smelting and concentrating plant is under way; when completed, a production of 500 tons of copper per month is anticipated. The resident manager is H. C. Bayldon, who is said to be doing excellent work.

Another promising enterprise is the Tanalyk, which, in 1912, acquired the property of a Russian company operating in the southern Urals. The control is nearly identical with that of the Kyshtim. A debenture issue of £200,000 was made recently for the purpose of completing the equipment, capable of treating 220 tons of ore per day and producing 1500 tons of copper per annum. As yet this is only a large and promising pros-

pect. The chief mine of the group is the Mambet, only 165 ft. deep, exposing a lode 10 ft. wide, assaying 2 to 3% copper, with 8 dwt. gold, and 10 oz. silver per ton. The first unit of the smelter to be ready in London.

The Sissert, which is also in the Ural mountains, was placed on our market in 1912, and since then has been quietly developed by means of bore-holes and mine workings, while increasing its production of copper to about 100 tons per month. Dividends of 10% are being paid on the capital issued, namely, £600,000.

The gold mines are not doing so well. The rich alluvial ground of the Lena Goldfields is being exhausted, although the returns do not show it. During the past season 820,189 cu. yd. of gravel was washed for a yield of £1,424,468, or an average of about 8 dwt. gold per yard; in 1910 the yield was £1,551,849 from 748,896 yd., or an average of 10 dwt. per yard. The cost is 25s. or about 6 dwt. per yard. The Company bought £82,880 worth of gold from its employees. Owing to Russian control of the management, the English shareholders get scanty technical information. The Consolidated Gold Fields, once the principal shareholder, sold out most of its holding long ago at about £4. The shares are now at £2. An effort to introduce American technical methods failed. A recent inspection by C. W. Purington may presage sundry technical improvements. Meanwhile the surrounding region has been investigated by several American and British engineers, with a view to new enterprises, but the remoteness of this Bodaibo district is a severe handicap. According to late advices, a railway is to be built down the Lena valley from Irkutsk.

The Orsk Goldfields is not doing any good. In 1912 the gold extracted was worth £36,662, as against an operating cost of £10,509, but the administration, royalty, maintenance in winter, and London expenses reduced the illusive profit of £26,154 to a loss of £3144. In the same way the Troitzk had an operating profit of \$7800, but a real loss of £600. These theatrical statements of profit are ridiculous. The plain fact is that both mines are being worked at a loss. No new gold-mining enterprises in Russia have come into prominence during 1913, but a great deal of scouting has been done by a number of engineers experienced in Russian conditions, and I anticipate that some of this search will result in new business.

	Dec. 1, 1912.	Dec. 1, 1913.
Lena Goldfields	3¼	2
Orsk Priority	1	¼
Kyshtim	3¼	3
Atbasar	1½	*
Spassky	†4½	‡2½
Tanalyk	3	2½
Sissert	1½	1½

*Absorbed by Spassky.

†Old capital, £595,330.

‡New share capital, £950,000.

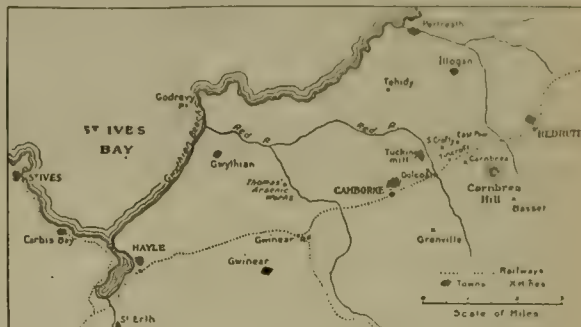
The Indian gold mines, on the whole, have given satisfactory results, and the output has been maintained. The Mysore continues its run of uninterrupted prosperity, which began in 1888, and the work-

ings at 3500 ft. vertical show no signs of exhaustion. The yearly output is maintained at about \$4,500,000, and the total since the commencement has been about \$75,000,000, of which nearly one-half has been distributed in dividends. The mine has four years reserves in hand. The Champion Reef is not the mine it used to be, for the grade fell away five years ago. At various points rich ore is still found in the deepest levels, and the average has slightly increased during the last year or two. The Oregum is in a more satisfactory condition than a year ago. Early in 1913 the developments at the Nundydroog were so discouraging that the output was reduced, but toward the end of the year an improvement took place, and the old rate of output was restored. At the Balaghat search is still being made for another shoot of ore, but without success so far. Exploration of the southern continuation of the lode outside the Mysore company's ground is being undertaken from the 2385-ft. level of the Mysore. The exploitation of this ground from the surface many years ago gave indifferent results. During the year several cyanide and slime plants have been erected in the Kolar goldfield, but as the proportion of gold not caught by amalgamation is small, the new plants will not increase the output to any important extent. It is worthy of record that the cost of mining has been greatly reduced of late years, chiefly by the introduction of electric power instead of wood-fuel.

As regards other Indian goldfields, the Anantapur in Madras has arrived at the profitable stage, for a small dividend has been paid by the North Anantapur company. The developments of the adjoining Jibutli property are sufficiently encouraging to warrant the provision of additional capital to provide a treatment plant and to continue developments on a large scale. The mill commenced work in November. On the Ramagiri block, in the same district, a promising ore-shoot has been disclosed, and probably a company will be formed to develop it. The Hutti mine in Hyderabad is making a good showing in depth after passing through a disappointing period. Here the 2140-ft. level contains a rich orebody. The Mangalore mine in the Raichor district of Hyderabad has proved a failure, and is closed. In the Shimoga district of Madras, additional capital has been subscribed for developing the two mines, which are to be worked conjointly.

In Cornwall the position of affairs in connection with lode-mining is far from encouraging. At Dolcoath the deep levels tapped by the vertical shaft are in ore of less than the average grade of the last few years, and the yield of black tin is less than it was a year ago. The seriousness of the outlook is recognized by the management, as is evinced by the fact that parallel lodes are now being explored. The difficulty of maintaining an output of profitable ore has once more been experienced at Carn Brea & Tincroft, and it has been necessary to close the Carn Brea section and devote sole attention to North Tincroft as the most hopeful ground for the discovery of future sources of supply. The grade of the ore at South Crofty is giving anxiety

to the shareholders. At East Pool additional capital has been provided by Bewick, Moreing & Co. for the purpose of pushing development work. This firm has also taken in hand the Phoenix mines in East Cornwall. At the Levant there is some doubt whether the present Company will renew the lease, for the landlords are asking onerous terms and say they have received more favorable offers from another party. The Botallack, which was re-opened six years ago, has proved a dire failure in spite of repeated supplies of working capital. We may hear of its suspension at any moment. The Wheal Jane, near Truro, owned by the Falmouth Consolidated company, has just been closed; three years ago the chairman grandiloquently asserted that there was sufficient ore to keep 1000 stamps going. The only lode mine that can be said to be doing well and to have encouraging prospects is the Grenville, though mention should not be omitted of the improved outlook at Wheal Kitty. If this article



IN CORNWALL.

had been written several months earlier it would have been possible to refer to the Geevor as a bright spot, for ample ore reserves had been developed and a modern dressing-plant erected involving the use of many new machines invented in America. But as the board has made a clearance of this plant for reasons that are no reasons at all, it is necessary to moderate our enthusiasm.

The most prosperous company at present is the Cornwall Tailings, which is making a handsome profit out of the old dumps at Carn Brea & Tincroft. Owing to the success of these operations, many promoters have sought similar properties. The sand on Gwithian beach at the mouth of the Red river, which has yielded a good profit on a small scale for many years, has been purchased by London interests and is to be worked on modern lines. Another similar tract on one of the creeks feeding Falmouth harbor is also being attacked on a large scale. A third is in the Helston district. In all these cases the material has to be pumped to re-grinding and concentration plant, and they are not in the nature of dredging projects, as might be supposed.

Much has been heard of the exploitation of radium ores in Cornwall during the year, and the Trenwith, near St. Ives, and the South Terras, at Grampound

Road, have both been in the limelight. The published statements show that radium bromide from the pitchblende at Trenwith is finding a market, and the recent great expansion of the use of radium in surgery has brought many inquiries and orders.

Various.—One of the most important features of 1913 has been the growth of interest in tin mining in the Malay States. The excellent results obtained by the Tronoh, Gopeng, Latah, Tekka, Kinta, Pengkalen,

formed in 1911, started its first dredge in January last, and has been recovering 1 lb. of concentrate or 'black tin' .72% metal per cubic yard. This preliminary work has justified the building of two more dredges, which will shortly be at work. F. W. Payne is the consulting engineer. The Siamese Tin Syndicate was formed in 1906 to exploit an alluvial area in the Renong district of Western Siam. A net profit of £40,822 was earned during the past fiscal year from a gross profit



MINES OF THE MALAYAN TIN DREDGING, LTD.: photographs by F. DANIELS POWELL.

CHINESE RAISING WATER AND 'WASH'—
BUCKET DREDGE AT JAMESSEN.

CHINESE TRIBUTE WORKINGS—
PUMP DREDGE, SHOWING UNEVEN BOTTOM.

Setupoh, and other alluvial mines in the Kinta district, in the state of Perak, have stimulated interest in that region. Across the border, in Siam, the Tongkah Harbour, Renong, Malayan, and Siamese companies are dredging, in contrast to the sluice and elevator practice in Kinta. The Tronoh is the premier mine, but it has passed its zenith. Last year 496,496 cu. yd. was washed with a yield of 12½ lb. black tin per cubic yard. The alluvial practice common to the Kinta district is to be supplemented at Tronoh by the introduction of bucket-dredging, on the suggestion of H. D. Griffiths, who has recently resigned as general manager. At the Tekka the ground is hydraulicked, while at the Taipings, also belonging to the Tekka company, a suction-pump dredge is used. The Malayan Tin Dredging Co.,

of 255,895. This was done with one dredge. Two more have been ordered. H. G. Scott is the manager. The Renong Dredging Co. has made a great success with the dredge erected in 1910. Two more dredges are about to start, and additional ground has been acquired. To do this the Company has been reconstructed, and £250,000 more capital obtained. It is estimated that a profit of £50,000 per annum can be earned when the three dredges are at work. Last year 682,986 cu. yd. was dredged with an average yield of 14 oz. black tin per yard, at a cost of 4.41d. per yard, but the total cost (including an export duty of 1.7d. per yard) was 6.07d. E. T. McCarthy and P. W. Payne are the advisory engineers. Recently a number of new dredging companies have appeared, such as the Ipoh and Kamun-

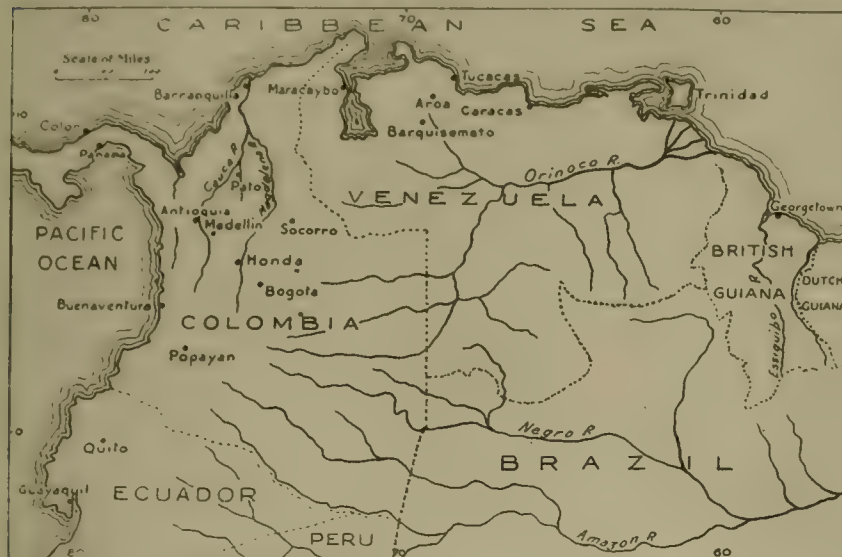
ting, both under good auspices. On the whole, this growth of the tin-dredging industry in the Malay peninsula is likely to prove a highly successful phase of Far Eastern development.

Lode mining as yet is represented only by the Pahang, on the east side of the Malay peninsula, an old enterprise with a chequered career, brightening of late. In the year ended July 31, 1913, the output was 1125 tons of black tin from 102,797 tons of ore, treated in a 50-stamp mill. In addition, 115 tons of alluvial tin was

experiments are made with a view to treating the second. The largest shareholder is R. Tilden Smith, and the managing director is H. C. Hoover. Recently C. H. Macnutt was appointed resident manager.

In South America the resuscitation of the old Quebrada copper mine, near Aroa, in Venezuela, is interesting. The first Company went into liquidation in 1895. W. A. Heywood, at one time of the staff of the old Company and known for his work at the Tennessee Copper, is the metallurgical advisor. A new smelter is being erected. The new Com-

pany, the South American Copper Syndicate, has already paid handsome dividends on a reduced capital by making shipments of rich ore. The St. John del Rey in Brazil continues its honorable career, producing nearly £400,000 worth of gold from 165,000 long tons and paying about £70,000 in dividends yearly. The workings are 5200 ft. vertical and 7300 ft. deep on the dip of the lode. Besides the Pato dredging affair, I may mention the Anglo-Colombian Development Co., organized by the Consolidated Gold Fields to exploit platinum deposits of alluvial character in Colombia. This is said to promise well. On the whole, the amount of British capital now embarked in South Ameri-



THE NORTHERN PORTION OF SOUTH AMERICA, SHOWING PATO AND AROA.

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	Dec. 1, 1912.	Dec. 1, 1913.
Dolcoath	25s.	17½s.
Cornwall Tailings	1¾	7½
Gopeng	1½	1½
Tekka	3¼	3½
Tronoh	3¾	2¼
Malayan Tin	2¾	2½
Siamese Tin	3¾	3¾
Mysore	5½	4½
Nundydroog	33s.	26½s.
Ooregum	18s.	22s.
Champion Reef	12s.	10½s.
South American Copper Syndicate....	34½s.	32s.

Apart from changes in the mines themselves, the year has been marked by general unrest in the ranks of labor, accompanied by scarcity in the supply of that prime instrument of exploitation. The growth of world-wide industry is making ever increasing demands for labor and the spread of what is called civilization tends to teach the subject races to ask for higher wages. Meanwhile, white labor becomes increasingly exacting. Hence trouble. To overcome this obstacle, the inventive genius of man must be supplemented by a humane effort to alleviate the drudgery of toil.

Review of the New York Share Market

By C. S. BURTON

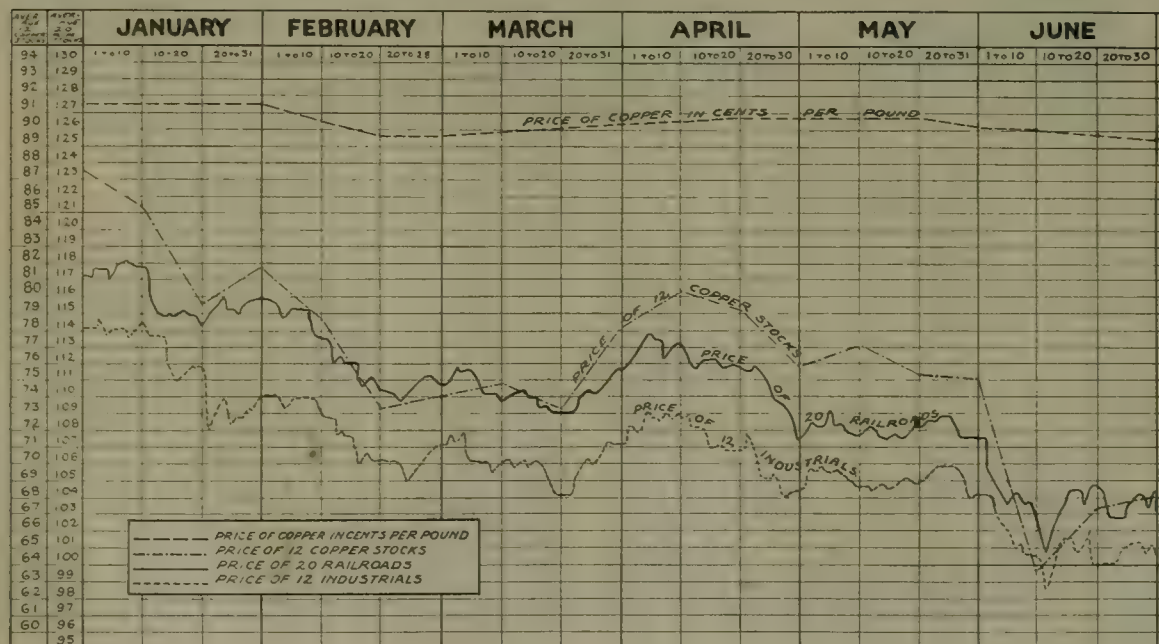
Any review of the markets for the year 1913 must differ in no small degree from any similar résumé of market factors in years gone by. If one were sufficiently venturesome at this time to name the element which has dominated, it is doubtful if any one else could be found who would agree with the conclusion. There are now so many cross currents, so many apparently contradictory phases in the situation, that there are almost as many minds as men, the reason for such diversity lying in the attempt to give specific explanation for general phenomena.

To take up first the features which appear to bear most directly and conclusively upon market action is to take a plunge into a wide field of economics. There is now a vast movement of readjustment making itself felt throughout the civilized world, and many of the phases about which much discussion is heard and which are spoken of as fundamental factors, appear, on deeper study, to be but parts of a vaster upheaval the end of which cannot as yet be comprehended. Everywhere there is increased governmental activity, which, regardless of opinion as to whether it is to be considered pernicious or not, is but an attempt upon the part of the masses to secure control of those functions of present day commercial civilization that reach the life of every individual.

Workmen's compensation acts, old age pensions, insurance for servants, public ownership of telegraph and telephone lines, and many other measures, including the projects for breaking up and redistributing land hold-

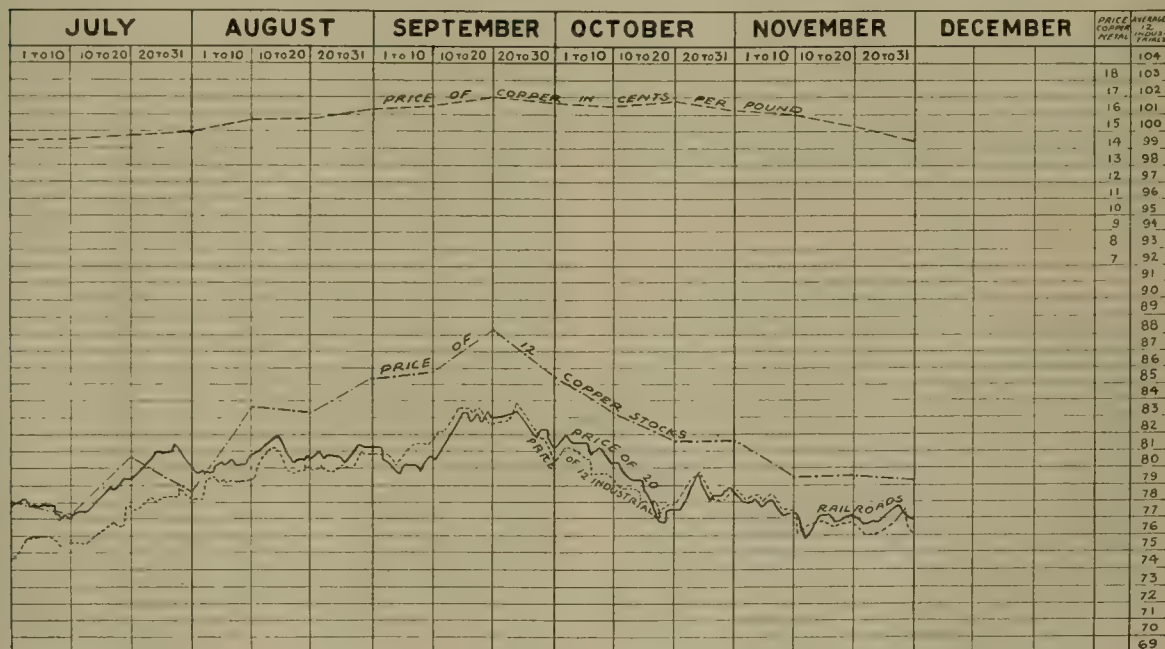
ings, have kept Great Britain in a turmoil and have made great inroads upon her hitherto adamant adherence to the ways of her forebears. In Germany, along with her industrial awakening, there has come a movement toward so-called radicalism, that is expected to make itself felt unmistakably when the present Kaiser's sceptre shall pass to his successor. In the countries bordering upon the Mediterranean the strife has threatened to involve all of Europe, and the market places have shown by their stagnation, the result of extraordinary calls for the unproductive use of capital in war. Our own conditions prove that it is not to the turmoil of war alone that the imperative demands for capital are due. American enterprises, private, public, and quasi-public, have alike had to face bewilderingly increased costs. Cost of labor and cost of material have caused gross outlays to increase in greater ratio than the expansion of business, even though the latter has been making record figures in many cases. With an increase in gross and a decrease in net on a record volume of business, it is not to be wondered at that investment values have been far out of line, measured by any previously known standard.

It is not the province of a review of the markets of the year to minutely describe conditions already well known and over much discussed, but some small analysis may be attempted and perhaps be considered not out of place. It sometimes happens that we cannot see the forest for the trees and in endeavoring to arrive at some conclusion concerning the problems now



It is to such fundamental conditions as are here meant to be roughly outlined, that present day market conditions are due. The huge demands for capital represent increased needs due to the complication of urban existence. The difficulty in meeting such demands is due at least in no small degree to the fact that our percentage of actual producers has relatively decreased and that a correspondingly larger proportion of both labor and capital are engaged in an endeavor to supply the needs of communities, rather than in the work of the actual production of wealth. Huge sums

Are we not now beginning to feel the part depletion of our principal? Our great West is not as it was, a vast empire where there was always room for the man who would try. We can no longer relieve our own congested centres of population by the mere slogan that there is a quarter section of land to be had for the asking. We are beginning to feel a little pressure here and there, and not having been used to it, there is the spendthrift's unwillingness to unpleasant facts. With all our riches, there has come a capacity to enjoy and a forgetfulness of the necessity for self denial, and an extravagance that manifests itself in ways that are a little disquieting. Automobiles and



are demanded for city needs; water works, electric light and power plants, urban and interurban transportation, for railway terminals. As a nation, we have been indulging in an era of extravagance; we have been vastly increasing, multiplying our overhead expense; and this probably has little more justification than the similar tendencies of the individual, who has wondered why he finds himself unable to maintain an automobile or two and increase his savings bank balance at the same time.

To treat of the market itself, it almost suffices to say that stagnation has ruled. The happenings of the year were not at any time such as to induce any large public participation. The death of J. P. Morgan in February left the New York money centre without the leader to whom it had looked for many years, and the opening of the new year has not as yet revealed his successor. In May the St. Louis & San Francisco Railroad Co. was placed in the hands of the courts and the revealments of its inside operations have not so far been of a nature



ALASKA PERSEVERANCE MINE, THE NUCLEUS OF THE ALASKA GOLD MINES PROPERTIES.

to reassure security holders. Later, the New Haven debacle furnished much argument and justification for those who have criticised so-called 'high finance,' and it left New England dazed and indignant. All through the year the troubles of Mexico have threatened to involve the United States and whether or not of real effect upon stock market movements, they have served continually as excuse for, or cause of, this or that prevailing market attitude.

In the world of mines and mining, conditions have been peculiar. Following the era of undue and unwarranted speculation of some years ago, mining share markets throughout the East have fallen into a rut from which it seems almost impossible to dislodge them. The results achieved by the porphyry coppers, for which the public has shown marked favor, form an exception; as does also the latest example of the public preference for large enterprises, the successful launching of the Alaska Gold Mining Company.

A very peculiar situation as to mining properties exists now in New York. There is an insistent demand for anything that is close to the point of production, but it is next to impossible to interest the same people or the public in anything that has to be classed as a

prospect. In a way this attitude is faulty as it overlooks the necessity for primary development, which requires some capital which, while it, in the majority of cases will probably be spent without return, need not be relatively large. It seems to be temporarily forgotten that there is always the possibility of the development of ground that will pay many times for all the previous fruitless efforts and expenditures.

In copper, the trend except toward the close of the year has been to give to the producer more and more the control of the metal market. The ravenous appetite of the commercial world for copper metal resulted in the reduction of the world's visible supply to a negligible quantity. However, the strength of the statistical position became apparent only at that juncture in October, when the business attitude was overwhelmingly and generally one of hesitation. There was a marked reduction from about 17c. per pound to 14½c. per pound notwithstanding the fact that supplies were smaller than at any time since the Producers' Association began to collect and publish figures covering production and consumption. A sharp reaction and higher prices may be anticipated if the turn of the year brings with it any resumption of normal activity. The year just closed saw a further growth of the Guggenheim organization in the field of copper production. The recent development of the Chile Copper Co. marks its deposit as possibly the largest copper deposit in the world now being mined. Unofficial estimates mention between 200,000,000 and 300,000,000 tons of ore of more than 2.5% copper content. This new development of the Braden coupled with the possibilities of this Chuquicamata deposit of the Chile Copper Co. promise the Guggenheim group a commanding place in copper output.

Eastern markets have shown a minimum of activity in precious metal issues. What trading has been done in Tonopah issues has been of a distinctly professional character with almost no interest manifested by outsiders. While Cobalt has surprised all those who have followed the history of the district and noted that it has maintained its production and marked another record for bullion output, there has been but very slight market interest in Cobalt shares. The Eastern markets remain, so far as mining shares are concerned, in a waiting attitude. Could there be opened a new precious metal district of real merit, the call for funds would be eagerly and generously answered. Until some such fortuitous discovery can be heralded, it is safe to anticipate continued apathy, though at the same time the market for partly developed properties was never better, and mining activity, apart from the share markets, never greater.

The details of the year's markets are perhaps sufficiently well shown in the accompanying charts. It will be noted that prices of shares in railroads, industrials, and mining companies have moved together and that all suffered alike a sharp decline in June and a temporary recovery in September, and that prices in December were much lower than in January.

Business and Mining—A Retrospection

By F. LYNWOOD GARRISON

At this season of the year when a business man is disposed to review the past and take stock of achievement many pertinent thoughts arise in the mind regarding the future of the particular occupation by which one's daily bread is earned. Indeed, this is the paramount question as long as life lasts, hence any facts regarding it which are more than commonplace, are certain to be of interest.

We note among other things numerous communications in the technical press asking why mining is languishing and whether prospecting has become a lost art; moreover one's mail is often not a little burdened with appeals for work from fellow engineers. It is impossible not to be impressed by the evident seriousness of this condition and it seems eminently proper and timely for us now to seek some of the causes that have led to it.

Capital on the Defensive

Statistics will probably show that on the whole mining is not decadent, quite the contrary in fact, for the output is greater and profits probably not less than last year. Conditions, however, are rapidly changing all over the world. The exactions of labor are greater and in this country at least, the insistence of the tax collector is much more pronounced. Such factors bear with increasing weight upon the operator, especially the small one, and capital is put on the defensive, a condition which inevitably results in combination. Once upon a time the railroads squeezed the weak and gave rebates to the strong. Now it is their turn to be punished, to the loss thousands of unfortunate stockholders who may have put life savings into their capital stocks, knowing that they are the arteries of trade and what hurts the transportation companies, injures the whole country; hence of all classes of investment, they should be under normal and logical conditions, as safe and sound as government securities.

Next to agriculture, mining is our second great basal industry; modern civilization cannot exist for a moment without it. With hydro-electric power we may mine and smelt our metals; we can, at a pinch, do entirely without fuel if we have hydro-electric power, but without metals we cannot generate and transmit this form of energy. In brief, we are a metal-using people and will revert to savagery without it. We must mine to get metal and mining will not cease as long as there is any metal to be got. This brings us to the question—are our mineral deposits being exhausted? The plain answer to the question is that they are, but also that the resources are so enormous and with the probability of much more being developed, we need have little anxiety on this point.

These reflections are so self-evident they are not

likely to be disputed, but they fail to carry us very far. We know, or at any rate believe, something is now wrong with the mining industry as far as we engineers are concerned. What it is and what may be the outlook for the ensuing year are matters which gravely concern us at the present time.

The profession, in common with most of the other engineering pursuits, is undoubtedly over-crowded. The mining industry is not, and has not been, for the past ten years capable of absorbing the multitude of graduates from our mining schools. It is a shame and it is disgraceful to see fine well trained young men, who have spent from four to six years at our colleges eagerly offering themselves for \$75 or \$100 per month and ready to go on such conditions to distant and unhealthy countries. The man or corporation which accepts such terms cannot be blamed, for it is simply a question of supply and demand; moreover, mining companies as a rule consider the comfort and health of their staffs, especially when abroad.

Another factor which is serving to depress the mining business is to be found in the political conditions now affecting Mexico. This unfortunate country is pre-eminently the most attractive in the world to mining men, and deservedly so, by virtue of its matchless climate, its resources, and its propinquity to the United States. Hundreds of American engineers are now out of employment by reason of these disturbances and there appears to be little hope for better conditions within the next year.

The enormous and astonishing development of the oil districts in United States and Mexico cannot fail to check the demand for coal, especially for maritime purposes. Settlement of Mexican difficulties and the rapid development of South American fields will permit fuel oil to be cheaply delivered on the Atlantic seaboard, and our Eastern coal operators will be forced to meet this formidable competition.

The Vanishing Frontier

With Alaska, Canada, the Central and South American countries undeveloped, not to mention Siberia, it seems unlikely any considerable slackening of metal mining may be anticipated due to exhaustion of resources. Moreover it must be evident to at least a few thinking and well informed mining engineers that some of our old districts in the United States are far from being exhausted, and that they will readily respond to the skill of the engineer and no longer remain condemned as worked out by the fiat of the so-called practical mining man. The danger of empiricism in this as in most affairs of life, is that it is always specific; its value depends upon a particular condition or case, it is not general. The practical man is often uneducated,

he knows, or can do, only a few things well, he necessarily has the limitations of ignorance and narrowness of an untrained mind. The value of education has never been more evident than today and perhaps never so inadequately rewarded, suffering by comparison in this respect with the artisan, who exacts more pay for less good work than ever before. The question, therefore, naturally arises—may we not be making technical education too cheap? Whether we are or not, it is certain we have spoiled many good farmers and mechanics in the making of supernumerary and indifferent engineers.

Lessons from Germany

Americans have been accused, and to some extent justly, of being unphilosophical and unduly practical. The most philosophical people in the world are probably the Germans, yet no nation in modern history can show such matchless practical achievement as has Germany within the past 25 years. If we permit prejudice, of which we have much, to have place in or replace our philosophy, we are absolutely certain to find ourselves at a great disadvantage in competition with the Germans, for we will thus discount at every turn the splendid technical training our educational institutions have afforded. It is to be feared we are, as a people, too conservative, even hide-bound and often niggardly and slow in keeping abreast with modern progress.

In our wild scramble for wealth we are sometimes so illogical as to defeat our own ends and even of occasion, have been known to deviate from a course of business honesty and rectitude, which sooner or later brings a just and merited retribution. Dishonest reports and lying prospectuses were never more easily discredited than at present and he who uses them does so at his peril.

If existing financial and business conditions have made legitimate mining somewhat sluggish, it has also put a most wholesome check upon wild-cat promotion and charlatanism. Sound ethics and personal character are as important to success as they ever were in the history of the world. Most of our mining periodicals and professional organizations today respond vigorously to these sentiments. I doubt if any satisfactory code of ethics can ever be devised for engineers. The younger men will be more influenced by what their elders do, than by any decalogue of don'ts. Man is a social animal, social ostracism punishes more effectually and keenly than the jail. If our professional organizations of all kinds rigorously purge their membership of men known to be disreputable or even open to that suspicion, it will be better for the country and for the profession.

Moralizing is tiresome even if needed; we may take satisfaction, however, in the obvious fact that the country is as sound, healthy, and moral as it ever was, even if some of our newspapers are reptilian and many of our so-called statesmen but ignorant bores. We cannot have self government and perfection, or

even economy, for it is ever costly in money and sometimes in self-respect. We elect our rulers from the most plausible talkers; indeed plausibility is their greatest asset and often the only gift some of our politicians possess. At present we are perhaps, as a nation, disordered but not diseased; we have been getting a good many nostrums for imaginary ills. Let us not indulge in a foolish clamor against corporations, for combination of capital will go where the individual fears to tread. All we ask is that both the individual and corporation get a square deal and no favors. But we can never hope to have it as long as we are content to fill big places with small men. Ordinary prudence forbids the placing of untried and untrained men in the management of a large mill or smelter.

Business and Government

The philosophy of government is not different from that of organized business, and it is beginning to become more and more evident that good business and good government must go hand in hand. At present it seems to me we are paying the penalty of indulgence in fads, fancies, and untried theories. Political parties are necessary to our form of government. The Southern states adhere tenaciously to one political party because they must, for reasons which are no way political, but unfortunately the best men of that section do not as of old, become the leaders of this party. I dare say the average American cares little which of the two great political parties are in power, provided he gets good government and his country is not made the laughing stock of a critical world. We can stand high tariff, low tariff, or no tariff at all, but we cannot afford to make ourselves ridiculous. Mistakes of policy or judgment do not shake confidence as does folly, blatant and crass ignorance; this, at the bottom, is what is the matter with mining and is troubling the whole country. We are rapidly getting away from the notion that business should be detached and apart from government. Whether or not we are correct in this assumption is beside the question, the fact remains these two great functions of civilization are growing more and more interdependent—what affects one will react on the other. It therefore behooves us to place our government in the hands of able and experienced men, and not to assume that people unfitted for responsible positions in business can creditably discharge equally important functions in the government service.

The Mexican Eagle Oil Co. reports that in the year ended on June 30 last, over 200 vessels have taken oil at Tuxpam. The facilities now permit the loading of a 10,000 ton ship in 24 hours. Leases have been acquired on 50,000 acres of additional oil lands and 30,000 acres have been bought. A new field was brought in with a 5000-bbl. well and development has been generally satisfactory. The profit for the year was \$8,166,514, which, after allowance for depreciation and fields redemption, left \$4,615,500 to be added to the existing surplus of \$631,805.

Work of the State Geological Surveys

By FRANK W. DEWOLF

The public is appreciating more and more the fundamental value of scientific work by the various state geological surveys. The growing need for accurate inventories of natural resources has brought into prominence the fact that work on the subject has been going on in a quiet way for a great many years. Intelligent development and conservation must, of course, be based on knowledge. While the function of the surveys is chiefly to aid the development of state mineral resources, and in some cases to investigate soils, forest, and highway work, nevertheless a large annual contribution is made to pure science itself.

There are 35 active state surveys, including the new organization created during the year in Oregon. Several of the surveys, however, are embarrassed from time to time by lack of appropriations. Thus the Arkansas Survey was officially inactive during 1913. Altogether, the surveys expended approximately \$475,000 and received the benefit of \$140,000 additional expenditure by cooperating federal bureaus. Over 100 scientists gave full-time service for the states and about 50 others, besides topographers and soil experts, were furnished by cooperating bureaus. Thus the surveys have a large and cumulative influence throughout the country for enlightenment and for scientific development of natural resources. The Association of American State Geologists meets each year during the Christmas holidays, and as a rule, in a spring conference at Washington. Beginning with 1914, field conferences of state geologists will probably be held, so that problems in common can be reviewed in the field, and coöperation between neighboring states can be rendered more efficient.

Organization and Funds

State geological surveys and mining bureaus are organized in one of three ways: (1) under state university control, or with the survey director giving part of his service to the state university; (2) under a commission or board, without university connections; (3) under a chief appointed by the governor, or otherwise independent. Considering the active surveys, 16 belong to group 1 and have financial support averaging \$7500 per annum. Group 2 includes 15 surveys, with annual appropriations averaging \$22,300. Group 3 includes two surveys with average funds of \$5600 per annum. Judging from the available funds, the most successful and active surveys are under commissions, and the directors or managers have no outside demands on their time. Exceptions in this group include two such surveys with funds averaging only \$8500; exceptions to group 1 include three surveys with annual funds of \$15,000 each, and one which receives \$27,500 per annum. Other factors affecting the strength of state surveys include the extent and variety

of the mineral resources of the area to be studied, and in part, the length of time during which the survey has been in operation. Those states with abundant mineral resources and important mineral industries either have very active surveys at present, or have had such service for many decades though the present organization may be poorly supported. Information regarding the mineral resources of the various states can be obtained without cost by addressing the officer in charge, as shown by the following directory:

STATE GEOLOGISTS

- Alabama—Geological Survey of Alabama; E. A. Smith, State Geologist, University.
- Arizona—Geological Survey of Arizona; Territorial Geologist, Tucson.
- Arkansas—Geological Survey of Arkansas; N. F. Drake, State Geologist, Fayetteville.
- California—California State Mining Bureau; F. McN. Hamilton, State Mineralogist, San Francisco.
- Colorado—Colorado State Geological Survey; R. D. George, State Geologist, Boulder.
- Connecticut—State Geological and Natural History Survey; Wm. North Rice, Superintendent, Middletown.
- Florida—Florida State Geological Survey; E. H. Sellards, State Geologist, Tallahassee.
- Georgia—Geological Survey of Georgia; S. W. McCallie, State Geologist, Atlanta.
- Illinois—State Geological Survey; F. W. DeWolf, Director, Urbana.
- Indiana—Department of Geology and Natural Resources; Edward Barrett, State Geologist, Indianapolis.
- Iowa—Iowa Geological Survey; G. F. Kay, State Geologist, Iowa City.
- Kansas—State Geological Survey of Kansas; Erasmus Haworth, State Geologist, Lawrence.
- Kentucky—Kentucky Geological Survey; J. B. Hoeing, Director, Frankfort.
- Maine—State Survey Commission; C. Vey Holman, State Geologist, Bangor.
- Maryland—State Geological and Economic Survey; William B. Clark, State Geologist, Baltimore.
- Michigan—Michigan Geological and Biological Survey; R. C. Allen, State Geologist, Lansing.
- Minnesota—W. H. Emmons, University of Minnesota, Minneapolis.
- Mississippi—Geologic, Economic, and Topographic Survey of Mississippi; E. N. Lowe, Director of the State Geological Survey, Jackson.
- Missouri—Bureau of Geology and Mines; H. A. Buehler, Director, Rolla, Missouri.
- Nebraska—Nebraska Geological Survey; E. H. Barbour, State Geologist, Lincoln.
- New Jersey—Geological Survey of New Jersey; H. B. Kümmel, State Geologist, Trenton.
- New York—Science Division (Geological Survey) of the Educational Department; John M. Clarke, State Geologist and Paleontologist, State Museum, Albany.
- North Carolina—North Carolina Geological and Economic Survey; Joseph Hyde Pratt, State Geologist, Chapel Hill.
- North Dakota—North Dakota Geological Survey; A. G. Leonard, State Geologist, Grand Forks. Agricultural and

Economic Geological Survey of North Dakota; Herbert A. Hard, Director, Fargo.

Ohio—Geological Survey of Ohio; John A. Bownocker, State Geologist, Columbus.

Oregon—Oregon Bureau of Mines and Geology; W. A. Parks, Director, Corvallis.

Oklahoma—Oklahoma Geological Survey; D. W. Ohern, Director, Norman.

Pennsylvania—Topographical and Geological Survey Commission; R. R. Hice, State Geologist, Beaver.

Rhode Island—Natural Resources Survey of Rhode Island; Charles W. Brown, Superintendent, Providence.

South Dakota—Geological Survey of South Dakota; E. C. Perisho, State Geologist, Vermillion.

Tennessee—Tennessee State Geological Survey; A. H. Purdue, State Geologist, Nashville.

Vermont—Geological Survey of Vermont; George H. Perkins, State Geologist, Burlington.

Virginia—State Geological Survey of Virginia; Thomas L. Watson, Director, Charlottesville.

Washington—State Geological Survey of the State of Washington; Henry Landes, State Geologist, Seattle.

West Virginia—West Virginia Geological and Economic Survey; I. C. White, State Geologist, Morgantown.

Wisconsin—Wisconsin Geological and Natural History Survey; W. O. Hotchkiss, State Geologist, Madison.

Wyoming—Geological Survey of Wyoming; C. E. Jamison, State Geologist, Cheyenne.

Topographic surveys were continued during 1913 in 14 states, under coöperative agreement with the U. S. Geological Survey, which shares the expense. More than 10,000 sq. mi. was mapped as a basis for geological and engineering studies. A large share of attention, and on an average of about one-third of the geologic funds in the various states, are devoted to economic and detailed areal surveys. Most reports issued describe local mineral resources in such a way as to encourage careful investment. Important deposits of stone and minerals available for building, or for use in cement, concrete, road-ballast, or in the arts, are found in many states. Investigations were made and reports published as follows: The marbles and crystalline rocks of Alabama, and slates of western Pennsylvania were investigated; reports on building stones of the states were in preparation in Minnesota, New York, and Ohio; a bulletin describing the cement materials of Washington was distributed early in the year; a study of limestone and marl for agricultural uses in southern Georgia was in progress; materials available in Iowa for road-building, and for concrete, were tested; the limestones of Michigan were also investigated.

Clay deposits of Colorado east of the mountains, and elsewhere in the vicinity of large towns, were tested and the results were published during the year. Clay materials available at coal mines were examined in Illinois. Practical tests of clays of Kansas were under way, and a study of Minnesota brick and clay industries was completed. Fireclays of Pennsylvania were the object of special study in that state.

The importance of lignite in those western states which have no adequate supply of high-grade coals, has recently been brought to public attention. Investigations of the availability of lignite for gas-producer practice, were continued in western North Dakota and

in South Dakota. A study of coal resources and mining practices in Illinois was continued in coöperation with the University and the U. S. Bureau of Mines, and three reports were issued, including proximate analyses of 350 mine samples. Several folios covering the coal territory were issued in coöperation with the U. S. Geological Survey. In Iowa, a series of ultimate analyses of coals was completed. Tennessee coals north and south of the Tennessee Central Railroad were described, and field work was finished for a report on coals of the state. Surveys of the important coal fields of Washington were continued. Nine reports for counties in the coal fields of West Virginia were either published during the year, or prepared for publication.

The surveys made extensive examinations of developed or prospective oil and gas fields. In California work was begun on a report for the entire state. In Illinois, a report on the southeastern fields was published, and three coöperative folios covering oil territory were in preparation. Michigan issued a bulletin on oil and gas resources. In the Oklahoma field, four parties were engaged in developed or prospective oil and gas territory. The detailed mapping of the Hominy quadrangle was completed in coöperation with the United States. The report on the Vinita and Nowata quadrangle was sent to press. In Washington, investigations regarding oil and gas in the western part of the state were in progress. Six county reports published in West Virginia had special reference to the structural relations of oil and gas. A conference was called during the spring at Pittsburgh between representatives of the various state surveys, of the U. S. Bureau of Mines, and of operators in oil and coal fields, for the purpose of considering the relation of gas exploitation to coal mine explosions. Many explosions have been due to leakage of natural gas into mines. As a result of the conference a model law providing for state inspection of drilling operations through workable coal beds, was recommended to the various legislatures.

Ore Deposits Examined

Surveys of the Platoro-Summitville gold district of Colorado were made. This is the old Summitville district which produced a considerable quantity of gold twenty years or more ago. H. B. Patton of Golden is directing the new work in the district. In Missouri, experiments on the electric potential of minerals were continued, and a study of the Aurora region was in progress. Copper prospects in Pennsylvania were investigated. Eastern Tennessee red-iron ores were described in a coöperative report. A bulletin on the geology and ore deposits of the Covada silver and gold districts in Washington was issued. In Wisconsin, the orebodies in the lead and zinc regions were mapped; and a magnetic survey was begun to outline new iron deposits and to classify the land of the northwestern part of the state for taxing purposes. Detailed areal work, including economic geology to some extent, continued in most of the states.

Although stratigraphic and paleontological studies

do not, at first glance, appear to have great practical importance, they nevertheless are necessary fundamental studies, and they have indirect economic value. Perhaps the most significant move of the season was the 'Mississippian Conference' which was called in the field in Missouri. Eight states sent delegates to the meeting, and the U. S. Geological Survey was represented by David White, chief geologist. A committee

of the state representatives was appointed to direct interstate work, so as to avoid conflict and unnecessary duplication of formation names and of field work. Annual mineral statistics were prepared in nearly all of the states. Bibliographies of great value to mining men were issued in Colorado, Iowa, New Jersey, and in Washington, and studies of road, soil, and other subjects were made in many states.

Zinc Ores and Metallurgy in 1913

By R. G. HALL

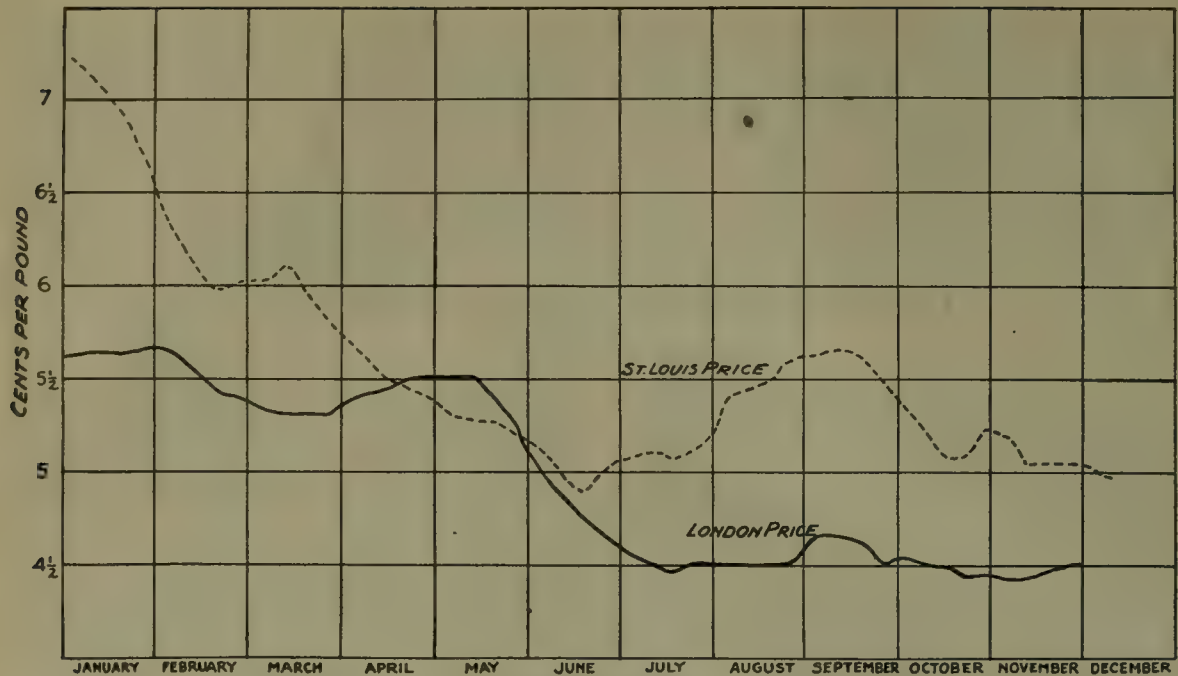
The history of the zinc industry for 1913 is not pleasant writing, and while the rôle of Cassandra has ever been a thankless one, it does not need the prevision of a Cassandra to predict a lean period for the ore producer in 1914. The year 1912 closed with a falling market, and a decreasing consumption. The elections of 1912 foreshadowed a marked change in the tariff conditions, especially as related to the steel business, and from a high point of about 7½c. in October, spelter had reached a figure of 7c. early in January. From that point, as may be noted, the recession was gradual until a price of \$4.90 per 100 lb. was reached in June. A recovery from this point was made to \$5.60 per 100 lb. by September, only to be lost again on the passing of the tariff bill, until December sees a price again below \$5. The cause of these fluctuations has not been entirely the tariff on zinc and zinc ores, but rather the general business conditions. It will be noted that at one time the official St. Louis quotations on spelter were practically the same as those of London, even at a time when the duty was still 1¾c. per pound, and even today the New York price is still below the import basis, and with the spelter stocks now on hand and yet accumulating, there is no prospect of an advance in the near future. The history of the iron and steel business has always been and always will be the best indication of the history of the zinc industry, and the past three years have afforded excellent illustrations of this characteristic.

Notwithstanding the much decreased prices, the production from the Joplin district has been about equal to that made in 1912. At this writing a total shipment of 'jack' of 280,000 tons and of silicate of 22,000 tons is indicated, these about equaling the record year of 1912, and a much larger stock of concentrate remains in the bins than was there on January 1, 1913. The most potent reason for this condition, of course, is what one might call the inertia of mining. During the period of high prices vigorous prospecting was conducted, and many new mines were opened. These properties, once opened, can hardly be closed without great loss. A long-continued period of low prices such as now prevailing will, of course, forbid the opening of new properties, and matters will right themselves some day. But—and here is the discouragement of the Joplin producer—in the meantime the production of the

Western states, due chiefly to Butte, is increasing even in spite of low prices, and the new tariff conditions have made possible importations of cheaper ore so soon as Mexico shall have settled to a point where mining can be resumed.

Wisconsin also will show a production of close to 72,000 tons of concentrate and carbonate. Colorado maintained its output close to the 1912 record, although some decrease will be shown in Leadville carbonate, as well as from smaller shippers in various parts of the state. Montana production is of course very much increased. At the first of 1913 the Butte & Superior company was marketing about 200 tons per day of 46 to 48% concentrate. The production at present is reported to be close to 350 tons of over 50% grade. The Elm Orlu has not again entered the list of producers, but is expected to do so early in 1914. Utah will show a considerable decrease due to the almost complete suspension of shipments except those from Park City and the United States mill at Midvale. Nevada also will show a decrease, as the Good Springs properties suspended production early in the year. They since resumed to some extent, but not up to the former mark. Idaho continues to produce to some extent, but as the production is mostly made in connection with lead mining it can easily be guessed what will happen under a combination of 4c. lead and 5c. spelter, with a freight rate of \$9.75 per ton to Oklahoma smelters. This gives them a price not much in excess of \$8 per ton for a 40% zinc concentrate on cars in the Coeur d'Alene district.

Zinc smelting in 1913 has not been productive of much cheer for those engaged therein. Even if the price of ore has fully followed down the price of spelter, it is not cheering to watch the shrinkage in the value of your stocks of at least \$1 per ton of spelter per week, and this not for one period but practically every week averaged throughout the year. November 1912 to November 1913 saw a drop throughout of \$50 per ton of spelter. At the same time the margin, as it is roughly figured on Joplin district ores, faded away from about \$18 in the latter end of 1912 to \$10 in December 1913 and at times during 1913, it was even smaller than that. When it is remembered that the works cost to the smelter is generally figured at about \$10, it will be easily figured that the most prob-



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able dividends of 1913 will be 'Irish' ones, or at best of the 'New Haven' variety.

The year started with a smelting capacity active in the United States of about 1000 tons per day, and the figures published at midyear by the U. S. Geological Survey showed 180,000 tons produced. As there has been no appreciable decline in production since that time, it is probable that the total production for the year will be in the neighborhood of 350,000 tons as against a production from all sources in 1912 of 338,806 tons. But the stocks of metal on hand during the first half of the year had enormously increased, and it is probable that the stock remaining in the hands of the producers alone on December 31, 1913, will be well in advance of 50,000 tons, indicating a consumption of somewhere in the neighborhood of 300,000 tons, as against 340,341 in 1912. At this writing it is impossible to give these figures with any degree of accuracy.

There have been no advances in the metallurgy of zinc in 1913 as relates to the practical operation of smelting works unless an enforced economy can be considered an advance. Much experimenting was done in electro-thermal smelting, and one experimenter has recently announced his intention of carrying on his work to a commercial basis in the near future. I understand also that work carried out by others gives promise of commercial results in the future, but up to today the amount of data published by anyone is insufficient on which to base commercial calculations.

The only new construction initiated during the year was the plant of the American Metal Co. at Burgettstown near Pittsburgh, Pennsylvania. The plant is not yet ready for operation. It is reported that the New

Jersey Zinc Co. interests will in the near future start construction of a plant at Martins Ferry, Ohio.

The effect of the change of duty on the future of the zinc industry is complicated by many factors. There is no doubt that under normal trade conditions in this country and Mexico the present scale of duties on ores and metal would work to the advantage of the smelter. Figuring old and new schedules on the basis of a 40% ore and a normal recovery of 640 lb. of metal therefrom, yields the following:

Old duty 1c. per lb. on zinc in ore.....	\$8.00
Old duty 1 3/4 c. per lb. on metal imported 640 lb.....	8.80

Protection for smelter per ton ore	\$0.80
New duty 10% of \$14 for 40% at border	\$1.40
New duty 15% on metal imported, value 4 1/4 c. London, 640 lb.	4.10

Protection for smelter per ton ore when metal is 4 1/2 c. in Europe, 5c. in St. Louis	\$2.70
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This makes a fair showing for the smelter, and one perhaps hardly intended by the tariff makers, but for the ore producer of the future the outlook is not so encouraging. When during the making of the Payne tariff bill, prayers were offered in the churches of Joplin for an extra heavy duty on ore, some profane Democrats were observed to scoff, but the tariff was certainly put high enough to satisfy any reasonable ore producer. Parties change and methods of making tariffs with them, but I am quite sure that the zinc ore producers and all good Republicans will agree with me that it is self evident that Mr. Underwood did not get his inspiration for the zinc ore tariff from the same source as did Mr. Payne.

Gold and Tin Dredging in 1913

By CHARLES JANIN

The gold dredging industry has had a quiet year; there has been no decided advance in methods employed, and few new dredges have been built, though a number of investigations of supposed dredging areas were carried on in different parts of the world. There has, on the other hand, been a decrease in the total number of dredges operating as compared to 1912 and the outlook in known dredging fields is not particularly bright for the future excepting perhaps in the far north and some in South American countries. In the Yukon the new 16-ft. dredge of the Canadian Klondyke Co., built by the Marion Steam Shovel Co., commenced operations and the four dredges of that Company are estimated to have made a profit over operating expenses of approximately \$750,000 for 1913. The North West Corporation was formed during the year to acquire A. N. C. Treadgold's holdings in the Granville Company and other claims and some new dredges will probably be ordered in 1914. The Granville is the holding company controlling 75% of the North West Corporation and 50% of the Canadian Klondyke Mining Company. The Yukon Gold Co. has dismantled two dredges which were operating near Dawson, and will move the machinery to the Iditarod. A small dredge ordered for unprospected ground in the Kotzebue district, Seward Peninsula, has also been sent to the Iditarod to be constructed next year.

In the Seward Peninsula the dredges in general have not had a successful year, the scarcity of water during the year and an early freeze up made a short season for most of the boats. Some areas, on which boats were built last year following the too frequent Alaskan practice of building a dredge before prospecting the ground, were found to have an insufficient gold content to pay operating expenses. Other dredges encountered difficult operating conditions, such as frozen ground, large boulders, etc., which had not been clearly defined or realized before. A few dredges, mostly of the flume type, and some in the Council district were operated successfully. There is a future for the flume type of dredge in Alaska and elsewhere if it is first properly determined that conditions are suitable for dredging and that there is a sufficient gold content to make the enterprise a financial success. Dredges cannot be moved as easily as chessmen and some idea of the gold content and working conditions to be encountered should be known before building a dredge, even an inexpensive one, on the haphazard chance that the ground might prove good. In other words prospecting with a dredge is neither good engineering nor good business.

It is said that the investigations of the Canadian Klondyke Co. on the Yukon have shown that after stripping the vegetation and top soil the underlying frozen gravel will be thawed sufficiently by the sun to permit of dredging without thawing by steam points as

practised by the Yukon Gold Co., thus permitting a much lower operating cost. This method of stripping and sun thawing I believe did not prove satisfactory when tried by the Yukon Gold Co., except in its first experiments. In actual practice it was found that steam thawing was necessary and during 1912 about 73.5% of the ground handled by the Yukon Gold Co.'s dredges near Dawson had to be thawed; the thawing cost accounts for about half the cost of operations.

Several extensive examinations were carried on in Russia and Siberia, but from what information I have, with the exception of a dredge for the Bodaibo district, all of these investigations of supposed dredging ground resulted unfavorably. It would seem that there is a field in Siberia and in Russia for small dredges of the flume type as used in Alaska if owners of some of the properties in question could be dealt with on a sane basis, and I believe that some of the dredges will undoubtedly be tried in the future.

The Pokrovsky dredge of the Orsk company, which was remodeled from the stacker scow formerly operated, started work during the year and reports a large increase in yardage as compared to the former methods. During 1912 the Kolchan dredge handled 382,550 yd. with an average recovery of 32.5 cents. The total operating costs of the dredge figured from the annual report of the Company are approximately as follows:

COST ON KOLCHAN DREDGE, 1912

	Cents per cu. yd.
Operating	4.09
Power plant	3.8
Winter up-keep	2.37
Administration (management, etc.)	8.37
	<hr/> 18.63
Royalty	6.3
Depreciation, London and general expenses, interest, etc.	10.4
	<hr/> 35.33

To obtain the figures of royalty, depreciation, etc., I have divided the totals as shown in the report by the total yardage handled. The yield of gold for August, 1913, from both dredges is given at £10,343 and the total yardage as 116,000 as against 62,000 in July and 41,600 in June. This indicates the efficiency of the Pokrovsky dredge. The next annual report of the Company will be awaited with interest as a real profit over expenses is looked for.

In South America investigations were carried on in Peru, Brazil, British Guiana, and Colombia. In the first two countries examinations resulted unfavorably. In British Guiana a new dredge is to be built by the Minnehaha company already operating one dredge on the Potero river, also the Guiana Dredging Co. on the Konowarook reports a successful year and another 10%

dividend making 62% since the Company started operating in 1907. It is stated that this Company handles ground at a cost of 10c. per yard but as no figures of yardage are given in the annual report this is probably an estimation only. In Colombia a number of investigations were carried on, one with considerable preliminary advertisement but so far no new dredging areas have been found and no new gold dredges have been ordered. Considerable prospecting work will be done in Colombia during 1914 by the Pato, Oroville, and other interests. The investigations of the American Goldfields Development Co. to the south of the San Juan river on the west coast have resulted in a dredge being ordered for 1914 to recover the platinum and gold shown by prospecting.

Fraser & Chalmers is building a 5-ft. open-connected dredge for the Servia and if the results prove as anticipated other dredges will probably be built in the same field.

In the Far East

In the Philippines the results from Guamos dredge during the first four months of the year gave considerable satisfaction to the shareholders and other dredging men interested in the country. The latest reports, however, are that the ground proved deeper than expected, and that the digging ladder could not reach bedrock and consequently there was a considerable falling off in output. This caused a small panic among the shareholders. Late papers from the Islands talk of an investigation. It seems, however, that an extension on the digging ladder would be more to the point. I have been informed by the New York Engineering Co. which built this dredge that an extension to the digging ladder, was contemplated at the time of construction, to be put on when necessary. The 5-ft. dredge being built by the Yuba Construction Co. for the Philippines is fast nearing completion, and will be operating in December. The dredge for the Andrada Company in Portuguese East Africa was expected to be finished in November. This being built by the Bucyrus Company, under charge of T. C. Nicolson.

In West Africa the Offin River Gold Estates, which was formed in 1900 to acquire dredging rights on the Offin river, has had a continuous production of gold since 1904 but no profit is yet available to shareholders. The bullion recovered to the end of 1912 has been £186,003, about all of which has been swallowed by expenses. The Ashanti dredges are working under tributaries, the operations of the Company being unsuccessful and unfavorable news is reported from the Ancobra dredging operations. Dredging in Africa has not been a success, due partly to building dredges unsuited to conditions of operations but mostly to poor advice when commencing operations. Had dredges properly designed to meet working conditions been built when the companies first started, and in some cases been properly handled afterward, a different tale might have been told to the shareholders.

Dredging in Spain has proved a failure and work has

been suspended pending a search for the 'pay channel,' which should have been done a little earlier. From Alaska to Spain is quite a leap but the same methods seem occasionally to be followed in both these countries as well as in others.

Some rich gravel is reported to have been found in San Domingo and if the values can be confirmed a new dredging area will be open to exploitation.

In the United States little of interest has occurred in dredging. There has been little new work in California, a number of boats have exhausted their holdings and one has been moved to other areas. One new dredge is reported, that of the Yukon Gold Co. near Auburn, the machinery of which was taken from an Oroville dredge which had been shut down. The Yuba Gold Fields had a successful year during 1912 and operations for 1913 are on the same order. The big all steel 14-cu. ft. dredge commenced work late in the year. The Natomas company has also had a fair year in its dredging operations and has overhauled several of its dredges. A new dredge was built by the Yuba Consolidated Co. for the Pabst interests near Salmon, Idaho, and the big 15-ft. dredge built by the same Company near Idaho City has been doing excellent work. A new dredge is reported for Gunnison county, Colorado. In Oregon the Powder River dredge is said to have done well and it is reported that a 3-ft. dredge has been ordered by the Gold Center Dredging Co., about 8 miles from Sumpter, Baker county.

Tin Dredging

While gold dredging has not shown much activity there has been a rapid progress in tin dredging operations and no review of dredging would be complete without some reference to the work done and the success made by the tin dredges. That tin dredging is widespread is learned by operations in the Malayan Peninsula the chief field for tin production, Nigeria where two dredges have been built during 1913, Alaska where the York dredge has been operating for three seasons, and in Portugal where a new dredge is being built which will commence operations in 1914. Among the companies which have ordered new dredges the Renong company in the Siam Eastern states operating one Werf Conrad dredge has ordered two more; the Tongkah Harbour Dredging Co. operating five Simon dredges has ordered a sixth; the Siamese Tin Dredging Co. has two new 14-cu. ft. Lobnitz dredges designed by Cutten Bros.; Fraser & Chalmers is building one for the Kamuning company in the Malay States; Arthur Brown is building two designed by Payne & Co. for the Malayan Tin Dredging Co.; two Werf Conrad dredges were sent to Nigeria; and Fraser & Chalmers has shipped a dredge which is being erected near Belmonte, Portugal. This latter is of interest as it is the first dredge of strictly California type to be built for tin dredging in Europe. It will have a close-connected bucket line of 4-ft. buckets, a steel hull, and will have a horizontal belt conveyor and be operated on spuds. The machinery will be driven by electricity. The boat

was designed by H. C. Peake of the Union Construction Co. for E. J. De Sabla.

The pump dredge has been successfully used for tin in the Malayan States and elsewhere and for a time two of these plants were operated in Cornwall. The high operating cost militates against their being adopted on areas suitable for dredging, or on areas unsuitable for dredging but having a low tin content. In Cornwall the cost averaged from 24 to 30c. per yard, and in the Malayan States according to Alexander Colledge* about 25c. per cu. yd. Though under extremely favorable conditions he figured it should be

done for 12c. Costs of tin dredging like costs of gold dredging, are sometimes a matter of book-keeping, and sometimes due to an overestimation of the yardage handled. The man with the most vivid imagination can thus obtain the lowest operating cost per cubic yard. In the Malay Peninsula it is generally accepted that dredging costs average from 9 to 10c. per yard. I have statements of costs under these figures but it is not stated how yardage is measured. For myself I prefer to figure on a basis of 10c. though a company operating a number of dredges under favorable conditions should do better than that.†

Recent Changes in Iron and Steel Manufacture

By BRADLEY STOUGHTON

Electric Smelting

There is but little recent advance of an industrial nature in the electric processes, and this applies especially to the electric smelting of iron ore, which does not seem to progress as rapidly as the advocates of the process and the theoretical calculations would lead us to expect. The electric steel furnaces, however, have increased rapidly in number. There are now nineteen in the United States, and commercial success seems to follow where electricity can be obtained at a low price. A number of improvements of minor nature have been made in steel-casting plants, and several new furnaces have been developed without any one of them coming specially to the front. The principal use of electricity in the manufacture of steel is in super-refining the product of the open-hearth or Bessemer furnace. The melting of scrap is also successful where electricity can be procured at a very low price, and where a good price can be obtained for castings of unusual quality. The melting of alloys to be used in open-hearth furnaces is also a successful electrical process, because of the possibility of melting without oxidation and waste of the costly alloys, such as manganese, chromium, etc. The refining of pig iron to steel is a process too costly to be generally applied on an industrial scale, but the melting of pig iron in the electric furnace for the manufacture of iron castings is said to be highly successful from the standpoint of the quality of the product. A new patented refractory material, consisting of boron nitride, will have important usefulness in electric furnaces if the claims of its inventor as to its fusibility and chemical inertness are borne out by practice.

Furnace Changes

A new furnace, having some of the characteristics of an electric furnace, a Bessemer converter and an open-hearth furnace, has been put in operation in Maryland, but has not been tried long enough to prove the industrial value of the apparatus. The Stock oil-fired

converter is a combination of the ordinary sideblow steel-casting converter and the reverberatory oil furnace for melting iron.

There is a tendency at the present time to return to the tilting type of open-hearth furnace as compared with the stationary type, on the ground of greater convenience, notwithstanding the heavy cost of repairs because of the strain in the brick-work during the tilting. A recent development in the heating of open-hearth furnaces is the use of blast-furnace gas mixed with coke oven gas. A process with future industrial possibilities involves the following principles: By means of carbon monoxide gas it is possible almost completely to reduce iron ore and produce a somewhat impure form of iron sponge, without the use of a blast-furnace, the resulting iron sponge can be melted and purified in the open-hearth furnace and thus produce steel from iron ore in a two-step process similar to the prevailing commercial process for steel manufacture, except that it is not necessary to use coke or other solid fuel.

The Roe mechanical puddling furnace, which was developed several years ago, is being tried on an industrial scale and apparently with satisfaction to its users.

Fuel Problems

The industrial use of oxygen for enriching the blast driven into the iron blast-furnace has been increasing so fast, and the price of oxygen is so much reduced, that it would seem to offer important possibilities to metallurgists interested in pyritic smelting of copper ores and the bessemerizing of copper, because of the valuable possibilities for abundantly and rapidly increasing the temperature of the operation without at the same time endangering the reduction of iron.

The increase in the price of fuel oil in the eastern part of the United States has caused a great extension in the use of pulverized coal for heating, melting, and annealing. The use of pulverized coal enables the

†A further review by states and districts will be printed later.

*The Mining Magazine, July, 1913.

engineer to control with great accuracy and facility the temperature and the composition of the flame; it gives a higher temperature than can be obtained with oil, and avoids the difficulty of deposition of graphite and soot, without at the same time requiring preheated air or too oxidizing an atmosphere in the furnace. Pulverized coal has, however, the disadvantage of being very severe upon the brickwork of the furnace, although much progress has recently been made in this respect.

Recent investigations into the heat lost from cupolas have shown the possibility of melting iron with a smaller proportion of coke than has been customary. A process has been announced for desulphurizing iron by blowing air through the bath of the liquid metal in such a way as to cause the manganese sulphide to rise to the surface, but without oxidizing the silicon and carbon and without increasing the temperature of the metal, as is done in the blowing of the ordinary Bessemer process. Steel borings and turnings have been melted in the cupola, without the ordinary briquetting or the canning processes, by blowing the fine particles in through the tuyeres with the blast. A process has also been announced from Sweden for the dephosphorization of iron by oxidation with air at a low temperature. The details of its commercial possibilities are not yet known.

Research in Steel and Iron

The tremendous industrial importance of the critical points of steel for all those interested in annealing or tempering steel is now well recognized. During 1913 a new method has been developed for the determination of the A_1 and A_2 points, and progress has been made in the elucidation of the mysterious hardness of steel by researches upon the properties of the allotropic modifications of iron.

A very important investigation by J. E. Johnson, Jr., was published in 1913 upon the 'Effect of Carbon on the Quality of Cast Iron,' which proved the special influence of the eutectic ratio upon the properties of this metal.

One of the most notable advances of the year has been the increased attention given to the ingot-forming stage of the steel-making processes, and the steps that are now being taken for insuring the production of sound ingots. Perhaps the greatest of all these steps has been the very efficient method of supervision of the process of manufacture, which is carried on and recorded by inspectors acting on behalf of the purchaser in the works of the manufacturer. Several important processes for the elimination of pipes from the ingots, by causing the upper portion to cool more slowly than the lower and thus draw the shrinkage cavity nearer the top of the ingot, have been described and introduced.

The diffusion of hydrogen gas through steel at a high temperature has resulted in the removal of some sulphur, phosphorous, and carbon in the form of hydrides without any harmful absorption of the hydrogen by the metal. An interesting study of the limit of the amount of oxygen absorbed by molten iron disclosed the wholly unexpected result that not more than

0.074% could be absorbed. The harmful influence of oxygen on iron and steel has made a good, rapid method for the determination of this element of great value. Much research has been carried on during 1913 to this end, and although full success cannot yet be claimed, the end is nearer than ever before. Progress has also been made in the development of a rapid method for the determination of nitrogen in steel, and evidence has been obtained which further indicates the harmful effect of this element on the quality of the metal. This has long been a disputed question.

Alloy Steels

Manganese steel, which is very extensively used for parts of crushing machinery and other apparatus which is subjected to great wear, is now commonly forged both hot and cold. It has recently been shown that it can be made either non-magnetic or magnetic, and that it has the great peculiarity of exhibiting changes in structure that do not seem to be related to critical points in its heating and cooling curves. Mayari cast iron and Mayari steel are natural alloys of iron, nickel, and chromium which can be made from some of the ores of Cuba and some of the ores of Greece without the addition of any alloying materials. They possess greater strength, hardness and durability than does ordinary iron and steel without the nickel and chromium, and are coming into extensive use in engineering. Cobalt is one of the latest additions to steel and is said to give greatly increased durability, especially in high-speed steels. Copper steel, containing from 0.1 to 0.5% copper, has been experimented with by many investigators in recent years in their search for a material which will give extra resistance to corrosion and durability against wear, such as is needed for railroad rails, for example.

Iron Ore Deposits

The iron ore deposits of Texas, Mexico, Central and South America have been developed to a very great extent and have attracted much attention in recent years. One of the largest of the eastern steel plants has acquired great holdings in Chile, and arrangements are being perfected for marketing Brazilian ores on a large scale. The opening of the Panama canal will, no doubt, bring the great deposits known to exist south of the Equator into still further prominence.

Colorado mines produced in the eleven months of 1913, with an estimate for December, according to Charles W. Henderson, of the U. S. Geological Survey, \$18,395,000 in gold, 9,150,000 oz. of silver, 85,500,000 lb. of lead, 7,634,000 lb. of copper, and 129,680,000 lb. of zinc, with a total value of \$36,200,000, compared with \$37,320,996 in 1912. This shows a decrease of \$200,000 in gold, an increase of 900,000 oz. of silver, an increase of 10,300,000 lb. of lead, an increase of 500,000 lb. of copper, and a decrease of 2,540,000 lb. of zinc. The heaviest decrease in value was \$1,732,000 for zinc, and there were increases of \$440,000 for silver and \$377,000 for lead.



FIG. 1. SURFACE WORKINGS AT MOUNT LYEEL, TASMANIA.

Mining Methods and Practice

By E. H. LESLIE

Reviewing this broad subject in the fewest possible words, it may be said that the effort is everywhere to reduce costs by increasing the scale of operations. Results on the Rand, where large capital expenditure has been called for, have not been altogether happy, but in general the movement is making possible the working of deposits lower and lower in grade. Lake Superior mines have pointed the way in open-pit work and in caving methods, and central electric stations are everywhere reducing power costs. Gas and oil-engines are making constant inroads on the field of steam, but the time-honored Corliss is still far from being driven from the field. Improved efficiency is being sought in every department. In underground work the one-man stoping drill has come to stay. In the Lake Superior copper mines it has reduced the stoping cost from 50 to 15 cents and increased the tonnage broken from 12 to 30. The motorman is replacing the 'mule-skinner'; crushing and sorting underground is finding favor; use of conveyor belts is increasing; grouting systems for reducing pumping charges are coming to be recognized; loading machines are being tried; and there is a distinct tendency toward making repairs to drills and pumps, and conducting drill sharpening, crushing, and sorting underground. The chief difficulty in the latter has been the outlay for separate equipment on each level, but by centring the work this is being met. Ventilation, of course, must be provided, but this is not proving difficult in practice. The efficiency of drills has been much studied at the North Star in California during the past year, and a rock-drill testing machine,¹ which gives promise of great savings, has been invented. Underground ore-crushing is now past the experimental stage and has been found to be espe-

cially advantageous where 'bulldozing' and underground sorting are necessary. The jaw-crusher recently installed on the 14th level of the Witwatersrand Gold Mining Co.'s property is used to crush the large rocks formerly broken by hand, and the discharge from crusher is sent direct to the shaft bins. At the Round Mountain Mining Co.'s property in Nevada during the year one underground crusher broke 22,688 tons of ore, of which 16,306 tons was rejected as waste and left underground, and another crushed 56,188 tons, of which 40,589 tons was rejected. The cost of mining this material is from \$0.80 to \$1 per ton, while the crushing, screening, and transportation, including all repairs and renewals, amounted to from 5 to 6c. per ton. The often advanced objection, the supposed bad effect upon the mine atmosphere, is not borne out in practice. At the Knight property on the Rand the crusher station is surrounded with atomizers and the amount of dust created is exceedingly small.

Mining Machines

The application of mining machines to metal mines is one of the latest developments. In the mining of coal, which, by the way, forms a subject worthy of the attention of the metal miner, mining machines have made possible the immense tonnages and rapid development which is characteristic of that industry. Recently they have been introduced on the Mesabi iron range,² where the influx of miners has not kept pace with the demand for increased output. At the Harold mine, in the Hibbing district, a pick machine is being successfully used in soft ground. Under the old method the miners drilled a round of 3 to 5 holes in the breast, each hole about 5 ft. in depth. The upper holes were usually fired first and the bottom

¹'Rock-Drill Testing at the North Star,' by Robert H. Bedford and William Hague, *Mining and Scientific Press*, August 2, 1913.

²H. E. Martin and W. H. Kaiser, *Trans. Lake Superior Mining Institute*.

holes after the broken ground had been removed. The amount of dynamite depended upon conditions, and varied from $7\frac{1}{2}$ to 15 lb. After the upper holes were fired the miners secured the back by poling from the last set of timber into the breast. When the broken ore had been removed, the miners trimmed the breast, back, and sides, and the ground was ready for timber. When doing the work with machines, the number of men required per crew is 2 machine men, 3 miners, and 6 shovelers. The minimum number of working places or rooms required for one machine has been found to be five, though a larger number will insure fewer delays and make for higher efficiency. The log of one round of operations is as follows: The ground is first undercut with the puncher to a depth of about five feet, the cut extending from the solid rib to within six inches or so of the opposite side, thus leaving a small pillar six inches wide and the full length of the 'set'; the object in leaving the pillar being to prevent premature caving. Two holes are then drilled with the air augur about one foot from the solid rib and spaced about two and six feet, respectively, from the back. Sometimes four holes are necessary. Two short holes are drilled in the small pillar supporting the ground, shoveling boards are placed in the cut, and under the ground to be broken, and the holes are loaded and fired. The back is then secured with poles and the room is ready to be cleaned. After the broken ore has been removed, the miners spare up the set, place the timber, and another cycle of operation is started. The average time for under-cutting one block of ground is 59 minutes, moving and setting the machine 26 minutes, drilling with the air augur 2.8 minutes per foot.

Aside from reducing the cost of production, the machine requires but one-half of the labor to be skilled miners, only one-half the amount of dynamite is required, there is less liability of the posts being blasted out, and there is always a smooth surface from which to shovel. The rooms worked by machine must be easy of access from one to another. Their height should not be less than seven or eight feet, and no bottom stoping should be necessary. In other words, the machines are applicable to slicing and square-set methods. While the mining conditions have not been ideal for the use of the machine, after five weeks' trial it was found that the average number of tons per man was 12, which is considerably above the average in most of the underground mines on the Mesabi. From the results obtained it is evident that the machines have found a place in iron mining.

Mining Methods at Joplin

At the present time over 50% of the concentrate produced in the Joplin district is from 'sheet ground' properties, that being a local name for a blanket deposit. The blanket from which the bulk of the output of the district is obtained varies from 8 to 20 ft. in thickness and lies at a depth of from 100 to 200 ft. As a rule, the ore-bearing ground lies under

a heavy limestone, which is supported by pillars of from 20 to 40 ft. in diameter, about 50 ft. apart. The ore occurs in a formation known as the Grand Falls chert, which is extremely hard, and is broken with air-drills and 40% dynamite by underhand stoping. The ore is shoveled from the faces of the stopes into tubs and run to the circular shaft on low platform cars. Another type of deposit is known as hard disseminated ground. In these deposits a good back is usually had and the mining is practically the same as in sheet ground with the exception that rooms are often cut out 30 to 40 ft. wide, 50 to 150 ft. long, and 20 to 100 ft. high. The third class of deposit is that which is known as 'soft' ground. In this form of deposit the roof is supported by timbers. The usual method of timbering consists of a cap and posts with collar braces, each set being tied to the one behind. It often happens that spiling boards are necessary, and lagging is used on the sides of the drifts. The average cost of mining in this district for all types of mines including sheet and soft ground is about \$1 per ton. This cost does not include amortization. Methods of mining in the Joplin district have been briefly described within the year by Clarence A. Wright in one of the series of technical papers published by the U. S. Bureau of Mines.

Flat River

The methods of mining used in the lead belt of southeastern Missouri are similar in some particulars to those at Joplin, underhand stoping and pillars being used. Operations in general, however, are on a much larger scale, and the equipment is of a more permanent nature. Prospecting is done largely by diamond-drills in the Flat River district, and mules and electricity are employed for underground tramping. The subject has been fully treated recently by H. A. Guess^a in a most interesting and valuable paper.

In both districts the pumping charge constitutes one of the big items of expense, and it seems probable that larger use could be made of the method of plugging water channels. The combination of wedging and grouting introduced by E. B. Kirby at the Federal Lead Co.'s property at Flat River, some years ago, proved a simple and efficient method of sealing and saved a large amount of pumping. By this method the channel is stopped with wooden or iron wedges, a pipe being first inserted into the channel through which the grouting is pumped. Pumping operations are continued until the flow of water from the channel has ceased, when the pipe is capped and the operation is completed. For filling the channel, either clay, sawdust, or a fine concrete may be used. When earth is used, a settling device in the form of a three-compartment classifier is employed. Only the finer material, that collected in the last compartment, is used for grouting purposes. George S. Rice has called at

^aMining and Mining Methods in the Southeast Missouri Disseminated-Lead District, H. A. Guess, *Trans. Amer. Inst. Min. Eng.*, December 1913.

tention' to an application of the method to preventing rock slides, and Francis Donaldson⁴ has discussed the matter in connection with shaft-sinking.

Square-Set Stopping

The square-set method of stoping, which was the standard practice for a number of years, has become modified and a combination with the filling system is being widely adopted. The Snow-Storm property at Larson, Idaho, presents an example of square-set and fill system. At this property the vein outcrops near the top of the mountain and dips at an angle of 65°. It is opened by four cross-cut adits at depths of 100, 200, 1100, and 1600 ft. vertically below the outcrop. Mining at present is being conducted through the 1100-ft. adit, which is about 1800 ft. long. The adits are connected by raises in the vein and drifts are made in the ore at approximately 100-ft. intervals. The stopes extend from one level to the level above. A back is left beneath each level until the ore is mined. The stopes are filled with waste material obtained from underground sorting and an open-cut. The sets are 6 ft. square and 8 ft. high. A plank ore-chute, timber chute, and man-way are carried up about every fifth set. Temporary incline chutes are put in when necessary. The ore is trammed by hand on the levels and dropped through rock raises to the adit-level, where it is trammed by horses to the portal of the adit and thence by aerial tramway to the mill at Larson. Ingersoll-Rand 3¼ and 3⅝-in. piston drills are used for driving, Waugh hammer-drills for raises and stopes, and Ingersoll-Rand jack-hammer drills for sinking. The cost of production for the year ended July 1, 1913, was \$1.444 for shipping ore and \$1.474 for milling ore.

At Victor and Cripple Creek the general method of mining is by stilled stopes, varied occasionally by filled stopes, or where the shoot is wide, by square sets. Stopping drills of the Leyner, Shaw, and Waugh makes are used for all general work, and with the aid of the 'blow-pipe' a great deal of driving and cross-cutting is done with these light drills. The machines generally used for long drifts are the Ingersoll 2¼-in. and the Leyner piston machines. At Stratton's Independence driving on a small vein in granite with 2¼-in. machine cost \$4.44 per foot, while the stoper in phonolite and porphyry the cost was \$3.25 per foot. Ordinary raising with a stoper is being done at a cost of \$3.50 per foot, while raising in caved ground averages \$9.19 per foot. The Independence property caved from the surface to the 500-ft. level in 1907 since which time a large part of the work has been in broken ground. The average cost of driving and cross-cutting in 1913 was \$4.10 per foot, while for development the cost averaged \$4.65 per foot of advance, covering all kinds of ground, both caved and solid. There is but one man to a machine, even on the Leyner and 2¼-in. machines, though a shoveler is allowed to help set up.

In the mining of wide lodes it has become customary to provide permanent tramping drifts in the foot-wall. From these, cross-cuts are driven through the orebody, from which stoping operations are conducted. As an example of this class of mining, the method at the South mine at Kalgoorlie may be cited.⁵ It is known as the 'rill floor' method and various adaptations of it are in vogue in the mines of Broken Hill. It provides for filling while the stopes are being worked.

At the property of the Mount Lyell Mining & Railway Co., at Mount Lyell, Tasmania, a similar method of mining has been adopted, which is a combination of surface and underground methods, and also bears some resemblance to the milling system of the Lake Superior district. Fig. 1 shows the surface workings, from which the idea of the scope and method of mining operations may be had. At the present time work is being continued on the overburden and ore benches, and a large tonnage is being uncovered. All of the filling for the underground workings is obtained from this source. As the property develops, the tendency is toward a diminution in the tonnage mined from the surface and an increase in the tonnage from underground workings, as at the Treadwell in Alaska.

The pit is worked in benches with air-drills and cars, the ore being either trammed from the benches through a tunnel to bins on the mountain slope, or dropped by gravity to the underground workings and thence to the surface. At the present rate of mining there is being stoped from the open pit of the Mount Lyell mine about 650 tons per day. The properties altogether produce about 30,000 tons per month at a cost of about \$2.25 per ton.

Caving Methods

Slicing and caving methods have been developed in the underground mining of Lake Superior iron ores to an extent not equaled elsewhere. For the first time these methods were comprehensively described within the year, in a volume⁶ written by C. E. van Barneveld and published by the University of Minnesota. By these methods the development period is made shorter than when open-pit methods are used, and the preliminary work, as a rule, is much cheaper. Another advantage of the caving system is that it is possible to select the ore and maintain more uniform grades than in open-pit and steam-shovel mining, as the unit of operation is smaller. The capital outlay for equipment is much less, and the method requires but a comparatively small amount of timber. The extraction is also high, being estimated at from 95 to 98 per cent.

The many advantages of these methods are leading to their wide introduction in the copper-mining districts of the West where wholesale mining is in vogue. At the Miami mine, near Globe, Arizona, a shrinkage method is employed which has made possible a cost of

⁴Jour. Wes. Soc. Eng., September 1913.

⁵See *Mining and Scientific Press*, November 29.

⁶'Open Stopping on Wide Lodes,' by Andrew Fairweather. *Proc. Australasian Inst. Min. Eng.*, N. S. No. 10.

⁷'Iron Mining in Minnesota,' Minnesota School of Mines, Experiment Station Bull. 1, p. 215. Minneapolis.

\$1.20 per ton. An interesting recent development is the handling of ore from the dump by means of a special form of drag-bucket scraper, described within the year.⁵ The drag-bucket, by the way, is now extensively used in mining iron ore in Cuba, and has found many applications in placer mining. At the Inspiration mine the method used underground is similar to that at Miami, though haulage is by means of compressed air and there are other differences. At Ray, the general system has been materially modified, and, as representing the latest development, may be described. The Ray orebody as developed by churn-drills is reputed to be the second largest in the world. The ore is in the shape of a huge blanket deposit with an average thickness of 107 ft. over an area of 183 acres. A detailed account of the mining of this orebody has

drifts are timbered with 12 by 12-in. timber sets on 5-ft. centres. On top of these drift sets, which lie within the orebody at intervals of 25 ft., 'pony sets' are erected to hold the stope chutes, and midway between the stope chutes are erected 'pony sets' for holding the pillar chutes.

While the haulage-way drifts are being driven, smaller manway drifts are progressing at 100-ft. intervals on the sub-level 25 or 30 ft. above. These manway drifts are offset 12½ ft. to one side of the motor drifts, and out of them are run at right angles a series of parallel sub-drifts placed every 25 ft. over the whole orebody. These are driven so as to be directly over the stope chutes on the motor level, so that when raises are made from the stope chutes they will break into the stope drifts and become chutes

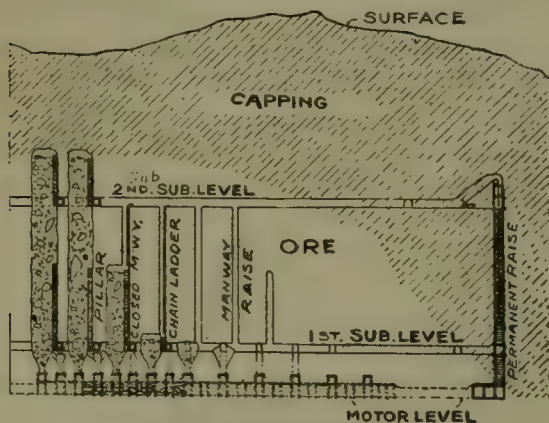


FIG. 2. LONGITUDINAL SECTION.

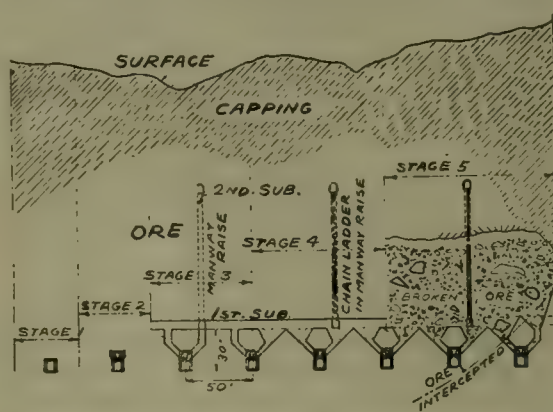


FIG. 3. CROSS-SECTION, SHRINKAGE STOPES AND PILLARS.

recently been written by L. A. Blackner,⁶ an abstract of which is reproduced here through his courtesy.

Owing to the heavy overburden and the low grade of the ore, it is necessary that a large tonnage be produced per day, and toward this end a caving system has been developed, which consists of weakening a block of ore by a series of shrinkage stopes, when, after undermining pillars, the ore is drawn down systematically, the capping crushing and settling gradually over it. At the present ore is being mined from two shafts by this method, while a third, in high-grade ore, opens a body which is mined by square-set methods. The low-grade deposits are opened by three motor-haulage levels. On each motor level a main drift is driven from the hoisting shaft along the edge of the orebody; from this drift a series of parallel side-drifts are run at 50-ft. intervals and completely through the orebody to a 'fringe drift' which runs parallel to the main drift. Somewhere at a convenient place along the main drift and outside of the orebody there is put in a raise to the sub-levels, as shown in Fig. 2 and Fig. 3. This raise is usually divided into two compartments, one to be used as a manway and the other for hoisting tools and supplies. The parallel

through which the ore is drawn to the tramming level. On a second sub-level, which is placed about 100 ft. above the first, manway drifts are driven parallel and directly above those on the first sub-level. These later serve as passageways through which the men and supplies enter and leave the stopes, and they also serve for ventilation. Along the manways of the first sub-level at intervals of 25 ft., or 7½ ft. from the centre of each stope, there are put in manway raises to the drifts on the second sub-level. Chain ladders are used in these raises for the use of the men. While the manway raises are being put in, men with stopper machines 'bell out' the chute raises so that when finished they have the appearance of funnels or inverted bells. In starting a stope, men with stoppers drill a line of holes into the side of the stope drift. This line of holes, when blasted together, widens the drifts to 15 ft., so that they are ready to be mined and stoping operations commenced.

When this has been completed, manway sets of 8 by 8-in. timber are erected in the manway drifts. In mining a stope, two lines of holes are drilled with stopper machines all along the back on both sides of the stope, one line near the side walls with the holes slightly 'toeing' toward them, the other about four feet away, with the holes inclined slightly toward the centre of

⁵Mining and Scientific Press, November 1, 1913.

⁶The Ray System of Mining Ore, Arizona Copper Camp.

the stope. In hard ground it is sometimes necessary to put in a third set of holes. The holes are loaded with three or four sticks of 40% dynamite and 7-ft. fuses are used. The ore is drawn from the stope chutes into 5-ton cars on the motor level and trammed to the shaft. Only enough ore is drawn from the stopes to allow the miners head room in drilling. Air for the machines is supplied through a supply hose dropped from the second sub-level. The manways are always built up above the broken ore, so as to keep them clear. When the stope has reached a point midway between the first and second sub-levels, the men usually descend into the stope through the manway raises, and the cribbed manways are left behind.

the ore. The total cost of mining by this method for the past year, including crushing the ore through an inch-mesh screen and delivering it on board cars with a proper apportionment of all fixed charges, was 77.55c. per ton. This cost is higher than the costs applying to those parts of the mine which have been sufficiently opened to permit of economical working, and is accordingly higher than it will be in the future.

Steam-Shovel Operations

Steam-shovel operation as applied to mining may well be said to be the most important development which the mining industry of the later day has experienced. The economic conduct of the operations, although seem-



FIG. 5. STEAM-SHOVEL WORK AT BINGHAM, UTAH.

When a block of ore has been mined by a series of such stopes, the undermining of the pillars is commenced, starting with the pillar nearest the 'fringe drift' on the motor level. Raises are run out on inclines from each pillar chute until they intersect. From these raises at a distance of 10 or 12 ft. from the chutes, raises are run back so as to connect with each other directly over the motor drifts. After the raises have been connected all along the pillar, they are widened and drilled and blasted with deep holes, so as to undercut the entire pillar. Each consecutive pillar is mined in this manner.

In most cases the orebody and capping is badly shattered and broken so that when the pillars are undercut the capping breaks in a nearly perpendicular plane to the surface completely around the area. An accurate account is kept of the ore taken from every chute, so that the ore remaining in each is always known. Only a few cars are drawn from any one chute at a time, so as to give the ore time to settle gradually with the capping following after and without mixing with

ingly simple, presents problems which if not properly analyzed may result in the difference between a profitable and unprofitable investment. Thorough prospecting, efficient arrangement of the workings, and thorough organization are the main points for consideration in open-pit or steam-shovel mining. As typical of this class of mining, the iron ranges of Minnesota present the standard practice, which with modifications to meet local conditions, have made possible the so-called porphyry-copper mines of the West. Excellent work is being done at Bingham, Utah, Chino, New Mexico, and Ely, Nevada. Steam-shovels are also used in coal-mining in Kansas, Illinois, and other states, and in placer mining.

Prospecting, if thoroughly conducted with churn, diamond-drills, or augurs (as at Moa) will clearly define the nature of the deposit, position and extent of commercial ore, amount of stripping, laying out the pit, entrance and grades, and position of benches upon which all subsequent operations are based. Without going into detail, the importance of each step is ap-

parent and each has been fully discussed by various writers in the technical press. The shovel itself is the keystone of efficiency. The tendency, which has been toward the adoption of shovels of increasing size has been stopped, and the 100-ton shovel, or thereabouts, has come to be accepted as standard. The difficulty with the larger and more powerful machine lies in the increased wear and tear due to rough handling, which increases repair charges and decreases running time. In steam-shovel work it is important to make every arrangement with a view to securing full time work with the shovels.

The orebody being mined by the Utah Copper Co. consists of lenses of ore with rock capping on the sides of Bingham and Carr Fork cañons. Owing to the unfavorable position of the orebody on steep mountain-sides, the site is not the most favorable for steam-shovel operations. Stripping operations require the

and has an average thickness of about 220 ft. The ore consists of chalcopyrite, chalcocite, and pyrite disseminated through a highly-altered porphyry, lying in great lenses at an average depth of 100 ft. below the surface. The deposit, being flat, is adapted to the same methods of mining as those employed in the Lake Superior iron pits. Stripping operations are conducted by steam-shovel at a cost of 33.64c. per cubic yard. In the stripping of this orebody, up to the beginning of last year, there has been removed 9,916,024 cu. yd. The longitudinal section, Fig. 6, through the deposit shows the amount of stripping necessary, the position of the orebody, the positions of the benches, and method of working. As the pit is widened and deepened, stripping and mining operations are carried on simultaneously. The difference in elevations of the benches is about 50 ft., and they are about 50 ft. wide. Operations are conducted by seven 95-ton and one 70-ton

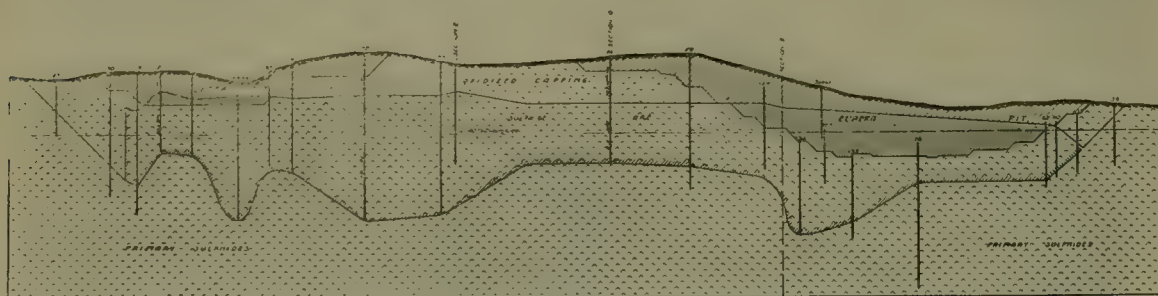


FIG. 6. LONGITUDINAL SECTION THROUGH THE COPPER FLAT OREBODY.

removal of capping in the ratio of one of rock to between three and four of ore. The average thickness of the capping is 110 ft., the total amount removed last year being 4,676,568 cu. yd., and was removed at a cost, including prospecting, of 8.84c. per ton of ore produced. The position of the workings and the steam-shovel benches are as shown in Fig. 5. The benches are connected by switchbacks and are at about 75 ft. differences in elevation. The capping and ore are broken by giant blasts. 'T'-shaped gopher holes are sometimes driven into the bank and giant blasts of black powder, ignited by dynamite and electric fuse, are used. Churn-drill holes are the common practice, eleven churn-drills being employed for this purpose. The holes are of 6-in. diameter and spaced according to the ground, the holes having a burden of 35 to 40 ft. at the bottom. The stripped material is handled by dump-cars, while the ore is shoveled directly into standard gage ore-cars of 100,000-lb. capacity and taken to the mills. The 22 standard-gage steam-shovels operate about 60% of the time. The actual cost of mining by this method last year was 26.35c. per ton, to which must be added the stripping and prospecting charge of 8.84 cents.

The Copper Flat deposit of the Nevada Consolidated presents an excellent opportunity for steam-shovel working. There are three pits, the Eureka, Liberty, and Hecla. The deposit is 2600 ft. long and 1200 ft. wide,

steam-shovels. In blasting, 'T'-shaped gopher holes are driven into the bank, as at Bingham, and churn-drill holes are used. The churn-drill holes are of 6 in. diameter and from 50 to 100 ft. in depth. They are chambered before firing.¹⁰ The present method of moving the drill by a crane has been found to be a very decided improvement over the old method of making roads and moving it by its own power. Five men are required where formerly ten were necessary, and a great deal of time is saved. The actual cost of mining, including labor, supplies, repairs, management, taxes, etc., at the time of the last annual report, was 17.35c. per dry ton. During the last year of operations reported, there was mined by steam-shovel methods a total of 2,596,991 tons of ore averaging 1.603% copper.

In this review only those features of modern practice as applied to the more important types of lode deposits have been touched, in the hope that such a general survey of the subject may point out the trend of present-day methods and the possibilities of increased mining efficiency. While the step from breaking ore by heat to the stoper and dynamite, from the 'chicken' ladder of the Aztecs to the giant hoists of Lake Superior and Butte, from the divining rod to the diamond-drill, and from gopher methods to the steam-shovel has been a long one, there is still room for improvement.

¹⁰'Blast-Hole Drilling in Open Pit Copper Mining,' *Mining and Scientific Press*, October 25, 1913.

The Decline of the Rand

By H. S. DENNY

There is something impressive in the suggestion that the huge gold-producing industry of the Rand has reached the downhill side of its wonderful career, and it smacks of the paradoxical to affirm this in the face of a record of steadily increasing gross production. Nevertheless, a study of the position must inevitably lead one to this conclusion, despite the fact that for the year 1912 the Witwatersrand produced gold to the enormous value of over £37,000,000 sterling, being an increase of over 3½ millions as compared with the previous year. The explanation, of course, is that as against the continued increase in production there is a marked decrease in the amount of distributable profit. The sum of dividends distributed shows a steady advance up to 1909, but the record since then, as indicated by the following summary—is eloquent of the change that has come over the industry:

Year	Tons milled	Output	Dividends
1909	20,543,759	£29,900,359	£9,523,518
1912	29,163,803	37,182,795	8,331,575
Difference	+8,620,044	+7,282,436	=£1,191,940

Since 1909, therefore, the tonnage crushed has increased say 40% and the output 24%, while the dividends have decreased 12%. From the investor's, and in fact from almost any, standpoint, the vital figure is naturally the dividend, and since the capability of the industry to continue its life depends upon its concurrent capability to earn dividends, it may logically be argued that the serious droop in the latter direction may be safely regarded as an indication that its vitality is on the wane. Every effort has been made to keep on the up-grade, because it was realized that once a sign of serious falling off became visible, all hope of ever recovering would practically be gone. The brains and the energies of the administration have, therefore, been turned from one point to another until it may be said with certainty that all the obvious remedial expedients have had a trial. In the past ten years we have seen the adoption of:

The tube-mill, with increased stamp-duty and higher gold-recovery.

Heavy stamps, with lower capital outlay and greater unit-efficiency.

Hand-stoping in narrow stopes, with less waste rock and therefore higher-grade mill-ore.

Machine-stoping in wide stopes, saving hand-labor, and giving large tonnage at low cost.

Selective mining, to give the maximum possible profit in the shortest possible time.

Central power-plants, to reduce the cost of energy.

Central administration, to reduce management charges and to increase general efficiency.

And what has been the result of it all? Certainly largely increased capital outlay, and equally certainly

much greater tonnage of rock handled, and undoubtedly a reduced 'working cost' per ton, but unfortunately a lower yield per ton and a smaller profit per ton.

There has been great argument as to the relative merits of big tonnage and low-grade ore, as opposed to small tonnage and high-grade ore. The objection to the former policy is that it has entailed heavy capital outlay and that it has led to the milling of much worthless rock. It is claimed, moreover, that any advantage thus gained in operating cost has been more than offset by dilution of grade. Against these arguments it is contended that 'working costs' have been reduced with the result that lower-grade ores could be worked at a profit.

Limits of Wholesale Mining

Without a doubt the practice of increased tonnage at any cost has been carried, in some cases, too far. There is a critical point naturally in the relationship of the tonnage milled per day to the economic working of any mine, but in arriving at this point, due weight must be given to a number of contingent factors such as labor, number of shafts, development facilities, etc., and any one of these may in itself set a limit to the possibilities. That is to say, it might be figured that a property containing a probable billion tons of ore would appear to be unsuitably equipped if it had a plant of only 100 tons per day capacity, and certainly, on the basis of working out the mine in any reasonable 'life,' it would appear to be so; but, for the reasons bound up in the contingent factors, above indicated, it might be quite impossible *efficiently* to handle more than 100 tons per day. In such a case, an equipment of 200 tons capacity would probably lead to inefficient work in the attempt to keep that plant running full time, and the result would be disappointing from every aspect. Apparently this is what has happened in many instances on the Rand. Shortness of labor, coupled with other difficulties, has forced managers to resort to all forms of expedients for keeping their mills running—the commonest evil being the inclusion of waste-rock with the mill-ore. Waste not only costs just as much to crush and treat as ore, but whereas it contains nothing when it comes to the mill, it has actually carried with it some of the precious metal when it is finally dumped. It has, therefore, substantially swelled the monthly statement of working expenditure, and has simultaneously appreciably reduced the revenue—both very undesirable results. Personally I hold the opinion that it is largely for this reason that, in several instances on the Rand, the increase of milling capacity has been attended with unsatisfactory results, and the degree of the disappointment is only properly realized when allowance is made for the amortization

of the additional amounts of capital involved. Take, for instance, the case of a company crushing 300 tons per day for 320 days per annum with a 20 years' life. Assume it increases its capacity to 600 tons for an outlay of £120,000. Without charging any interest, this sum would represent in its redemption an amount of 1.3 shillings for every ton of ore milled during the rest of the life of the mine, and if a reasonable rate of compound interest be allowed it becomes a correspondingly more serious matter. Unless a mine is in a position adequately to satisfy the demand for the larger tonnage, therefore, without undue strain at any point, it cannot do it to advantage. Hoisting shafts, surface and underground ore-stations, stope-faces, tram-levels, breaker-stations, etc., are all called upon for extra duty, and it has not infrequently occurred that, while the treatment plant has had its capacity doubled, nothing has been done relatively to increase the capacity at other points, and the management immediately upon starting its new equipment, has found itself in serious trouble with no possibility of saving the situation except by shutting down—a resort too alarming from the stock market standpoint to be feasible. In shaft-work alone the additional time required for introducing and clearing the increased number of underground laborers, and handling the extra amount of tools, stores, etc., is in itself an important matter—especially in deep mines—that must be considered before the question of handling extra milling and development rock is solved.

Then again the demand for largely increased development area and number of stope-faces has in many cases not been properly met. In short, while every care has been bestowed upon the reduction plant, the tendency has been to neglect the more vital underground part, with the result already indicated.

A legitimate increase in milling capacity, consistent with the other features specified, must be beneficial to the business side of the profit-and-loss account, but it may easily be conceived from the foregoing remarks that an ill considered, or one-sided increase, might not only fail to secure any real benefit, but might even do great and lasting injury; and when this was done merely to follow out a fashion that had for its object the automatic lowering of working cost, there is no doubt that it was unprofitable.

Investors might therefore have been saved a large amount of capital outlay that indirectly has had to come from their pockets.

The Labor Shortage

The labor difficulty has been more serious than is realized by most people outside the Rand, and ever since the repatriation of the Chinese, there has been a shortage in the supply. It will be remembered that at the end of the Boer war, there was a great deal of optimism regarding the supply of native labor, and the leaders of the industry, men of great experience, were confident that with the declaration of peace would come a big inflow of natives. In this they were disap-

pointed. When it became clear that the supply was unequal to the demand, recourse was had to Chinese labor. The initial cost of the introduction of this labor was exceedingly heavy, first because of the stringent regulations in regard to housing and feeding, and the control generally, and, secondly, because of the inexperience of the coolie in mining. No sooner had the industry fought its way through these difficulties than the Chinese labor question became a political gambling counter, and most unjustly it was decreed that the coolie must be repatriated. Thereupon the old difficulty in regard to native labor was renewed, and the industry suffered a serious misfortune, and incidentally a number of the mines, whose equipment had been increased on the assurance of a full labor supply, found themselves unable to keep their mills adequately supplied with clean milling ore. Wider stoping and the more extended use of machine-drills were adopted to meet the difficulty, with the results already indicated. Unfortunately, the average width of the orebodies of the Main Reef series is low, especially in the higher-grade stopes, and the shattering effect of blasting heavy machine-drilled holes inevitably led to the inclusion of much fine waste-rock that defied the closest sorting operations.

The Interest Charge

From the financial aspect, the increase of milling equipment necessitated the finding of large sums of money and led to watering of capital on a big scale. The money was either obtained by the issue of new shares, or by borrowing at fairly heavy rates of interest. In the former case, the dividends had to be distributed over an increased share capital; in the latter case, profits had to be absorbed over long periods for repayment of the loan. Since the increased profits were not commensurate with the redemption of the increased capital, the shareholder naturally suffered. The issue has been obscured, however, because of the practice of declaring 'working profits' per ton—an arbitrary figure that takes no cognizance of either capital redemption or dividend distribution. A good deal has been written on Rand methods of book-keeping, and it has been shown* that on the monthly profits declared by the various companies approximately only 60 to 80% is actually distributed in dividends. Custom regulates practice in the matters, and once having begun the policy of issuing this form of statement it became almost impossible to alter it. The term 'profit,' however, if it be rightly interpreted, permits of none of these fanciful constructions, and the use of the word on the Rand has, therefore, been incorrect and calculated to mislead. Many mines have been in the habit of declaring 'monthly profits' when the amount of such 'working profit' would not nearly cover a conservative contribution to the interest and redemption fund; in other words, while declaring 'working profits' the company was actually losing money. While there may be, and doubtless is, much to be said from the financial

*In *The Mining Magazine*, for example.

expediency point of view, in favor of running a 'working account' that makes no provision for capital redemption and that permits of independent current capital account, there can be no argument as to what, in the strict business sense, the practice should be. So long, however, as custom permits, there is little probability of a change.

Selective mining, like increased milling capacity is, in principle, easily capable of abuse, although frankly, I am of the opinion that for the Rand a little more of

is found in the deep levels today. In effect, therefore, the average grade of the ore on these levels in comparison with the average grade down to the lowest workable depths would represent a selected product, or, in other words, to reproduce the same average grade of ore from the lower levels, would, under present conditions, require a great deal more selection.

It has been argued, in fact, it is still argued by some, that there is no diminution in the grade of Rand ores as depth is attained, but the argument can hardly be sup-



HEAD-FRAME OF THE CASON MINE, EAST RAND PROPRIETARY, A TYPE OF THE NEWER CONSTRUCTION ON THE RAND.

the former and a lot less of the latter would, all things being considered, have been better. So long as selective mining is followed on the principle which has for its foundation the desire to earn the maximum profit, and into the calculation of which all those essential considerations of capital redemption and working expediency are included, so long and so far will it be profitable. There can be no law laid down for its universal application, because the conditions are never quite the same in any two mines, and each must be figured out on its own merits.

In the earlier history of the Rand, and in the shallower zone, nature had so arranged matters that in most cases selective mining was imperative, that is to say that owing to surface concentration, the proportion of high-grade ore on the upper levels was greater than

ported by a reference to the facts, and indeed it requires only a cursory study of the statistics over the past few years to be satisfied on this point. On several occasions lately I have not hesitated to express my views in this connection in writing, and in 1911 F. H. Hatch, the well known geologist made the following statement:

"I have not been able, with the material at my disposal, to come to any definite conclusion on this point; but I am inclined to the view that a general impoverishment in depth does exist. It would be quite possible, from existing records and assay-plans, to settle this really vital question; but hitherto no figures relating thereto have ever been published by any of the big houses."

It is interesting to note that very recently one of the

largest of the groups† on the Rand included in its technical statements the following:

"There can be no doubt that there is a gradual falling off in the average values over large areas of the ore developed as the deeper sections of the Rand are opened up, and the time will come when the full importance of considering every point which will tend to the lowering of costs for the successful treatment of enormous quantities of low-grade ore, will be realized by the Government and the general public of South Africa at large. This fall in average grade with depth at the individual mines has been shown to be true, not only by the screen samples of the ore milled, and by the re-

tracted from the Chamber of Mines' past records, and dealing with the dividends paid on the capitalization of some of the most successful companies speak for themselves:

Name of company.	Dividend return on capital.
Ferreira	4415%
Crown Reef	2404%
Johannesburg Pioneer	2107%
Wemmer	1237%
Meyer & Charlton	1105%
Durban Roodepoort	1100%

As evidence of the magnitude of the operations of some of the companies, the following is interesting:

Name.	Issued capital.	Tons crushed.	Gross production.	Value per ton.	Dividends distributed.
Robinson	£2,750,000	5,971,075	£17,378,969	58/3	£9,574,688
Village Main Reef	472,000	5,475,566	11,271,376	41/2	2,911,943
Crown Mines	940,106	15,908,724	29,540,128	37/2	3,807,428
East Rand Proprietary	2,445,897	14,097,016	23,157,114	32/10	3,655,138
Goldenhuis Deep	585,753	10,177,511	16,842,039	33/1	1,969,853
Randfontein Central	4,193,700	10,956,484	15,687,985	28/8	209,685
Simmer & Jack	3,000,000	8,681,486	13,122,964	30/3	4,566,461
Meyer & Charlton	200,000	2,132,701	4,026,446	37/9	1,155,308

Note: These are only some of the best; there are many others.

covery value per ton, but by the careful sampling and assaying of level by level in each mine as greater depth was reached, by careful sampling of stopes on each level sending ore to the mill, and by the yearly recast of the ore reserves in each mine."

The mere fact that high-grade ore is still found to occur in the deep levels is of no weight in the argument. The question is one of average width and value per foot of linear development, and the available evidence of a gradually falling grade, so far as my information goes, appears to be overwhelming. But, to my mind, there is nothing extraordinary in this; on the contrary, it is in keeping with all mining history, and is, in the nature of things, to be expected. And surely it is better to have had miles of high-grade ore-shoots of lateral continuity than isolated and narrow vertical shoots descending miles on the dip. The question requires no discussion.

Out of a total production of £347,054,851 from 1887 to 1912, dividends amounting to £88,159,489 have been paid, equivalent to about 25% of the gross production. From 1890 to 1912 the world's production had risen from £24,421,000 to £98,267,000, and of this latter figure the Rand is responsible for roughly 40%. Of the total increase in the year 1912, as compared with the year 1890, therefore, the Rand, single-handed, is responsible for as much as the rest of the world put together—a remarkable record truly, and it is difficult at the moment to see from what source any falling off from the Rand is to be made good, for in the last few years there has been such a dearth of new heavy producers as to make the present outlook rather black.

Some of the individual performances of the Rand mines have been splendid. The following figures, ex-

In a comparison with other goldfields of the world the Rand, considered as a whole, has no parallel, either in the nature of its formation or its magnitude. True, auriferous conglomerate occurs in several other localities in South Africa and also in the United States, but only very limited areas have proved capable of being worked at a profit. The mines of the Rand, with the exception of the main east and west breaks, are divided merely by boundary lines, and the Rand may be looked upon as one immense mine, arranged for division of ownership and convenience of working into a number of small units. At Butte there is something of the sort on a smaller scale in the copper mines; and at Pachuca and other places in Mexico, in silver mines; and at Kalgoorlie in gold mines; but there is nothing really comparable with the Rand. Out of the first 60 gold mines of the world over 30 are on the Rand.

I have been among those who have, in the past, pointed out the advantages of having the mines tied one to the other like a string of beads. The obvious advantages are so obvious that to think anything different at this stage seems rather feeble. But, frankly, I do not feel quite so sure about it, not that I dispute the obvious advantages at all—they are actual without a doubt—but I think that some of the disadvantages that are not so obvious may be just as material or even more so. When two engineers are left to battle by themselves with a given problem, it is possible that they both may arrive at some original solution, but if the two work together on it, the weaker or the less industrious one may be tempted to lean on the other, or, for other reasons, one of them may utterly fail where, if he had been left with the responsibility, he might have accomplished something. A tour of inspection along the mines of the Rand must impress even a casual observer with the fact that there is a faithful reproduction of

†Consolidated Gold Fields report by H. H. Webb of South Africa.

method as between mine and mine. In fact, duplication everywhere is so patent that the observer could not be surprised to learn that the design had emanated from a very few individuals. This in itself might not always be a bad thing, and assuming that the responsible men in charge of the laying out of the development and equipment were invariably right, then there could be no question as to the benefits of the system. But if these men should have been obstinately wedded for sentimental reasons to methods or designs that, from a practical aspect, were opposed to the best knowledge available in other parts of the world, persistence in such an idea might conceivably cause an enormous amount of useless expenditure. Furthermore, the policy of leaving the responsibility of these things in the hands of a few is apt to lead to the stultification of ideas on the part of subordinate engineers.

Engineering Versus Profits

There can be no doubt that a great deal of excellent work has been achieved on the Rand from the engineering standpoint, but it cannot be denied that the expenditure on capital account has in many cases grown out of all proportion to the real requirements, and to some extent the proximity of the mines to each other is responsible for them. While the metallurgists of the Rand have been spending millions in covering large areas with heavy, expensive, and cumbersome percolation cyanide-plants, and decantation slime-plants, other countries have been able successfully to evolve, under much more trying conditions, and often with meagre financial resources, new systems of treatment on more complicated ores even with great profit. The Rand, since the introduction of the cyanide process in the early days, has done practically nothing to add to the glory of engineering achievements. It has rather followed a policy of sticking to the one old principle and developing the details of that principle to the last limit. In my opinion, and I share this with a great many other engineers, the Rand might have saved itself a large amount of capital outlay if it had adopted immediately after the war, for the treatment of its unusually simple clean ores what has been accepted all the world over in the last ten years, namely, the one-product one-treatment method. The real truth of this matter is obscured by the fact that metallurgical working costs do not on the Rand take into account the amortization of capital expenditure, and, therefore, no matter how absurdly high that expenditure may have been, the real meaning of it has not been realized. It would be safe, however, to say that there are instances on the Rand in which, if this principle be applied, the redemption figure per ton treated would amount to almost as much as the stated figure of 'working cost,' and it is just as real a figure, although not shown, as the other one. If the mines of the Rand had been more isolated, individual effort would have been greater, competition keener, methods more original, expense much less, and profit correspondingly much greater. I am making no personal attack in these remarks, being

in many respects perhaps as responsible, and therefore as blameworthy as many others, but I put it down to a system that could only have arisen out of the proximity of the mines.

In heading these notes 'The Decline of the Rand,' it must not be inferred that I am pointing to any precipitous ending of the industry; I believe firmly, as before stated, that the Rand will die very hard, and, for many many years to come, it will hold the place of pride in the world's gold production. It is not possible, of course, to foresee what new methods may arise in the treatment of ores to lower the cost of production, but it may be taken for certain that as the margin between expenditure and revenue becomes narrower, so will the effort to keep them apart increase, and ways and means that are not known today will be born of necessity to keep the industry still alive. It is fashionable to talk about the possibility of treating the untold millions of tons of ore lying in the Kimberley Reef series, and it is a fact that even up to now this series has been able to produce quite an appreciable tonnage of pay-ore. There is always, however, a limit to what is feasible under given conditions, and the one great limiting factor of the Rand is the comparatively narrow average stopable width. To get tonnage on narrow orebodies means extensive development, and costly mining, and even with heavy reductions in the cost of materials such as explosives and so forth, one cannot at present see that it can ever amount to enough to make 2 or 3 dwt. ore cover all expenditure, and return a reasonable interest on the money invested. Failing the discovery of new deposits therefore, the end, though not in sight, is within the limits of approximate calculation even after liberally discounting for new unforeseen favorable conditions.

Decline in Speculation

Probably the worst feature of the decline is that speculative interest gradually dies out, and it is difficult to interest the public sufficiently to get their purse-strings loosened for new capital requirements.

With the channels of fresh capital dry, the encouragement to lay out money on attempting new expedients for the reduction of working costs is little, and those now in financial control will probably be inclined rather to keep down all new capital expenditure to the narrowest limits, leaving the bulk of the present producing mines to end their lives with the barest maintenance of their existing equipment. This, of course, is always assuming, as before stated, that there is no new and startling discovery of some unforeseen nature, favorably affecting the question of working cost, because, after all, that is the crux of the whole of the problem now facing the Rand. My summarized reading of the indications is that the gross output, like the dividends, will soon begin to decrease, and the drop will be steady, though sure.

Finally, the Rand industry is like a great man who even in his declining years has still stood head and shoulders above everybody.

Hydro and Pyro-Metallurgy of Copper in 1913

By THOMAS T. READ

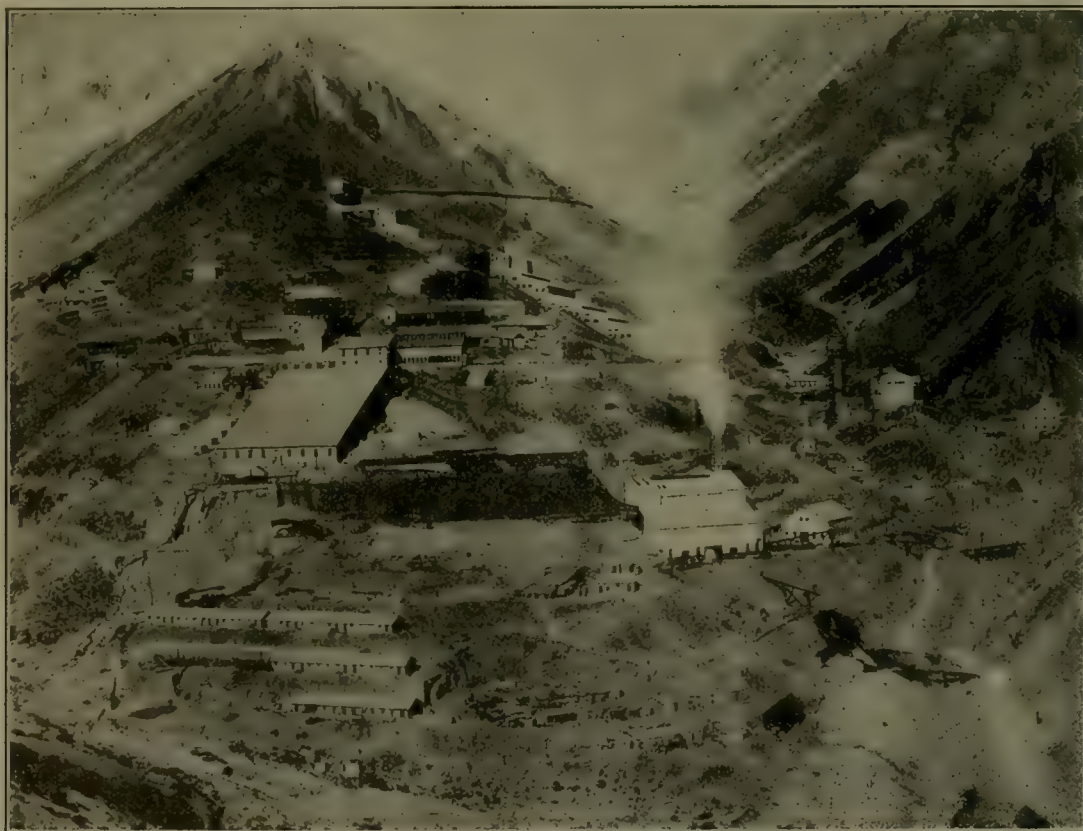
I. Hydro-metallurgy

It is somewhat illogical to place the discussion of the hydro-metallurgy of copper before that of ordinary smelting methods. But this reversal is perhaps justified by the present keen interest in wet methods for the extraction of copper from its ores, arising from the necessity for devising some means to recover the copper present in the form of oxidized minerals in the enormous tonnages of low-grade ores now being mined and milled in many different places. The oxides, carbonates, and silicate of copper are all rebellious both to ordinary wet concentration and to flotation, and the use of hydro-metallurgical processes seems the only possible means of effecting the recovery of their copper content. The general criteria of the hydro-metallurgy of copper has been discussed at some length in these columns on several occasions,¹ and needs no further references. All the most promising

of recent work has centred around leaching in sulphuric acid solution. The simplest method, to be applied on the largest scale, is that proposed for the brochantite ore of the Chile Copper Co. at Chuquicamata. This has already been described at some length,² but may be summarized by saying that careful large-scale experimental work done by E. A. C. Smith has demonstrated that the copper content of this hydrous sulphate of copper can be extracted by leaching the ore, after crushing to 3-mesh, with 8 or 9% sulphuric acid solution. This is to be done in concrete vats holding 9000 tons each, and it is estimated that one day will suffice for filling, two or three days for leaching and washing, and one day for discharging, which is to be done with clam-shell buckets. The copper in the pregnant solution will be precipitated electrolytically, a 40,000-kw. generating station on the seacoast and a 100-mile transmission line being already under construction. This ore contains no gold, silver, bis-

¹'Wet Methods of Copper Extraction,' Editorial, Sept. 21, 1912; 'Sulphuric Acid Leaching,' Editorial, Aug. 16, 1913; 'Leaching of Copper Ores,' John Rooke-Cowell, Aug. 23, 1913.

²'Leaching of Copper Ores in Chile,' Editorial, *Mining and Scientific Press*, June 21, 1913.



BRADEN MINE, MILLS, AND SMELTER, RANCAGUA, CHILE.

mith, arsenic, or antimony and, being a sulphate, the solution builds up in sulphuric acid, so that acid consumption is *nil*. Small amounts of chlorides and nitrates are present and cause difficulties which have been successfully overcome, but the means by which this is done have not yet been disclosed.

Leaching work at the Braden has been delayed by more urgent problems, and the necessity of using the available electric energy for other purposes. E. A. Cappelén Smith has recently described the proposed process as follows: "The process decided on was roasting of the concentrate in a Wedge furnace in such a manner as to eliminate practically all of the sulphur and at the same time oxidize all the iron to the ferric state. The concentrate, after roasting, contained 2 to 3% sulphur, practically all in the form of sulphate, 15 to 18% copper, and about the same amount of iron, of which only a very small amount was present in the ferrous state. The roasted concentrate was leached with dilute sulphuric acid, the leaching operation being divided into two stages: first, neutralizing leaching; second, acid leaching. The solution from the neutralizing leaching was electrolyzed direct, whereas the solution from the acid leaching was neutralized by the following batch of calcines. Several leachings made in the plant indicate an extraction of between 90 and 95% of the copper present in the concentrate."

Leaching at Butte

The most interesting announcement of the year³ was that roasting and leaching with sulphuric acid, following a method devised by Frederick Laist, was to be tested on a large scale for treating the tailing from wet-concentration processes at Anaconda. An 80-ton experimental plant was constructed, and the results of the first work were published⁴ during the summer. As this paper is readily accessible and contains many important details, it should be read by all. Briefly, the process consists in drying the tailing from wet concentration on the upper hearths of a McDougall roaster, adding salt, and roasting at a low temperature to keep down the volatilization of copper chloride and the production of ferrites. The calcine is then leached with sulphuric acid solution. Experimental work later in the year has been highly successful. It was at first proposed to precipitate the copper from this solution by H_2S , thus regenerating H_2SO_4 , but more recent work indicates the desirability of using an iron sponge produced by reducing 20-mesh calcine with coal dust in a McDougall furnace. The sulphuric acid required for leaching is to be made in lead chambers, from the SO_2 gas obtained in roasting rich coarse concentrate, at an estimated cost of \$4 per ton. Tentative plans for a 2000-ton plant are well advanced. As a result of the success of this work experiments along similar lines are being made at several places.

In preceding years I have usually closed the dis-

³Editorial, *Mining and Scientific Press*, May 3, 1913.

⁴'Roasting and Leaching Tailings at Anaconda,' Frederick Laist, *Bull. Amer. Inst. Min. Eng.*, July 1913.



CANAL, GATE SPILLWAY, AND AUTOMATIC SPILLWAY.
PENSTOCKS AND POWER-HOUSE, BRADEN MINE.

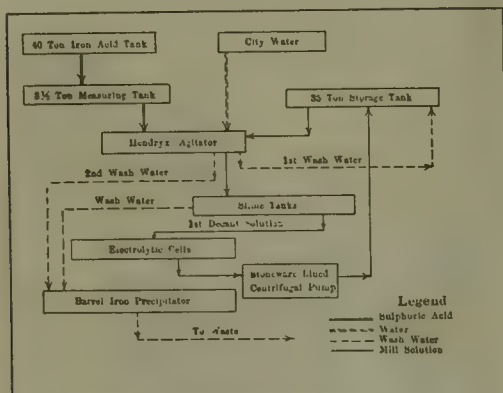


DAM AND INTAKE HOUSING, CACHAPOAL RIVER; BRADEN POWER PLANT.

cussion of this topic with an expression of hope that by the following year details of the practical operation of leaching plants would be available. That hope has at last been rewarded, P. E. Peterson² having published descriptions of the Butte-Duluth and Bullwhacker plants, which were erected at Butte last year. It is to be deplored that these descriptions do not include any account of the numerous difficulties encountered in the early operation of these plants, as being more helpful to operators elsewhere than the methods found successful. These plants operate under special conditions, in that they treat silicious ore comparatively free from the iron oxides present in ordinary oxidized ores. The Butte-Duluth plant is 100-ton and

where it is heated to 60°C., and thence to the electrolytic cells. Each of these is 30 by 39 in. and 8 ft. long, lined with hard lead, and provided with 20 anodes of hard lead, weighing 20 lb. per square foot. The cathodes are ordinary starting sheets of copper. The current density used is 12 to 13 amperes per square foot, and the cathodes assay 99.96% copper, according to Mr. Peterson. The present cost is estimated by him as 14c. per pound of copper, but he thinks this can be considerably reduced, as the sulphuric acid required now costs \$27 per ton or 43½c. per pound of copper produced. If locally manufactured on a large scale, the sulphuric acid should not cost over 1½c. per pound of copper. The percentage of extraction on the ½-in. ore was so low that it was necessary to abandon that method and for a little over two months now the following process is being successfully carried on.

The Company is building at the present time a 1000-ton dry-crushing plant to reduce the ore to 10 mesh. This consists of swing-jaw crusher, intermediate gyratory crusher, Symons disc crusher, rolls, and impact screens. The dry ore is fed to a mixer with



ORIGINAL FLOW-SHEET, BUTTE-DULUTH PLANT.

the Bullwhacker 125-ton. In the former the ore is crushed, by gyratory and Symonds disc crushers, only through a ½-in. screen; in the latter it is reduced by rolls until it passes 16 mesh. The ½-in. ore is dumped into V-shaped leaching vats, provided with a filter bottom of boards bored with 5/8-in. holes. After leaching with acid, the vats are discharged through doors in the bottom. The solution is drawn from the vats, allowed to settle, elevated to lead-lined tanks,



CENTRAL MONTANA.

²Min. Eng. World, Sept. 6 (p. 423) and Oct. 4 (p. 585), 1913.

approximately four times its weight of 8 to 10% sulphuric acid which discharges to a Dorr classifier, which is the first of a series of 6 arranged in such a manner that the sand will discharge from one into the next. Various times of contact with the acid in the first four Dorr classifiers were tried out and it was found that approximately 40 minutes gave an extraction between 85 and 90%. The last two classifiers, No. 5 and 6, in the series, are used for washing. The overflow from No. 5 is used to make up for the loss of acid in the strong acid solution.

The overflow from No. 1 classifier carries off approximately about 13% of the total weight of ore as slime. This, as well as the overflows from classifiers 2, 3, and 4 are run to the acid leaching-tanks in the bottom of which is a layer of crushed ore to act as a filter. The underflow from these filters passes to the electrolytic cells and on to the strong acid storage-tanks where the solution is brought up. This method of running the slime to the acid leaching-tanks is only temporary as later on it is intended to recover the dissolved copper content by passing this pulp through a series of Dorr continuous thickeners operated so as to give counter-current washing.

Handling Acid Solutions

The second water wash, which is applied to the last classifier, goes to scrap iron precipitation. The sand discharged from the classifiers approximates 18 to 20% moisture. No. 1 classifier in the series is a machine 30 ft. long by 4 ft. 6 in. wide. The rest of the classifiers are of standard duplex size, 15 ft. long by 4 ft. 6 in. wide. These machines are built with wooden boxes and all moving parts that come in contact with the acid, also built of wood (hard maple). The wear of the wooden teeth is surprisingly small, but experimentation has shown that plate glass teeth are the proper thing to use here, and will be installed in any future classifiers built for this purpose. This series of 6 classifiers is operating at the present time and has a capacity of approximately 200 to 220 tons per 24 hours.

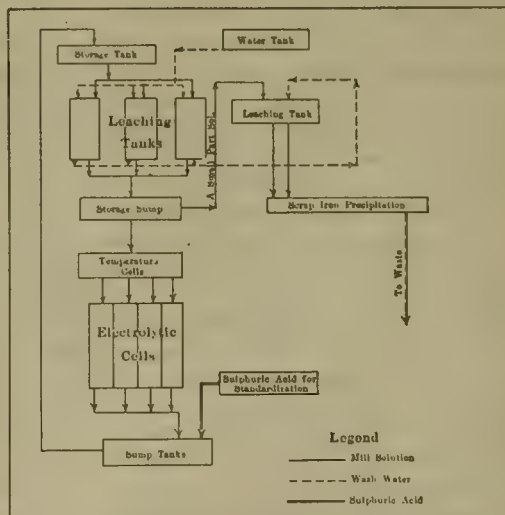
The Dorr Cyanide Machinery Co. is building another series of 5 machines each 30 ft. long by 8 ft. wide, which should have a capacity of 400 to 500 tons of ore per day. At the present time strong acid solution is being added with the ore to No. 1 classifier, but later on this practice will be altered and the overflow from No. 5 Dorr classifier will be mixed with the dry ore; the advantage of this being that the strong solutions can be kept from coming in contact with the slime, the weak acid solution not taking iron and aluminum into solution so readily as the strong. All solutions in the plant are kept at approximately 55° C. The cost of this in the northern winter climate is likely to form a considerable item of the total working cost.

At the Bullwhacker plant, which is near by, the ore, crushed to 16 mesh, is agitated with 10% H_2SO_4 solution, 2 tons of solution to 1 of ore, in a Hendryx agitator. This agitator is to be replaced by Dorr classifiers when the plant is enlarged. The effluent solu-

tion, containing as much as 4 to 5% copper, is decanted from settling tanks, and sent to electrolytic cells which differ from those previously described in being circular, 9 ft. in diameter and 5 ft. deep, holding 24 cathodes. About half of the copper content of the solution is deposited electrolytically, and it then goes back to be used for further leaching. The cost of production of copper is here also about 14c per pound.

Difficulties in Leaching

The difficulties of the method employed in these two mills are, perhaps, not unnaturally, not discussed at length. They may be summarized as follows: fine crushing is necessary in order that the copper minerals shall be completely soluble, but leads to the production of colloids ("slime") which make the solution cloudy and difficult to settle. It is, of course, impossible to deposit a pure cathode from a solution containing impurities. The leached ore is difficult to wash for the same reason, and also because the use of wash-water involves the discharge of solution, which ear-



FLOW-SHEET, BULLWHACKER PLANT.

ries away with it not only the expensive sulphuric acid but copper as well. This copper can be precipitated on iron, but the consumption of iron by the acid cuts down the net return. The difficulties and excessive consumption of energy in precipitating copper electrolytically when using an insoluble anode are too well known to need repetition. Here the resistance of the solution has been decreased by preheating it, and its conductivity is kept as high as possible by only precipitating half of the copper present. At several other mines, notably the Nevada-Douglas, preparations are being made for the construction of similar plants, but it is not to be expected that these can be put into operation without first solving local problems.

At nearly every important copper mine in the West some member of the chemical or metallurgical staff is

studying hydro-metallurgical problems in the light of local conditions. The work at the Shannon, Calumet & Arizona (Ajo), Arizona Copper, and Braden mines was described in my review for last year, and no reports of progress have since been given out. At the Keystone and Inspiration, both a Miami, interesting work is being done. J. Parke Channing has described this work in the *Bulletin of the Mining and Metallurgical Society of America*. R. C. Canby, at the Keystone, suggests the possibility of using cast-iron hearths as at the Steptoe Valley smelting plant, later mentioned, in the McDougall roasting furnaces, so that the fuel used on one hearth would better heat those above. He proposes to use a special design of burner which will permit the use of oil as a fuel along with the maintaining of a low temperature on the hearth. At the Copper Queen the leaching of low-grade ores is also being studied.

Leaching at Ray

W. Y. Westervelt describes in some detail, in the November *Bulletin of the Mining and Metallurgical Society*, the following record of a 33-day test on the average ore at the Ray mine in Arizona.

"The ore in the vats at the beginning of the tests was carefully sampled and assayed by the vat. That added during the test was weighed, sampled, and assayed by the vat charges of 200 lb. each. Tailing rejected during the test was sampled, and assayed by the vat discharged. The ore remaining in the vats at the end of the test was sampled and assayed by the vat.

"At the beginning of the tests the solutions in the vats were carefully drawn off, measured, and sampled. The same was done independently with that in the electrolytic tank, and again independently with that in the storage tanks. All acid added (commercial 66° B. sulphuric acid) was carefully weighed as added. Additions of water were measured, the condition of the solution was daily determined by assay, and on completion of the test, complete measurement and assay was again resorted to.

"The electrolytic copper was deposited on copper cathodes previously made from the Ray ore by stripping the deposition on rolled copper sheets. These cathodes were removed and weighed daily. The voltage maintained at the tank was determined hourly by a Weston voltmeter capable of being read to 0.01 volt. The amperes were determined both by hourly readings of a Weston ammeter and by checking against the daily weighings of a standard copper voltmeter.

"The heating was done solely in the leaching vats by means of closed lead-pipe coils placed in the bottoms. Steam was supplied to these coils from a main line running over the five vats and the condensed water was all secured by connecting the ends of the coils with the main drain pipe, the latter itself discharging into a measuring can. The steam supply was regulated by a valve to each coil, as was also the discharge into the drain pipe, by another valve. The drain pipe itself, in which the condensed water accumulated, was kept

closed by a valve so that no uncondensed steam could escape.

"The ratio of volume to surface of the vats employed was 3.03, while that of 26-ft., 100-ton vats is 0.487, or less than 1/6. In other words, the heat radiating and conveying surface of the experimental plant was over six times as great proportionately as would be that of a 100-ton vat plant. Again, the evaporative surface of an operating plant would not be 1/4 as great proportionately as that of the experimental plant, while a considerable part of the steam condensing surface in the experimental plant was outside the vats, thus doing no



MAP OF ARIZONA.

work, while registering as condensed steam. Due allowance was accordingly made for these which may be summarized as below:

Copper deposited, total run	40.28	lb.
Copper deposited, per diem	1.22	"
Amount ore in vats	1000.00	"
Copper deposited per diem, per ton in vats (0.122%)	2.44	"
Days required to extract 40 lb. per ton	16.4	days
Acid consumed	91.4	lb.
Acid consumed per pound copper deposited..	2.27	"
Ampere-hours consumed	22,382	
Ampere-voltage	1.7	
Kilowatt-hours	38.0494	
Kilowatt-hour per pound copper	0.945	
Ampere-hours consumed per pound copper....	556.0	
Steam condensed per pound copper deposited.	33.0	lb.
Extraction	80%	
Average temperature of vats	72°C.	
Assay of tailing	0.3%	

The Bradley leaching plant at Anaconda has

closed down, having proved a failure. The various other patented processes seem not to have made much headway during the year. The McKay process, which is now being developed by Archibald Carmichael, was under investigation by important interests, but it is reported that negotiations have been dropped. The owners of the Alexander process are carrying on experiments, but have made no report of progress. The same may be said of the Robertson process. The Irving process is elsewhere described by L. S. Austin. The leaching of the copper contained in the burned cinder from sulphuric acid making is being done in a number of places, but is quite a different operation from the leaching of raw or roasted ore. In the precipitation of copper from mine-water, J. W. Richards has suggested that if the scrap iron used for this purpose were laid upon sheets of copper, a galvanic couple would be established and the surface of the iron kept cleaner and consequently more efficient. It is proposed to use sponge iron for this purpose in place of the usual scrap iron, but the experiment has not yet been made. In conclusion, it may be said that the experimental work at Anaconda has demonstrated the possibility of roasting sulphide tailing at a low cost, and the leaching plants at the Bullwhacker and Butte-Duluth have demonstrated the practicability of sulphuric acid leaching and electrolytic precipitation for oxidized silicious ores, with prospects of attaining a low cost. It must not be forgotten, however, that local conditions create fresh problems at each mine.

II. Pyro-Metallurgy

The year 1913 has been made notable in copper metallurgy by the great number of important papers on that subject which were called out, largely through the efforts of B. B. Thayer and C. W. Goodale, in connection with the meeting of the American Institute of Mining Engineers. These papers contain so much of interest that it is impossible in the space available to discuss them in any detail. In blast-furnace smelting, J. A. Church, Jr.,⁶ has described the development of the blast-furnace at Great Falls, Montana, to a width of 7 ft. R. P. Roberts⁷ has discussed the thermal effect of blast-furnace jackets. The problems of blast-furnace smelting at high altitudes has been discussed by Vincente Pazos y Sacio,⁸ who points out how the decrease in pressure due to altitude decreases the temperature of combustion within the furnace so that "oxidizing smelting in Peru today is nothing but pot-roasting carried to fusion at the expense of fuel." He suggests the use of back pressure on the blast-furnace, hot blast, and the reducing to a minimum of radiation and conduction losses. Herbert Lang has discussed⁹ the possibility of the use of crude oil in blast-furnace smelting, but no new experimental data have been made public during the year. The use of electric

furnaces in the smelting of copper ores is being exhaustively studied by the United States Bureau of Mines, and D. A. Lyon and R. M. Keeney, who are in charge of this investigation, presented a preliminary paper¹⁰ at the Montana meeting of the Institute and a general discussion of much interest before the Denver meeting of the Electrochemical Society.¹¹ I have already discussed¹² this at some length. The metallurgical profession is greatly indebted to the Bureau of Mines for undertaking the study of so timely a topic upon a scale which would not be practicable in connection with ordinary metallurgical operations.

Roasting

Two important papers on roasting have appeared during the year. S. S. Sorensen has described¹³ the roasting practice at the Steptoe Valley plant, where, in order to economize on the heat balance when roasting concentrate low in sulphur, air cooling was substituted for water by boring holes in the rabble arms and blowing air through them, at 2½-in. pressure, by the aid of a fan. Oil-firing was substituted for coal, and the lowest hearth was made of cast iron. As a result of these improvements the tonnage roasted was raised from 50 per day to over 100.^{*} These are 18-ft. McDougall furnaces. F. R. Corwin and S. S. Rogers have described¹⁴ the carefully conducted experiments by which the tonnage of the 16-ft. Evans-Klepetko furnaces at the Great Falls smelter was increased from 45 to over 100 per day, the limit being apparently the mechanical strength of the apparatus. This paper is full of valuable experimental data and should be consulted by everyone interested. I can only mention a few interesting points. The tests were first directed to merely increasing the tonnage roasted per furnace day, and it was found that this could be doubled by supplying sufficient oxygen, regulating the heat so the furnace would not get too hot, and by regulating the drop-hole area so as to avoid too great concentration of heat and too high a velocity of the gases through the drop-holes, which leads to the building up of heavy crusts on the roof of the hearths. The maximum proportion of screened raw ore to concentrate was then studied. By the use of compressed air, blown in through small pipes placed beneath the roof of the fourth and fifth hearths, and about 6% of slack coal mixed with the ore in the feed hoppers, raw ore containing 17½% sulphur could be roasted without the addition of any high-sulphur concentrate. The next investigation was directed at decreasing the amount of flue-dust made in roasting, with the result that by properly proportioning the drop-holes and by using 'spark-

¹⁰'Smelting of Copper Ores in the Electric Furnace,' *Bull. Amer. Inst. Min. Eng.*, August 1913.

¹¹'Possible Applications of Electric Furnaces to Western Metallurgy,' read before Denver meeting of the American Electrochemical Society; see *Mining and Scientific Press*, Nov. 1 and Dec. 20.

¹²Editorial, *Mining and Scientific Press*, Nov. 1.

¹³*Eng. & Min. Jour.*, June 25, 1913.

¹⁴*Bull. Amer. Inst. Min. Eng.*, July 1913.

⁶*Bull. Amer. Inst. Min. Eng.*, July 1913.

⁷*Bull. Amer. Inst. Min. Eng.*, July 1913.

⁸*School of Mines Quarterly*, July 1913.

⁹*Mining and Scientific Press*, Feb. 8 and July 12, 1913.

catchers' to prevent incrustations on the hearth roofs, the amount of flue-dust made was reduced from 18% to about 10% of the weight of the charge. Finally, reinforced concrete was substituted for brick in the hearth construction, with the result that repairs were greatly decreased, and incrustations were more easily removed.

In the field of reverberatory smelting, the most important paper of the year is that of S. S. Sorensen,¹⁵ who has given the result of a 3-months' comparative test of Sterling and Babcock & Wilcox boilers for the recovery of the waste heat of the gases in reverberatory smelting. This test showed that although the Sterling boiler is much more easily cleaned, the Babcock & Wilcox gives nearly 20% greater efficiency as a result of better arrangement of the tubes. I have already reviewed¹⁶ reverberatory smelting practice in the southwestern United States and will not again refer to it here. (Since this was written the reverberatory furnaces at the Calumet & Arizona and Arizona Copper smelters have been blown in, but none of the results attained have as yet been made public.) The substitution of coal-fired for gas-fired reverberatories at the Great Falls smelter is in progress, but none of the furnaces have yet been blown in. Presumably some interesting new data on reverberatory smelting will be available next year. As usual, L. D. Ricketts has given interesting data in his annual report of the operations of the Cananea Consolidated Copper Co. During 1912 the smelter handled 653,595 tons of new copper-bearing material at a cost of \$2.48 per ton. The reverberatory furnace handled 145,970 tons (62,147 tons flue-dust, 52,541 calcine, and 31,282 tons Miami concentrate) at a net smelting cost of \$1.66 per ton. The average charge per furnace day was 223 tons. These furnaces are 19 by 100 feet.

Sintering

In regard to the handling of fine ore, there is a tendency toward the increased use of Dwight & Lloyd sintering machines, good results in handling the sulphide in this way having been attained at the plants of the Tennessee Copper Co., which is using three machines, the Cerro de Pasco, which has six, and the Tacoma and Trail smelters, which have two each. The Mond Nickel Co. has recently started a single machine on its fine ore. The use of these machines to sinter flue-dust was discussed in my review of the subject for last year. R. L. Lloyd has published¹⁷ an interesting discussion of the criteria of sintering at high altitudes, and brings out the interesting fact that at 14,000 ft. elevation ore carrying as high as 25% sulphur can be sintered without the generation of excessive heat. It is also interesting to notice that at the new Arizona Copper plant two mixing cones¹⁸ will be used to mix fine silicious

material with converter slag before sending them both to the reverberatory furnaces. In this way the excess iron in the converter slag is to be made to serve as a flux for the excess silica of the fine. Converter slag continues to be a bugbear and nearly everybody pours it back into the reverberatory furnace or through the blast-furnace settler so that it will not hurt the professional pride of the technical staff, as it would do if allowed to run directly to waste. Where converter slag can be chilled and added to the blast-furnaces it doubtless serves as a flux, but, except for keeping the charge easily fusible, its rehandling offers little.

Converting

Converter practice has changed little during the year, except that at the plants where converters of the Great Falls type have recently been constructed the workmen and technical staff have learned by experience the details of their control. The Pierce-Smith converter has apparently regained some of the regard which it seemed about to lose last year, and in several plants very good results have been attained by its use. Converter practice at Great Falls has been described by A. E. Wheeler and M. W. Krejci.¹⁹ This should be read by every copper metallurgist. In the following discussion a number of other important points were brought out by other metallurgists. E. P. Mathewson²⁰ described the development of the basic-lined converter and Ralph Baggaley²¹ controverts his statements. It seems but just to believe that Mr. Baggaley should have the credit for first successfully maintaining a basic lining and supplying the necessary silica by the addition of ore, but his work was so mingled with financial disaster and the use of impractical forms of equipment that there will always exist a difference of opinion as to whether he made a success or a failure. None of those who developed the basic-lined converter perceived, until after success had been attained, that the essential feature is to use a large enough mass of matte so that its temperature can be maintained and controlled. In an interesting review of the development of converter practice,²² Herbert Haas has pointed out that Paul David deserves equal credit with Pierre Manhés for the first successful work in producing copper from matte in a converter, and draws attention to the fact, too often overlooked, that Hollway, in his classic experiments, was not attempting to make copper from matte, but to smelt sulphide ores without the use of fuel. Hollway should therefore be regarded as the pioneer in pyrite smelting, rather than in converter practice.

Smelting Mixed Sulphides

The treatment of complex mixtures of copper and zinc sulphides has been described at some length²³ by

¹⁵Bull. Amer. Inst. Min. Eng., Aug. 1913.

¹⁶Bull. Amer. Inst. Min. Eng., July 1913.

¹⁷Bull. Amer. Inst. Min. Eng., Nov. 1913.

²²'Development of Converter Practice,' *Mining and Scientific Press*, Oct. 25, 1913.

²³*Mining and Scientific Press*, April 12, 1913; Bull. Amer. Inst. Min. Eng., Aug. 1913.

¹⁸*Mining and Scientific Press*, Oct. 11, 1913; see comment by Hervey Gulich, *Mining and Scientific Press*, Nov. 23.

¹⁹'Copper Smelting Practice in the Southwest,' *Mining and Scientific Press*, Oct. 4, 1913.

²⁰*Mining and Scientific Press*, June 14, 1913.

²¹*Mining and Scientific Press*, Dec. 13.

S. E. Bretherton, who proposes to use, at Ingot, Shasta county, California, the Schnabel process of extracting zinc as oxide from the roasted ore by the use of ammonia and carbonic acid, smelting the leached ore in a reverberatory furnace. H. O. Hofman has pointed out²⁴ that this process was tried at Lautenthal, in the Harz mountains, and at Hoboken-les-Anvers, with the result that it was found impossible to compete with retort distillation. W. McA. Johnson has announced the successful conclusion of a large amount of experimental work which he has done at Hartford, Connecticut, in developing a continuous zinc furnace in which the zinc is distilled off, while the copper or lead present is drawn off as matte or bullion. It is expected that one of these will be put in operation in California during the coming season, and the comparative results of the two methods will be watched with the keenest interest.

Smelter Fume

The event of the year in advancing toward the solution of the smelter fume problem was the announcement²⁵ that the Hall process for the roasting of sulphides without the production of SO_2 was to be tried at the smelter of the First National Copper Co., Shasta county, California. This process consists in so controlling the temperature and admission of oxygen and steam into a roasting furnace of the McDougall type that the metals are oxidized while the sulphur is not, but distilled off and caught as flowers of sulphur. The early experiments were handicapped by troubles with the gas-producers used for making gas from crude oil, but these have been overcome and the outlook for eventual success seems bright. J. Nelson Nevius has published²⁶ a thoughtful study of the conditions in Shasta county, California, made for the Los Angeles Chamber of Mines and Oil. Edgar M. Dunn has described²⁷ the methods for the determination of the gases and dust in smelter flues in an important paper. James Elton²⁸ described the methods of the recovery of As_2O_3 from flue-dust practised at Anaconda, and C. W. Goodale and J. H. Klepinger have published²⁹ a detailed description of the Great Falls flue system and chimney, which is full of interesting details. The metallography of refined copper has been discussed by E. S. Bardwell.³⁰ The electrolytic refining of copper is mentioned elsewhere in this issue.

Actual progress, it is but fair to say, in the metallurgy of copper has probably not been much more rapid this year than in preceding ones, but the year has been made a red-letter one by the generous way in which metallurgists have contributed from their experience to advance the general good.

Electrometallurgy in 1913

By G. A. Roush

The advances in the various lines of electrometallurgy are so numerous, so diverse, and so widely scattered in the literature, that in the preparation of a review of this kind, all one can hope to do is to select some of the more striking discoveries in the more important fields to serve as illustrations of the general trend of the industry. What the breadth of these advances has amounted to, as measured from time to time, can probably be fully appreciated only when one considers the enormous development of electrometallurgy as it stands today, and measures up against it the comparatively short span of years through which this development has extended. By thus setting up the milestones, as it were, one secures a better idea of the general perspective into which this brief sketch of recent progress must fit.

Copper

So far as the current literature shows, there are no copper ores being treated at the present time in the electric furnace in this country. Trial smeltings of copper in a 1000-hp. furnace with an estimated production of 2000 tons per year have been reported from the Ilen Smelting Works at Trondhjem, Norway, but no detailed data concerning these experiments have been found.

An article in *Elec. Rev. West. Elec.*¹ describes electric copper smelting tried at Globe, Arizona. Test runs showed an extraction of 98% of the copper content of the ores. The furnace was of the vertical-shaft resistance type, 6 ft. in height, and lined with magnesia bricks. The opening of the furnace was 22 in. diameter at the top and 20 in. at the bottom, with a 5-in. Acheson graphite electrode swung at the top and a stationary electrode fixed at the bottom. Heating was started by an arc, and continued as resistance heating as soon as the charge was sufficiently melted. The power required was 3500 kw-h. per ton of charge.

Stephan² gives an account of experiments on the reduction of copper and nickel in furnaces similar to the Girod steel furnace. It was attempted to reduce a copper oxide ore high in silica and carrying some iron and cobalt, using solid carbon as a reducing agent, and limestone as a flux. A continuous run of several days resulted in a power consumption of 1000 to 1200 kw-h. per ton of ore. This figure is high on account of the high temperature required to keep the very viscous slag fused. With a more easily fluxed ore, the power consumption was as low as 500 kw-h. Charcoal, coke, and anthracite, to the extent of 25% of the copper in the charge, were all used successfully as reducing agent. The pig copper produced carried

²⁴Bull. Amer. Inst. Min. Eng., Nov. 1913.

²⁵Mining and Scientific Press, July 5, 1913.

²⁶Mining and Scientific Press, March 8, 1913.

²⁷Bull. Amer. Inst. Min. Eng., Aug. 1913.

²⁸Ibid.

²⁹Ibid.

³⁰Ibid., July 1913.

¹Volume 63, page 636.

²*Metall. u. Erz.* Vol. 10, pp. 11-17, 84-86; *Met. Chem. Eng.* Vol. 11, pp. 22-23.

65 to 95% Cu, 1 to 21% Fe, and 1 to 11% CO, depending on the temperature conditions in the furnace. The lower the temperature, the smaller was the amount of impurities reduced, but the larger the loss in unreduced copper.

Lyon and Keeney³ report a series of experiments on the smelting of copper in the electric furnace. Experiments on sulphide ores, where the smelting consists simply in melting down the ore, volatilizing out sulphur, and separating the slag and matte, indicated that in a furnace of commercial size the power consumption would be about 480 kw-h. per ton of ore for a low-grade ore producing a matte carrying 1.22% Cu. There was some loss of silver by volatilization, but very little gold or copper. The authors conclude that the smelting can be done as efficiently in the electric furnace as in the reverberatory or blast-furnace, and the desired reactions can be carried out as satisfactorily.

This does not include patents granted on a number of different forms of electric furnace, and various electrometallurgical processes, concerning which nothing is known outside of the patent claims.

On the whole, the problem of the electric furnace reduction of copper seems now to be on about the same ground as the electric furnace reduction of iron was a few years ago. It is largely a question of the substitution of electric heating for carbon heating, which means that it is largely a question of the comparative cost, at a given locality, of electricity and coal or coke, and the relative efficiency with which they can be utilized. The electric furnace under these conditions is not the competitor of the combustion furnace, but a substitute for the combustion furnace under certain conditions.

Electrolytic Refining

Burns⁴ describes experiments on the electrolytic refining of copper precipitate anodes. About 1400 tons of copper precipitate was melted down in the reverberatory furnace, about 25% of the charge being anode scrap, etc. The results showed that wire bar copper could be produced from these anodes at a current density of 17 to 18 amperes per square foot, while ingot grade copper is produced at a current density of 33 to 35 amperes per square foot.

Peterson⁵ describes the leaching process of the Butte & Duluth Mining Co., Butte, Montana. These ores are oxidized varieties, carrying about 2% Cu, readily soluble in dilute sulphuric acid. Leaching with 10% acid for 24 hours dissolves the copper from the ore, and the acid solution is then electrolyzed, recovering the copper and regenerating the acid, which can then be used for further leaching, after the addition of sufficient acid to restore the original concentration, and make up for losses throughout the process. This

amounts to about 3½ lb. of acid per pound of copper recovered. The power used is about 1 kw-h. per pound of copper. The copper produced analyzes about 99.96% pure.

Then there is the sulphatizing roasting of copper ores, followed by leaching and electro-deposition. Sulphide copper ores are roasted under conditions giving a maximum formation of sulphate. In this way 93 to 95% of the copper content of the ore can be made soluble in dilute sulphuric acid. The acid leach solution is then electrolyzed for the recovery of the copper and the regeneration of the acid, which can then be used for further leaching.

Zinc

Of all the different metals that are being treated by electro-metallurgical processes, probably none has been the subject of more discussion than zinc. Iron and steel take precedence over zinc only in the importance of the greater tonnage involved. Zinc secures this attention because of the proportionately small amount of progress that has been made in recent years along the lines of the present standard methods of treating zinc ores, and the possibility, not only of developing a process that can be run at a better efficiency than the present pyro-metallurgical methods, but also the possibility of securing a method of treating ores that cannot be treated at all by the present methods. And it is in this latter field that the electro-metallurgy of zinc promises the most satisfactory returns, at least for the immediate future. Numerous patents on furnaces and processes have been granted during the past year, but as little is known concerning most of these, beyond the claims stated in the patent, I will confine myself to the various publications of the past year giving the results of experimental work and information in regard to the general condition of the electro-metallurgical side of the zinc industry.

Uebbing⁶ describes two methods of working a zinc-bearing burned pyrite. The first method was by a reducing smelting in an electric furnace, using CaO to assist in slagging the sulphur. Most of the zinc was volatilized from the charge, and the iron was obtained as pig iron. In order not to have too much sulphur in the pig iron, it would be necessary to reduce the sulphur in the raw material to less than one per cent. The second method consisted in reducing the sulphur by further roasting, briquetting the pulverized material with tar or pitch, and heating. A preliminary baking produced a part reduction, and subsequent heating in a vacuum furnace at 1000 to 1100° reduced all the iron and distilled out the zinc.

On account of the low cost of power, the Scandinavian countries have progressed further in the commercial application of electric zinc-smelting than have any of the other countries. There is one plant in Sweden, one in Norway, and it has been recently reported that a plant has been started in Finland, using 2500 hp.,

³Bull. No. 80, Amer. Inst. Min. Eng., pp. 2117-2149.

⁴Bull. No. 79, Amer. Inst. Min. Eng., pp. 1163-7; *Min. Eng. World*, Vol. 39, pp. 469-70.

⁵*Min. Eng. World*, Vol. 39, pp. 423-5.

⁶*Metall u. Erz*, Vol. 10, pp. 1 and 607-611.

which is to be later increased to 6000 hp. In the *Australian Mining Standard*⁷ it is stated that the Sulphide Corporation has constructed at Cockle Creek, New South Wales, a 500-hp. electric furnace for the electric smelting of zinc, combined with the manufacture of sulphuric acid and superphosphate.

A recent report of the directors of the Hydraulic Power & Smelting Co., Ltd., gives the following information in regard to Scandinavian zinc smelting. The capacity of the works at Sundlokken (Sharpsborg), Norway, has been increased from 8000 to 10,000 tons per year, and contracts for the sale of the entire coming year's production have been made under terms giving a satisfactory profit. The erection and equipment of a new plant at Trollhättan, Sweden, is being pushed as rapidly as possible, and 13 furnaces of 1000 hp. and 8 of 500 hp. have been installed. Five more 1000-hp. furnaces will be built.

The problem of electric zinc-smelting is being studied in Canada under the direction of Stansfield and Ingalls, under a grant from the Canadian Government, but no recent publications have been made by them. The leading investigators in this country are Johnson and Peterson, both of whose processes are described in considerable detail in papers presented at the Denver meeting of the American Electrochemical Society, September 1913.⁸

Zinc Smelting Near

While there have been no radical improvements in the various processes for the electric smelting of zinc during the past year, the gradual advance of the experimental and semi-commercial processes that are being tried out seems to lead to the conclusion that for complex ores, where the recovery of the zinc must be accompanied by the simultaneous recovery of copper, lead, silver, and gold, electric smelting processes show decided possibilities. After considering the various sides of the question, Ingalls comes to the conclusion that if the zinc can be smelted with an expenditure of not more than 1200 kw-h. per ton of ore, the electric smelting processes will become a possibility worth considering. Johnson, in the article cited above, publishes values of kilowatt-hours per ton ranging from 1100 to 1700, and expects to secure still better results with further development of his process, and, with larger size furnaces, Peterson figures on a basis of 1400 kw-h. per ton of ore.

All things considered, the electric smelting of zinc seems to be a commercial possibility of the near future. The fact that the zinc can be reduced, and that the other metals of the ore can be satisfactorily recovered, have been already shown. The principal things remaining to be done are, first, to control the condensation of the zinc vapor so that a satisfactory percentage of it is condensed as metallic zinc, instead of blue powder, and second, to control the furnace operation so that the cost of replacing electrodes does

not exceed the present cost for retorts and condensers.

Iron and Steel

The electric reduction of iron is certainly no longer in the experimental stage. It is meeting the requirements in the localities where it has been introduced, and for some uses the electric furnace produces a more suitable metal than the blast-furnace. For example, electric-furnace pig iron can be made much lower in impurities than ordinary blast-furnace pig iron, which makes it much easier to convert into steel in the open-hearth furnace.

The electric iron-smelting furnace at Trollhättan has, according to a writer in *Engineering*,⁹ been modified to use round electrodes 600 mm. in diameter, and an apparatus has also been added to purify the gas by washing. The furnace used 1749 kw-h. to produce 1000 kg. of iron, an efficiency of 74.39%. The consumption of charcoal is only 35 to 45% of that required in the blast-furnace. From results secured at Trollhättan it appears that the electric furnace is subject to greater variations than a well run blast-furnace and that the sulphur content of the iron is higher.

As a result of the successful operation of the Trollhättan furnace, three other furnaces have been built in Sweden, the four using 12,000 hp.; in Norway there is one 3500-hp. furnace in operation, and three 3000-hp. furnaces are under construction; in Switzerland a 2500-hp. furnace is being built; these, with the two California furnaces, one of 2000 hp. and the other of 3000 hp., make a total of 32,000 hp. for use in the electric reduction of iron.

Lyon¹⁰ compares Scandinavian practice with the electric iron furnace with California practice. The main differences are that in California no attempt is made to secure any reduction in the stack of the furnace, there is no circulation of the furnace gases, and the limestone used is calcined outside of the furnace. Further details on the operation of the California furnaces are given by Crawford¹¹. The minimum power consumption under present working conditions is given as 2200 kw-h. per ton of pig iron. The efficiency is not quite so high as the Swedish shaft-furnaces of the same power rating, but the extension of the length of the furnace is expected to remedy this, since the end electrodes work at a lower efficiency than the electrodes in the centre of the furnace, due to the increased radiating surface.

The size of the units in use is constantly increasing. Most of the Scandinavian furnaces are rated at 3000 hp., but it is reported that the A. B. Elektrometall has completed the design of a 7500-hp. furnace. The California experiments have led to the development of a furnace rectangular in shape, with the electrodes in a straight line, and it is thought that it will be possible to increase the length of this furnace indefin-

⁹Vol. 94, pp. 395-7 and 630-5.

¹⁰*Mét. Chem. Eng.*, Vol. 11, pp. 15-19.

¹¹*Mining and Scientific Press*, June 28; *Met. Chem. Eng.*, Vol. 11, pp. 383-8.

⁷May 22, 1913, abstr. *Met. Chem. Eng.*, Vol. 11, p. 463.

⁸*Trans. Amer. Electrochem. Soc.*, Vol. 24.

itely, as has been done with the modern rectangular copper blast-furnace.

A good summary of the present status of the electric furnace in smelting of iron ores is given by Lyon and Keeney in their paper.¹² 'Possible Applications of the Electric Furnace to Western Metallurgy,' presented at the Denver meeting of the American Electrochemical Society in September 1913.¹³

The principal advances in the electro-metallurgy of steel are along the line of increased size of furnaces, and better control of the furnace operation, giving greater capacity and more thorough purification of the charge. An induction furnace of 25 tons capacity has recently been constructed in Germany. The electric furnace is also proposed as a holder for melted steel, giving the steel time to clear itself of gas and slag before it is cast.

The number of electric steel furnaces now in operation are as follows: Europe, 112; United States, 19. The production of electric-furnace steel is rapidly increasing in Europe, the 1912 production being about 11,000 tons more than the 1911 production. In the United States, however, the production has decreased about the same amount in the same time.

The Société le Fer¹⁴ effects the removal of the hydrogen in the production of electrolytic iron by adding to the bath Fe_2O_3 , which is reduced to FeO . Iron of high quality is obtained with a current efficiency of 95 to 98%, even with current densities as high as 1000 amp. per square metre.

Ferro-Alloys

The growth of the ferro-alloy industry in the United States has been much slower than in Europe, this country having only two plants using electric-furnace processes, compared with 25 in Europe. This makes the production of the ferro-alloys, particularly of manganese, silicon, and tungsten, of interest in this country, since the production is not sufficient to meet the demand, and large quantities are imported annually, while the growing importance of high-grade and alloy steels is making these alloys of continually increasing importance. The production of ferrochrome, ferrotitanium, and ferrovanadium is sufficient to meet the domestic demand. The principal reason for the more rapid growth in Europe is the fact that power can be obtained cheaper than in this country. Ores of chromium, tungsten, molybdenum, and vanadium are found in the western United States in sufficient quantities to make further development of ferro-alloy manufacture well worth while. Keeney¹⁵ gives the results of a series of experiments in the manufacture of the various ferro-alloys in the electric furnace. Flöge¹⁶ describes the use of an electric furnace for melting the ferro-manganese used to de-oxidize steel,

resulting in a saving of 35% of the amount required when it is added in the solid form, besides giving uniform quality of metal and saving considerable time. Bingham¹⁷ patents the production of ferrosilicon using as a raw material scrap silica bricks from the lining of open-hearth furnaces, that are partly saturated with iron.

Gold and Minor Metals

The electric furnace has not yet been applied to the working of gold or silver ores, although there are conditions under which this might be advantageous. There has recently been installed at Lluvia del Oro, Chihuahua, Mexico, a furnace for the electric smelting of the zinc precipitate from the cyanide plant and smelting ore concentrates. The bullion is shipped and the slag is re-smelted or concentrated.

The electric smelting of straight lead ores has not been attempted, largely because of the ease with which these ores can be handled in combustion furnaces.

Working in a small furnace, Stephan¹⁸ reduced from an ore containing 8.33% NiO 350 kg. of ferro-nickel, carrying 4.33% Si . The power consumption was about 2000 kw-h. per ton of ore, which could probably be reduced to about 1200 kw-h. in working.

The increased use of platinum in jewelry makes it desirable to have a small furnace capable of melting over scrap to recast into ingots. In *Brass World*¹⁹ a small 'Hellberger' furnace is described. This is a small electric furnace with a removable crucible, taking 110 or 220 volts, a special transformer cutting this down to the desired voltage. One kilogram of platinum requires 10 kw-h. for melting.

Particulars concerning some experiments made by the Gröndal-Kjellin Co., of London, in smelting tin ores in Cornwall, are contained in the *Revue Industrielle*. Pure ores yielded metal of 98% purity, and Bolivian ores containing about 50% of tin and 15% of iron gave metal of 92 to 97% purity. The latter could be further refined to a purity of 99.75% by blowing air through the molten mass. The energy consumed was 1700 kw-h. per ton, but this may be reduced to 1400 kw-h. with an efficiency of 55% by using two furnaces, one for the production of high-grade metal and the other being used for the treatment of rich slags.²⁰

Michaud and Delasson²¹ patent the electrolytic refining of tin in a SnCl_2 solution carrying some MgCl_2 and H_3BO_3 . The tin-bearing material is placed in a flat porous basket that serves as anode, and the cathode is a copper plate, from which the deposited tin is removed by scrapers. In order to keep the electrolyte saturated with tin, it is circulated through a container filled with tin scrap. The yield is 2.22 gm. of tin per ampere-hour.

¹²Brit. Pat. 22,755, Oct. 16, 1911.

¹³*Metall u. Erz.* Vol. 10, pp. 11-77, 84-86; *Met. Chem. Eng.* Vol. 11, pp. 22-23.

¹⁴Vol. 8, p. 273.

¹⁵*Met. Chem. Eng.* Vol. 11, p. 653.

¹⁶Fr. Pat. 435,936, and addition 16,388, Aug. 24, 1912.

¹⁷*Mining and Scientific Press*, Nov. 1.

¹⁸See also *Mining and Scientific Press*, Dec. 20.

¹⁹Fr. Pat. 446,614, Oct. 6, 1911.

²⁰*Trans. Amer. Electrochem. Soc.*, Vol. 24.

²¹*Chem. Zeit.*, Vol. 36, p. 307.

Metallurgy of the California Mother Lode

By M. W. von BERNEWITZ

A general impression exists that ore treatment along the Mother Lode is sadly behind the times. During November I visited all the operating mills from Amador City to Jackson, and must confess that I was agreeably surprised, and so far as my own observations go I consider the general impression unjustified. Relatively little has been written in recent years regarding ore treatment along the Lode and the following general resumé may therefore prove useful. Except where stated otherwise, my observations relate only to that part found in Amador county. For a complete understanding of the Mother Lode of California, I would refer the reader to the interesting articles of J. H. G. Wolf, in this journal of June 21 and 28, 1913.

The ore, which is mined from all depths to 4100 ft. on the incline, may be described as a quartz containing from 1.5 to 3% iron pyrite. It occurs mostly in graphitic slates or schists. While ore averaging as high in value as \$7 per ton is produced from one mine, the general average is said to be about \$4 per ton. Ore as low as \$3 per ton may be profitably mined and milled. The ores of Bendigo, Australia, are very similar to those of Amador county, save for the arsenic in the Bendigo sulphides. The treatment is precisely the same, only that the Mother Lode mills are more up to date.

A General Review of the Milling Practice

Both vertical and inclined shafts are found along the Lode. The angle of the latter is never very flat, and skips up to 4-ton capacity are used. Rock-crushers, mostly of the jaw type, are placed on storage bins near the shafts. A noticeable feature is the complete absence of any belt-conveyors from these bins to the mill-bins, cars holding up to 4 tons moved by man or mule power being used. While it is true that in some instances the shaft-bins are a considerable distance from those at the mills and long belt installations are expensive, yet their total absence is marked. The cars of ore at the Argonaut are weighed. Elsewhere they are merely counted and a constant weight assumed. Mill-bins are all built with sloping bottoms, and there are three types of battery frames, namely, the front knee, 'A,' and standard construction. These seem to be about equally popular. With the first named, the main drive-shaft is level with and in front of the cam-shafts, the arrangement necessitating tight belts. Ten stamps are driven by each belt, and the driving pulley is driven by a clutch. King posts and other timbers are of the regulation pattern. Feeders are of the suspended and hopper Challenge types. Mortar-boxes, stamps, and other machinery made by many well known engineering firms is found in the various mills, but the local firm of Knight & Co., of Sutter Creek,



seems to have the lead in supplying mill machinery. It also makes hoists and other surface equipment. The average weight of stamps used is probably 950 lb. There are several mills, however, where the weight is as much as 1050 lb. The quartz ore is friable, and when slate is mixed with it, the average is soft, so a light stamp with a 6-in. drop, falling 95 to 104 per minute, is sufficient to do the work. It has a capacity of four to five tons per stamp-day through a 20-mesh screen. In the new 300-ton mill for the Plymouth mine, on the same vein system, 12 miles from Jackson, heavy stamps and a two-stage system of crushing with classification is to be installed, so interesting comparisons will be possible later. Both inside and outside amalgamation is practised, but although in some mills quicksilver is fed into the mortar-boxes, there are no inside plates. There is also a wide variation in practice regarding copper plates; one plant will have only a short plate, while others have sluice plates up to 20 ft. in length. With one exception, the Original Amador, no classification whatever of pulp from the stamps is made. I was informed that it had been tried often, but without improvement in results. The pulp from each battery of five stamps is divided evenly between two or three Frue vanners. It is peculiar how the millmen in different mining centres, almost as if by agreement, find one particular concentrating table to suit conditions best here the Frue type is most favored. The only other type is the Deister, there being seven at the Original Amador. The 6-ft. Frue vanners give entire satisfaction, and they are certainly skilfully operated. They are driven at from 180 to 200 strokes per minute, and the belt travel is from 2 to 6 ft. per minute. As with all ores containing pyrite, a consid-

erable amount of fine mineral escapes with the tailing, and strenuous efforts are made to catch this by canvas plants of many kinds. For many years the tailing has been allowed to flow down the different creeks in the district, but as the farmers on the lower lands complained of drainage, arrangements are now being perfected for its disposal otherwise.

To the natural question why tailing is not cyanided along the lode, it would be safe to say, generally, that it is doubtful whether it could be made to pay. It is true that a small plant is treating the tailing from the Bunker Hill mill, but under conditions that would not be profitable to a company. Both local and outside men have sampled and experimented on the mill residue, and intend doing so again; but results have not proved favorable. I think that the main impediment is the graphite in the slate or schist, which is crushed with the ore. In cyaniding, this mineral causes a premature precipitation of gold from solutions, which is not recoverable. It is held by Stuart Browne that it is the occluded gases in the mineral that causes the precipitation. Even so, the fact remains that the graphite, or something in it not yet determined, and which is probably not to be commercially removed, gives trouble. The proof of this may be seen at the cyanide plant of Messrs. Darrow & Fitzsimmons treating the tailing from the Bunker Hill mill, where a great deal of graphitic scum is seen floating about, and recovery was reduced very considerably lately; due, without doubt, to this mineral. It is said that greasy slates in the mines will form this scum also, and possibly may give trouble. Strange to say, the addition of caustic soda to the charges of sand in the leaching vats, greatly improves extraction. Graphite is a stable mineral, and would hardly be changed by adding this alkali, yet its addition has been beneficial. Tailing from the mills is certainly rich enough for treatment if there was no deleterious matter in it. Perhaps, however, the extreme fineness of the mineral escaping the vanners and canvas plants prevents its being caught when leached as such. The problem is interesting, and before long there will undoubtedly be further work along this line.

All the mills are situated from two to four miles from any railroad terminus and concentrate has to be hauled over rough roads for shipment to smelters. The Kennedy Mining & Milling Co. treats its concentrate by chlorination, but there would seem to be a field for a central custom plant, since the cost of treatment need not be much more than the \$2 per ton freight rate to the smelters. The concentrate contains practically gold only, and with good mechanical roasting furnaces, grinding, amalgamating, and, finally cyaniding, a high extraction at reasonable cost should be made. I understand that the average extraction of gold in the mills by the present methods is 82% and the cost 50 to 55c. per ton.

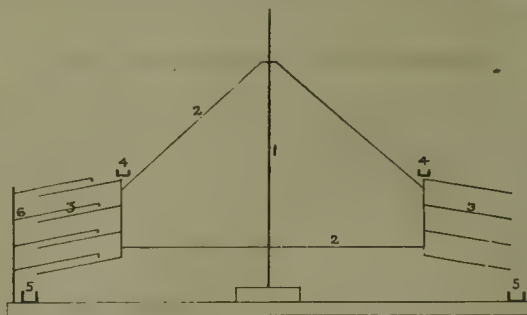
Where steam is required on the surface for power, oil is used for fuel at a cost of from 90c. to \$1.25 per barrel. All the mills and small outlying plants are

motor driven, electric power from the 'Electra' hydro-electric power-station of the Pacific Gas & Electric Co., eight miles away, being supplied at \$4.50 per horsepower month. Water costs 15c. per miners inch per month; yet no attempt is made to return waste water to the mills. Probably this will be done when some of the tailing impounding systems are in operation. The stamp-mills are all well kept, which is always an important point not to be overlooked, and the labor required is small.

Fremont Mill

The Fremont mine is worked by two shafts, 1500 and 2100 ft. deep, respectively, and produces 6000 tons of ore per month. At each shaft is a crusher; one jaw crusher and one of Gates type. The broken ore is conveyed several hundred feet by mule traction to the mill-bins. The battery frame is of standard design, and suspended feeders supply ore to 40 stamps dropping 6 in., 105 times per minute. Guides made by the Globe Iron Works of Stockton, and Blanton cams are used. The mortar-boxes are from the Union Iron Works of San Francisco. A 75-hp. motor is belted to the main drive shaft, and jockey pulleys keep the cam-shaft belts tight. The stamps crush through a No. 6 slotted screen, and outside amalgamation is practised on long plates. Sixteen Frue vanners save the concentrate and are driven by a 20-hp. motor. This mill is exceptionally well kept.

The tailing from the vanners is sold on a royalty



SECTION OF A REVOLVING CANVAS CONCENTRATOR.

- (1) Central spindle gear or rope driven on footstep bearing;
- (2) Tie or stiffening rods; (3) canvas or felt sloping trays; (4) annular feed launder; (5) tailing launder; (6) spray pipes.

basis, and is treated on a revolving canvas plant. In it are two 24-ft. slowly revolving machines, with several sloping decks about 12 in. apart. The distance from the central spindle to the inner periphery of the deck, which latter is about 4 ft. wide, and divided into 4-ft. sections, is 8 ft. Pulp from the mill is fed upon these decks at the inside periphery, and thence flows across to an annular launder. The decks are either covered with canvas or felt, which catches fine mineral escaping the Frue vanners in the mill. At one side of the canvas buddle, or revolving canvas strokes, is a vertical 2-in. water-pipe, to which are fitted short 1/2-in. spray pipes,

one for each deck, manipulated by a crank in such a way that the sprays wash the fine mineral off each section as it comes to the proper point. Before that part reaches this point the pulp flow is stopped on the section before. In this particular plant, after the concentrate is washed off the machines, it is elevated to a 15-ft. machine for reconcentration, the tailing being returned again to the first 24-ft. machine. The fine concentrate is shipped to smelters. During the night this plant runs without attention, being motor driven and everything slow moving.

Bunker Hill Mill

Next along the line of the Lode is the Bunker Hill. At the shaft is a jaw-crusher and 3-ton cars are trammed by hand several hundred feet to the 40-stamp mill bins. The framing is of the 'A' type with the main drive-shaft behind the mortar-boxes, this shaft being driven by a 50-hp. Westinghouse motor. The stamps and the boxes were made by Knight & Co. of Sutter Creek and are of the usual type. Punched screens are used, and amalgamation is both in the mortars and on long plates outside. Twenty-four 6-ft. Frue vanners, three to each battery, save the concentrate, which is shipped. The pulp from the concentrating tables then flows to Darrow & Fitzsimmons cyanide plant. Here it is first of all cleared of rubbish by a revolving screen driven by a small water-wheel set in the pulp launder, the flow of the pulp turning this with ease. The pulp runs from this to cone classifiers, the underflow going to eight 12 by 16-ft. wooden leaching vats, about 80 tons being treated daily. Lime is generally used to neutralize any acidity; but on account of recent troubles, due apparently to premature precipitation by graphite, caustic soda is being tried with good results. Pulp from the canvas plant drives the distributors above the leaching vats. Cyanide solution washes are forced up through the charge or on top as desired. The total time in treating one vat is ten days, after which the residue is sluiced down the creek. The overflow from the cones goes to two 30-ft. diameter revolving machines with eight decks each, having a total of 168 canvas trays with a fall of $1\frac{3}{4}$ in. per foot, similar in operation to the one shown in the sketch. Feed is stopped two trays before the final spraying, and these are given a clean-water wash, leaving only fine clean concentrate to be sprayed off. The preliminary handling of pulp from the mill launder is to be somewhat altered in a short time, by the installation of new cones above two new 10-deck machines with 140 trays covered with asphalt-felt, painted and sanded. These machines will be centre-fed over umbrella-shaped plates, instead of being fed on the inside periphery. The mechanism will also be different, as the decks of trays will revolve independently of the central feed arrangement. Generally speaking, this new machine bids fair to be the last word for this class of work.

Concentrate washed off the present machines flows to three small Pachuca tanks, which hold 188 cu. ft. of

charge per tank, the pulp being fed down a 6-ft. hose, and clear water overflowing by an annular launder. About six tons of concentrate and fine sand is caught daily. When the vat contains the required charge, lime is added at once, then the whole is given a violent agitation with air, allowed to settle, and water siphoned off. Strong cyanide solution is then added, and agitation proceeds for eight hours and settlement for four hours, when the solution is decanted to sand filters. The treatment is simply air agitation and decantation covering a total of 72 to 80 hours. All solutions are well aerated by a pump and tower. Gold-bearing solutions are precipitated by zinc shavings in small tubs, seven rows of five each for strong, and four rows of five each for weak solutions. Barren solutions go to three 30-ton wooden sumps. In cleaning up the zinc-boxes or tubs, the zinc is washed, the sludge given a sulphuric acid treatment of 24 hours, and chlorinated by adding salt, manganese dioxide, and potassium permanganate for 48 hours. Gold is precipitated from chlorine solution by ferrous sulphate, filtered, dried, and melted; the resulting bullion is of high grade. Only a small number of men are needed at this plant, and being interested in it, they work long hours. While proving that a certain recovery can be made by cyaniding the sand and fine concentrate, it is generally believed that not much profit is realized.

Original Amador Mill

The Original Amador, opened to 700 ft. by an incline shaft, is at the edge of Amador City. One and a half-ton skips feed the jaw-crushers above the mill-bins, and the broken ore is fed to twenty 1000-lb. stamps. These drop 105 times per minute and crush 90 tons per day through a 20-mesh wire screen. The battery frame is of standard design, and the boxes and stamps were made by the Joshua Hendy Iron Works of San Francisco. A 50-hp. motor drives the main shaft behind the boxes. Both inside and outside amalgamation is practiced, the latter being on plates $4\frac{1}{2}$ by 14 ft. in area. Pulp from the plates is classified, this being the only plant along the Lode where it is done. The coarse pulp flows to four Deister tables, and the overflow from the classifier goes to another cone, the underflow from which is treated by three Deister tables. Middling from the fine tables goes to a Frue vanner running at 85 strokes per minute, and the clean



SOUTH EUREKA MILL, NEAR JACKSON.

pyrite is pumped to a tank, drained, and shipped. Classification has proved to be an advantage in this mill.

South Eureka Mill

Between Amador City and Sutter Creek are several old mills which are not working, and which have the appearance of being 'old-timers.' Farther south is the South Eureka mine, which is opened to a depth of 2700 ft. on the incline. A geared hoist driven by two 400-hp. General Electric motors coupled to a rope pulley, which drives the pinion shaft, brings the $3\frac{1}{2}$ -ton skips

atically takes a cut of the whole stream in the launder once in five minutes.

Oneida Mill

A pleasant ten minutes walk brought me to the Oneida mine, which is being developed to 2200 ft. vertical depth. Flat ropes are used on the hoist, which raises the skips to a jaw-crusher. From this the ore is trammed a considerable distance to a hydraulic elevator, which lifts the cars about 30 ft. to the mill-bins. Pressure is obtained from a water-tank on a hill nearby, while the descent of the elevator forces the water



KENNEDY MINE AND MILL AT JACKSON.

to a Knight jaw-crusher, the ore falling into a storage bin. From here it is trammed to the 80-stamp mill, built by Knight & Co. This plant is a credit to any mining company, and is certainly well maintained. The framing is of the 'A' type, and four 50-hp. Allis-Chalmers motors drive the plant in four units, there being one belt to each cam-shaft with five cams driven from the main drive-shafts. The stamps crush five tons per day through a 24-mesh, brass, wire screen. They weigh 1050 lb., and drop 102 times through $6\frac{1}{2}$ inches. Shoes last 135 and dies 60 days. Amalgamation is along the usual lines. Three Frue vanners deal with the pulp from each battery, making 48 in all. They run at 200 strokes and the belt travel is 40 in. per minute. Eight tons of concentrate is collected per day. All mill floors are hosed to a collecting tank, and this material is re-treated. Before the tailing goes to the new settling pond, it is sampled by a pipe which auto-

used to a reservoir for the mill supply. The mill has 60 stamps, but only 20 of 1000 lb. each are at work. They crush about 90 tons daily through a 24-ton cap-screen, dropping $6\frac{1}{2}$ in. 100 times per minute. Twelve 4-ft. Frue vanners complete the treatment, after which the tailing is collected in a pond close to the mill. A 100-hp. motor drives the whole plant.

Kennedy Mill

The Kennedy, about one mile from Jackson, is being actively worked to a depth of 3600 ft. vertical, and the vein has been followed to 3850 ft. I saw the stopes between 3300 and 3600 ft., getting an idea of the nature of the ore and country rock. The surface equipment includes nine return-flue oil-fired boilers, making steam for a first motion Allis-Chalmers hoist, which hauls 4-ton skips. As a large quantity of timber is used in the mine, there is a considerable quantity

stocked on the surface, and a complete sawmill is in operation. The skips dump the ore upon a grizzly, and the larger pieces are broken by a jaw-crusher. All the ore drops into a storage bin, and 5 ton cars, drawn by mules, take it to the mill-bins. There are 100 stamps crushing 13,000 to 15,000 tons per month through 20-mesh screens. The style of framing is the front knee, with the main drivesshaft level with the cam-shafts. Two 150-hp. motors each drive a small counter-shaft, this in turn driving the main-shaft by ropes. Motors are placed at each end of the plant. The cam-shafts are driven by belts from clutch pulleys. The stamps, 10 to a shaft, work in Pacific guides, and drop 100 times per minute through 6 inches. Inside and outside amalgamation is the rule, the latter being



ARGONAUT MINE AND MILL, JACKSON.

on long sluice plates. Forty Frue vanners, recovering about ten tons of concentrate daily, are driven at 180 strokes per minute, and this product is reconcentrated on two more Frue machines. Below the mill is a large plant of sloping canvas tables in four units, each being divided into 13 parts. The feed is regulated to give waves of pulp on the canvas, and at regular intervals the flow is shut off each, and the fine mineral sprayed, collected, and drained. The final tailing is run down Jackson creek, but the new scheme of disposal by four elevator wheels in series will soon be in operation.

Concentrate from the vanners and canvas plant is carted to a plant about a quarter of a mile away for local treatment. This is conducted in two oil-fired, hand-fed, and rabbled, one-hearth furnaces, the firing being intermittent. The roasted ore is raked into barrows, damped down, and shoveled into four wooden vats of 10 tons capacity each. Chlorine gas is made in the usual manner by sulphuric acid, salt, and manganese dioxide. The gas 'flows' up through the charge, having about four hours contact, regular tests being made with ammonia at a vent to see if the gas is coming through. The charge then stands about 48 hours before being washed. Gold is precipitated by ferrous sulphate in wooden vats. This is made in the plant by treating iron with sulphuric acid. The precipitate is finally dried and melted at the mine and the bullion shipped.

Argonaut Mill

The Argonaut mill is opposite the Kennedy on a steep hillside. On the incline the main shaft is down 4100 ft. It is served by an electric hoist. A 12 by 16-in. jaw crusher, of Knight & Co.'s make, breaks the ore, this then drops into a bin high above the mill. Two-ton cars, hand pushed, take the ore to the mill-bins, every other carload being weighed. The battery frame is of the front-knee style. Challenge feeders supply forty 850-lb. stamps, dropping 6½ in. 96 times per minute, the daily output being 200 tons. The screening varies, but 16 mesh is mostly used. A grading test shows the following:

Screen.	Per cent.
On 40.....	13.33
On 60.....	16.67
On 80.....	11.67
On 100.....	9.33
On 150.....	6.67
On 200.....	5.84
On 300.....	1.50
Through 300.....	31.67

This shows how extremely fine the slaty matter in the ore becomes reduced even when using so coarse a screen as 16 mesh.

The mill is driven by an 80-hp. General Electric motor. Amalgamation is mostly inside, 60% of the total gold being caught there. The apron plate is 4 by 5 ft., and the sluice plate 22 ft. long. There are sixteen 6-ft. Frue vanners, which save 3½ tons of concentrate per day. Pulp from these machines flows to a canvas buddle 30 ft. diameter, with 16 decks, divided into nine tables to a deck, each table being 4 by 5 ft. The speed of the machine is one revolution in 17 minutes. Its operation is similar to that of the one described, the fine concentrate being cleaned of barren material on a 4½-ft. vanner. The buddle saves 14 tons per month. By concentration, 15% of the gold is recovered, so the Argonaut mill has a total extraction of 85%. Further experimenting is to be done on the ore at an early date.

Zeila Mill

The Zeila mill is near Jackson, and is of an old style, and out of 40 stamps only 25 are working at present. Three and a half-ton cars drawn by a stubborn mule, transport the ore to the mill-bins, after being crushed by jaw-crusher at the shaft. The battery frame is of front-knee construction. The crushing capacity of the 800-lb. stamps varies from four to seven tons per day, as the ore consists of mixed upper and lower level material. Sixteen-mesh screens are used, and inside and outside amalgamation is the rule. Pulp flows to 16 Frue vanners, 11 of which are working, and the concentrate is shipped to smelters. The vanner tailing is sold on a royalty basis, and is treated by a 40-ft. revolving canvas machine, making one revolution in 17 minutes. It consists of four decks with thirty 4-ft. tables in a deck, which are sprayed as previously described. The mineral and fine ore caught is reconcentrated on four vanners.

Progress in Gold and Silver Ore Treatment in 1913

By ALFRED JAMES

The depression of the day has surely spread to progress in practice. One would this year have seriously contemplated the necessity of sending out a blank sheet, as an adequate summary of our progress, but for the brilliant work of Denny at Nipissing. Whether looking at crushing, classification, fine grinding, agitation, filtration, or precipitation and recovery, one is impressed by the idea that during the year we have had nothing new of note, indeed that in some respects practice has possibly become decadent, due perhaps to the remission of the efforts of men formerly interested in keeping up the level of practice at certain points. There have been but few new mills and even those have been on lines already familiar. The good work of the Consolidated Langlaagte, as shown by the extremely low cyanide costs (see official report, September 30, 1913, cyaniding cost of 27c. per ton) is perhaps counterbalanced by the extreme caution which made the staff defer the adoption of filtration in place of decantation until their recent mill, the Van Ryn Deep, and even now in the new mill they are not yet prepared to install the Nissen stamp, which proved itself so satisfactory at the City Deep. The Cam & Motor and Shamva mills are not yet started.

Generally, for the year it may be taken that exceptionally progress has been on chemical rather than on mechanical lines. In addition to the Denny aluminum preparatory process we have also the increasing use of so-called 'acid' solutions in cyanidation and the substitution, in at least one case, of aluminum-dust precipitation for zinc dust.

Agitation

Agitators widely heard of last year seem now to have disappeared. To my queries as to the position addressed to the leading exponents of advanced practice in Mexico and in South Africa, respectively, I have received strong endorsements of Jay A. Carpenter's statement in the *Mining and Scientific Press*: "that no one of the many less costly types of agitators has as yet proved to the general satisfaction that under varied conditions it is the equal of the Pachuca for reliability and low operating costs;" and this opinion is confirmed by the adoption of this agitator in every new African wet-crushing plant.

A reference to the valuable table on compressing given in the *Mining and Scientific Press* of October 15, 1910, will show one reason for the advantage of a tall tank over a short tank. Assuming the quantity of air to vary as the diameter of the tank and the pressure as the height, then we may take it that the same quantity of air will agitate double the quantity of material, provided the latter is charged into a tank of double height. The pressure of the air, however, would

be doubled, but to compress 10 cu. ft. of free air per minute to 15-lb. takes 0.6 hp., to 30-lb. 1 hp., to 60-lb. 1.6 hp., to 90-lb. 2 hp. It would thus appear that by using a tank sufficiently tall to require high pressure air it should be possible to agitate three times the quantity of material for twice the horse-power; but an even greater advantage of the tall tank is that the lessened number of cubic feet of air necessary for a given tonnage of pulp oxidizes or carbonates a less amount of cyanide. It was surprising to find that, whereas in New Zealand results showed a less consumption of cyanide by Brown agitator than by mechanical agitator, the saving being most marked in the agitation of heavy material such as concentrate, in America at times heavy consumptions of cyanide have been reported as due to aeration action only. In every case of such consumptions which has come to my notice investigation has proved that the quantity of air used was out of all proportion to the New Zealand standard—and it must be remembered that in the latter territory not only is slime and a mixture of crushed sand and slime agitated, but even coarse sand, tailing, and concentrate.

The Continuous Process

As to whether the continuous agitation which has proved so attractive in practice—at the East Rand four nominal 100-ton agitators agitate 1700 tons of slime per diem with an extraction of 97%—should not be modified, particularly in the case of certain ores, by the interposition of desolutionizers so that the remainder of the series of agitators may be charged with fresh solution, is a matter engaging some little attention. It may be well conceived that a Dorr thickener interposed between, say, every three agitators, may have a very useful effect in the treatment of some ores, but on the other hand engineers have been faced with just this problem since cyanidation came into being. It was a question as to how many transfers were desirable, and apparatus was invented for making transfer so cheaply that even treatment in four separate vats was economically possible; but in practice it did not prove desirable and the ultimate tendency has been to revert to single treatment in one vat only, and by means of the perfect sand feed now possible from the use of the Caldecott sand and table and cone or of mechanical classifiers, for instance as the Dorr and Ovoca, collection and treatment take place in the same vat.

A New Type

A new agitator of the year is that described by Whitman Symmes in the *Mining and Scientific Press* of July 19, 1913. The agitator is an ingenious adaptation of the multi-air-lift principle to a flat bottomed

tank, and one looks forward to receiving further accounts of the results obtained in practice from its use.

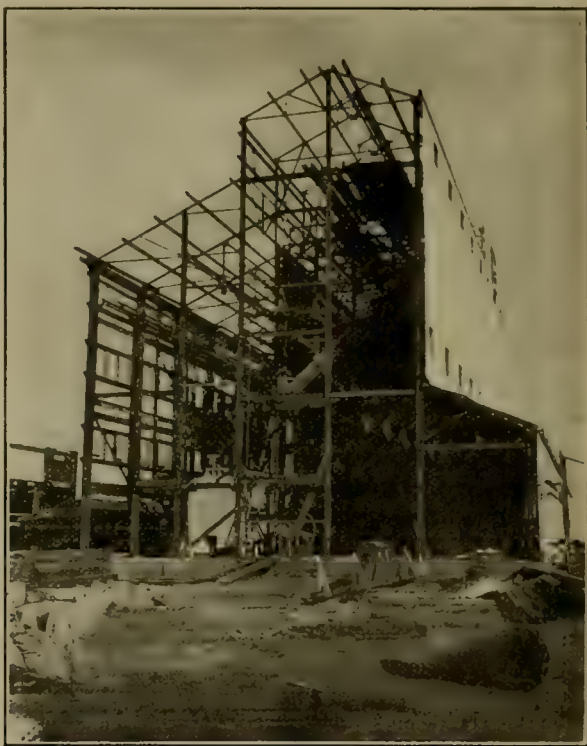
Classification

All of us have at times used cones. Many of us have passed from the use of cones to classifiers such as the Dorr. Perhaps none of us who have once used classifiers of this type have reverted to cones, and I therefore confess to some little surprise at the geographical limitation of the use of these classifiers. Is it that temperaments differ, the nature of the work differs, or that it takes a long time and the expenditure of considerable effort and money to displace practice once settled? For new mills operating under the Sunday Law in the Transvaal one would have imagined that classifiers, which could be stopped at once and started up at once, would be much more convenient than cones, which have to be cleared out and re-started, and then there is the question of labor and of work accomplished. It has been a common experience to go through a large mill and to find the Dorr, Esperanza, or Ovoca classifiers absolutely unattended and with no laborer anywhere near it. Experience with cones has been quite the reverse, and the product of the latter impresses one as containing a greater proportion of fine slime than that of the former. A metallurgist of experience, who has evolved perhaps the most perfect cone of the day, writes as follows: "The cone, on the other hand, makes large capacity possible, on account of the length of the overflow rim, and is not as sensitive to changes in the amount of feed. However, I think the best classifier, where it is important to save mill head, would, or should, combine the advantages of each (classifier and cone) type, the design to embody (a) peripheral overflow rim (b) mechanical removal of sand (c) more perfect elimination of slime by an auxiliary rising current of clear water," and he suggests that (a) and (b) be accomplished by a screw conveyor attachment to the bottom of a conical classifier, which brings us to classifiers of the well known screw type of which one sees advertisements in the technical press.

Costs

There is an increasing tendency to the publication of costs in the technical press. This makes detailed reference less necessary. During the year the Hollinger mill has undoubtedly impressed everyone as a clean equipment, cleanly run, with clean methods showing clean costs. Seldom has a property received a more beneficial advertisement than that which the methods of the Hollinger staff has secured for their operations. A reference to *The Engineering & Mining Journal* of October 18, 1913, page 739, gives the costs in very great detail and also the proportion of labor and supplies comprised in such costs. Thus we find stamping costs 18c. per ton; classification and tube-milling, 28c.; thickening, 1c.; agitation, 3c.; and filtration, 15c. Smelting and retorting (6c.) comes out to nearly as high a figure as the coarse crushing. Is it too much to expect that other concerns should give their costs as frankly as the

Hollinger? Such a course certainly creates confidence and interest. If we assume an average cost for the cyanidation of crushed pulp of 1s. 6d. (36c.) per ton, it would be interesting to receive statements from the various parts of the world where these costs are being bettered, such statements to be accompanied by a note of the quantity and nature of material treated, labor conditions and rates of pay, and other items of interest. The low cyaniding cost of 13d. (27c.) per ton at the Consolidated Langlaagte has already been referred to above. At the Goldfield Consolidated² the cost may be taken at least at 62c. per ton, not including 2c. for assaying, 7c. for precipitation, and 5c. for refining, and



THE VAN RYN DEEP MILL.

omitting the water charge altogether. At the Hollinger apparently the cost is 30c. per ton, not including 7c. for classification and precipitation and 6c. for smelting and retorting. At the Nevada Hills mill³ tube-milling is given as 29c., and the system of interrupted agitation with decantation washing appears to amount to 85c., and even so filtration comes to 18c. and discharge to 12c. It would thus appear that the interrupted method of agitation referred to above may be considerably more expensive than the direct method, and the previous decantation treatments do not apparently avail to reduce the filtration costs below the high figure shown. The government report shows that the Indian mines are working at very low figures; for example,

²*Mining and Scientific Press*, Dec. 28, 1912.

³*Eng. & Min. Jour.*, March 29, 1913, p. 646.

at Balaghât cyanidation comes to 15d. per ton treated, closely followed by the Mysore at 16 pence.

Fine Grinding

The success of the Hardinge ball mill for coarse grinding, as contrasted with the modified success of the conical mill for fine grinding, has long since caused speculation as to whether short tube-mills would not be as superior to the Hardinge for coarse crushing as the lengthened mills have shown themselves to be for fine crushing.⁴ Development has been proceeding along these lines, particularly in America, where a short tube-mill 7 ft. diameter by 10 ft. long is reported to be beating a conical mill by approximately 60%: "while it takes considerably more power it gains more than twice the tonnage." In Africa the Albu-introduced shorter 16 ft. 6 in. by 6 ft. tube-mill is now almost universally adopted in preference to the old standard 22 ft. by 5 ft. 6 in. The report from Mexico as to the results obtained by boring holes in the diameter of the tube-mill at various distances and taking samples from the effluent would be more valuable if the sizing tests had been given in full and also had the relation been established between the product at the periphery of the tube-mill and that delivered at the centre. If it were assumed that a certain proportion of the particles of pulp—taking tube-mills changed below the axis—were free to traverse unground from the intake to the exit of the tube-mill along its axis, then it would be admitted that a sample taken from the periphery did not represent the pulp at the axis or even pulp at varying distances from the axis toward the periphery. To that extent, therefore, the tests may not be reliable, but it is certain that in adopting as standard the old cement ration of 4 of length to 1 of diameter, however correct this standard may have been for use in Western Australia where fine sliming to 200 mesh was employed, such ratio could scarcely be the most economical ratio for such coarse grinding as was formerly the practice in South Africa (60 mesh) or even the 90 mesh now prevalent. The shortening of the tube-mill seems therefore a step in the right direction, as also the increase of the diameter to meet the increasing size of the particles fed, owing to the adoption of coarser mesh for the stamp screens.

For some years past I have been endeavoring to have exhaustive tests made in South Africa as to the size of particle which should be the economical limit for tube-mills of the size there installed. So far back as 1905 I was led to understand by Mr. Davidsen that 10 or 14 mesh was this economical limit. If this were true—and Mr. Davidsen's figures have proved remarkably accurate in practice—then it is obvious that the proportions for a tube-mill which should be suitable for taking a 20 or even 12-mesh product would not necessarily be economical for a 3-mesh product, much less the ½-in. clear aperture product recently tried at one of the latest mills on the Rand. The Rand benefits most freely by the adoption of methods introduced from the

outside. The adoption of tube-mills was worked out in Australia, in New Zealand, and even in Korea, before they were introduced to the Rand, and all the information was freely available to the Rand, just as today, when the Rand is adopting Brown agitators and Butters filters, it is adopting devices which have been worked out and proved elsewhere. At the time of the introduction of tube-mills to the Rand they were used mainly for the manufacture of cement and in gold mining for absolute fine sliming (minus 200 mesh). The results of the work of various observers were freely published⁵ for the benefit of the Rand. Surely the Rand might have published in return the results of its investigations into the problems of coarseness of feed, dimensions, charge, and other matters more particularly referred to in this review for last year and in my remarks to the Chemical Metallurgical & Mining Society of South Africa. It is for the benefit of the Rand that this information is required. But even in the matter of peripheral discharge, referred to in this review for 1908, as having given to all tests a greatly superior result to the ordinary discharge, the advantages or disadvantages have not been publicly threshed out, and it has been left to this review to suggest the only possible disadvantage yet suggested, the question of consumption of power. Strange though it may seem a wet-crushing mill which discharges either at the periphery or through the trunnion by means of elevator vanes lifting the pulp from the periphery, similar to the Abbé or Schmitt feed—these elevator vanes were provided in many of the first tube mills sent to the Rand—takes more power than a mill discharging through the trunnion in the normal fashion; and again, a mill with a discharge outlet considerably larger than the inlet takes more power, other conditions being equal, than a mill with a discharge only slightly larger than the inlet—owing doubtless to the greater proportion of pebbles rubbing idly, unlubricated by pulp. It is probable that there will yet be a development on the Rand in favor of peripheral discharge, but the increased results shown by the latter cannot be properly appreciated or discounted until one knows precisely the variation in power conditions required to produce these increased results.

Power Consumption

Apart, however, from the question of proportion of diameter to length, and even of variation in size and weight of pebbles for feeds of different coarseness, there is no doubt that the main question is that of power consumption which is now so heavy as to cause one a feeling of great uneasiness. It is true that in Australia and New Zealand, and in probably other districts where tube-mills were first introduced, mills are still operated for very low power, as a result of the adherence to the old standard number of revolutions and amount of pebble charge, but a consumption amounting to 1 hp. per ton of slimed product has to be reduced.

⁴See also Gates, *Bull. Amer. Inst. Min. Eng.*, Nov., p. 2706.

⁵See *Trans. Inst. Min. & Met.*, Vol. XIV.

Various liners and roller bearings have been put forward as a solution of the problem, at least in part, and there is evidence of remarkable savings arising from the adoption of such power-saving devices, but the publication of such a paper as that of M. G. F. Söhnlein* on 'Economical Fine Grinding Pans' arouses a keen feeling on the subject.

A Remarkable Grinding Pan

At times pans certainly appear most attractive. Some experimenter publishes results which appear to be better than those obtained in practice or which do not stand critical investigation. Mr. Söhnlein's paper is thought-compelling. His 5-ft. pan, taking say 6 hp. for only 32 revolutions per minute, gave only 2½ tons per 24 hours. This result probably reflects more on the type of the initial experiment than on the actual capacity of the pan. When, however, the pans were made to handle 7 tons of sand in 24 hours, he was obtaining a result of course better than the initial result: but at 40 r. p. m. the work of the pan did not compare with that obtained in Australian practice, where the normal speed is 56 r. p. m. for coarse crushing and about 50 r.p.m. for fine sliming. Mr. Söhnlein, however, by means of a most careful attention to detail and the exercise of no little ability to read the indications shown by his various tests and to devise improvements accordingly, was apparently able to grind 30 tons to minus 200 mesh with his one pan for less than 7 hp. This is good work and is taken as showing a result of over 43½ tons slimed per horse-power day. Here Mr. Söhnlein's practice differs from Australian practice, which is against the breaking down of coarse sand and the fine sliming of it in one operation. A 5-ft. Australian pan is assumed to grind 20 tons of coarse sand (say 200 holes to the square inch), but to fine slime to 200 mesh 20 tons per day two pans would be installed in parallel for breaking sand with a further pan in sequence to fine slime the product of the other two pans, or say 20 hp. in all.

When one comes, however, to look into the means by which Mr. Söhnlein achieved such extremely satisfactory results, he is met immediately from various quarters with a statement that all these methods have been tried before. In Cornwall at the tin works the investigator is shown pans made in Helston with a central feed somewhat similar to that shown by Mr. Söhnlein. From Australia he is met by the statement that the central feed was tried and discarded because the centrifugal motion was such that the feed was found to be sent from the centre between the shoes to the periphery anyhow, and therefore the central feed was unnecessary: and it was pointed out that special passages between the shoes and dies were a feature of Australian practice. Be this as it may, one is impressed by Mr. Söhnlein's work, by his methods of achieving his results, and by the fact that possibly the methods employed by him were discarded by previous operators because they were not tried in the same way. Any

methods which will give four times the pulp crushed for the same horse power are surely deserving of the closest attention of the industry, and we shall be much disappointed if we do not hear from Mr. Söhnlein and of his pan.

A point, however, which arises from perusal of his paper is that his discharged pulp, containing nearly 50% of plus-100 product, is coarser than that met with in Australia, and that it may be that the Australian practice of slining coarse product in a separate pan accounts for the apparent excess horse-power consumption. It is difficult to realize how, if Mr. Söhnlein slimes only 30% of his material in one passage through his pan, he is to slime the other 70% and at the same time break down the new ore coming from his mill. Thus, if we assume a feed of 38 tons of sand from the Overstrom tables, and that in one passage through only one-third of this is ground, then we are met with a return of two-thirds of this to the Dorr classifier with a consequent reject of 25 tons, or 65 tons in all to be fed to the pan, which is only capable of slining 13 tons, so that there is a consequent return of a still greater amount to the classifier until a position of equilibrium is established resulting in a lessened fine sliming output per passage. The paper is silent on the question of these returns. It is precisely for this purpose that the extra pans are required in Western Australian practice. We hope Mr. Söhnlein will let us have a further paper, with results of monthly runs; either his daily feed to his one pan is 114 tons per diem instead of only 38, or he is figuring on one-third of 38 tons only slimed per diem with results more nearly approaching those of the Ivanhoe and other mines at Kalgoorlie.

Filtration

There must be some reason for the advertised adoption of the Oliver filter at so many mines possessing fixed submerged filters. It is not suggested that the Oliver filter is a thorough washer. It was stated in this review for 1909 that there was far too great a tendency to use the fixed submerged filter in such a way that the results obtained were merely identical with those to be obtained from settlement and decantation. One welcomed Mr. Hamilton's statement as to his own particular practice, but the remarks were made as a result of working conditions observed at various plants and it would really appear as though, in the absence of any particular incentive on the part of the advertisers of the fixed submerged filter to maintain or effect a high efficiency, users are discovering that for mere subsidence results the Oliver filter is simpler and, in spite of the results shown above at the Nevada Hills, probably cheaper. W. A. McLeod† shows how the discharge of unfiltered (unwashed) pulp is prevented in Western Australia, and from Asia, from Rhodesia, and from Mexico good results—6 tons per leaf per diem—are reported from submerged vacuum-filters of rapid transfer type. It is surely a decadent proposal that for thorough washing shall be substituted a mere variation of the

**Eng. & Min. Jour.*, Sept. 27, 1913.

†*The Mining and Scientific Press*, September 13, 1913.

decantation process so thoroughly tried out in South Africa and in Western Australia. Even if the attractive proposal, from time to time put forward in the technical press, of the continuous use of a number of Dorr thickeners and Pachuca tanks in series be considered, it is found that the number of washing transfers is so great as to make such a process appear unprofitable when contrasted with cheap effective filtration, and certainly the statement of the Nevada Hills costs previously referred to does not help the decantation theory. As worked out for a South African project of 100 tons of 21 dwt. material, it appeared that the loss of dissolved metal in residues would be 1 dwt. per ton and in solutions $\frac{1}{2}$ dwt., or 2s. per ton; the difficulty in the case of solutions being aggravated by the impossibility of adding absolutely barren solution for the various transfers.

The experiments at Pachuca of dissolving the metals in filter-presses have been as little successful as the similar experiments carried out many years ago in Western Australia. It was then established that successful work depends on efficient solution of the valuable content of the ore prior to the introduction of the latter into filter-presses. Any additional extraction obtained by solution wash through the filter-press is regarded as an acceptable contribution toward the cost of filter-pressing but not as a serious process for the total solution of the gold in an ore.

Advocates of decantation are apt to forget the trouble and expense of handling huge quantities of material; a trouble plaintively brought to my notice from the El Oro district at the time the Hacienda San Francisco, Pachuca, introduced the simpler direct practice. Even with very expensive decantation plants worked on the huge Witwatersrand scale, my experience has been that the amount of dissolved metal lost in the residue, even on very low-grade material, is greater than the extra cost of treating that same residue in Dehne filter-presses—the most expensive form of filtration at present commonly employed.

Chemical

Reference was made at the outset to J. J. Denny's work at Nipissing in the desulphuring of silver ores at Cobalt. To those of us who since the days of Moldenhauer have worked in various ways with aluminum in our solutions and have invariably discarded the use of this metal owing to the fouling of the solutions with the much too readily formed aluminum hydrate, the statements coming over on this side and finally the description of Mr. Denny in the *Mining and Scientific Press* of September 27, 1913, caused some little incredulity; but incredulity or no incredulity, the fact remains that Mr. Denny's process is giving effective results and that it has to be taken seriously. It is true that it is stated that Mr. Denny's treatment at Cobalt effects a saving of from one to four ounces of silver per ton, depending on the amount of refractory minerals present, at a cost of, say, 1 oz. of silver or actually 54c. per ton, or the cost of roasting ores at

Kalgoorlie (see this review for 1906), and therefore as a mere substitute for roasting it may appear that there is but little to gain by the change; but the more closely one investigates Mr. Denny's discovery the more one is convinced of the advantages which may arise from its application under certain conditions. W. E. Simpson has told me the result of his immersion of some Australian telluride ore in Mr. Denny's solution apparatus, and experiments carried out by me here have confirmed the importance of Mr. Denny's discovery. Metallurgists in difficulty are invited to experiment with this new contribution to our knowledge, or, better still, to communicate with Mr. Denny at Nipissing.

With regard, however, to the use of this method in practice, as also to the use of aluminum dust in place of zinc for precipitation, we have not yet sufficient information to enable us to determine the effect in practice of the accumulation of aluminum in the works solutions. We were fortunate in the early days of cyanide in the aid of natural reactions which prevented the zinc from accumulating in solution. Unless we have some similar reaction in the case of aluminum, the difficulties arising from its use may be greater than the benefits. Mr. Denny is silent in his paper, but doubtless will give us the benefit of his experiences at an early date.

Another improvement of the year is the use of so-called 'acid' solutions in the treatment of ores which are found to foul and decompose the ordinary alkaline solutions. G. Gitsham's process has been described in 'Cyanide Practice in 1910-1913,' pp. 102-104, and reference to it will also be found in the *Journal of the Chemical, Metallurgical & Mining Society of South Africa*. At one of the great gold mines in Asia, where acid solutions have been employed, a lessening of cyanide consumption is reported for the same recovery as heretofore. Sulman and Picard point out that hydrocyanic acid is commercially impracticable as a solvent for gold, but the addition to the hydrocyanic solutions of a small quantity of ferrous or ferric sulphate, or of copper sulphate, in presence of air, renders hydrocyanic acid an effective solvent, and this is probably the explanation for the use of these 'acid' solutions on ores otherwise untreatable in view of the cyanide consumption when alkaline solutions are employed.

At Pachuca, tailing formerly treated by cyanide is now being leached for a long time with hyposulphite solution containing copper. There is an extraction of 50% of the gold, a much better extraction of the silver than formerly obtained, and in addition practically a total extraction of the mercury. Solutions are precipitated by copper pellets instead of by zinc, and the sludge is distilled. The cost is less than the cyanide treatment and the mercury is saved in addition. The volatilization process of gold recovery at the Gwalia Consolidated has been closed down. This news was not unexpected. It was recognized that Ben Howe had to deal with very serious difficulties in the recovery of volatilized gold.

Progress in the Application of Compressed Air

By ROBERT PEELE

No marked improvements or radical departures in practice are to be noted for the past year, in the production, transmission, and use, of compressed air for mining service. The field of application of compressed air power transmission, however, is continually widening in connection with the arts and manufactures, as well as in mining. In foundry work, pneumatic hammers have become indispensable for compacting large molds. This practice, which began about 1908, is now common in all foundries of any importance, and many different types of hammer are in use. The applications of compressed air have also extended in other directions, for foundries and machine-shops, as adjuncts to the main power-plant.

Progress in the use of electric drives for air-compressors has continued. It is unquestionable that, whenever electric current is obtainable at low rates, as from a central power-plant, both first cost and operating cost are reduced, as compared with steam-driven compressor plants. The installation of such plants for compressed-air hoisting engines, which began at the mines of the Miami and Anaconda companies in 1911, has given satisfactory results. Seven of the main Anaconda steam hoists were changed to compressed-air drive in 1911 and 1912, namely, at the Mountain View, High Ore, Diamond, Leonard, West Gray Rock, Tramway, and Pennsylvania shafts. During the past year the work of remodeling on the same lines the plants of all the remaining Anaconda shafts has been in progress. Ultimately, at this mine, there will be 9 main and 12 auxiliary hoists operated by compressed air.¹ Tests on the Mountain View hoist (the first to be run on the new system) showed a total mechanical efficiency, without reheating, of 36.37%; with reheating, something over 50%. This practice is likely to be followed at other properties where a number of hoists can be run from central electric and compressor plants. At the Copper Queen mine, five direct-acting main hoists, and two geared hoists have recently been converted to the use of compressed air, the old boiler plants being utilized as receivers. The air is reheated to 275° Fahrenheit.²

The increase in the use of hammer-drills has been general in this country for stoping and raising and sometimes shaft-sinking. In South Africa, also, where their introduction was at first slow, recent reports show that they are growing in favor. A number of new designs, and modifications of the older patterns, have lately been put on the market.

In connection with a new method for putting down large diameter drive pipes for foundation work, by means of the Goubert pile-driver, compressed air is

used for cleaning out the pipe. As the pipes are to be filled with concrete, the material within them must be completely removed. For this purpose, at intervals of every two or three feet, the driving is stopped, a small air-pipe is forced down inside as far as it will go, the receiver pressure run up, and the compressed air turned on. This quickly empties the pipe, and driving is resumed. On the Trans-Caucasian railways, compressed air, instead of steam, is now used for atomizing fuel oil. It avoids the formation of explosive gases in the furnace and economizes fuel consumption.³

A new high-vacuum air-pump has been invented by W. Gaede. It is of the multiple rotary type, working up to about 8000 r.p.m., at which speed a nearly complete vacuum is produced.⁴

The granulation of slag by compressed air is superseding the older method by water, and is the subject of a paper recently read by G. Juntzen before the German Metallurgical Association.

The Inspiration Consolidated Copper Co., of Arizona, has ordered six 10-ton, compound, compressed-air locomotives, together with a charging compressor of capacity sufficient for 14 locomotives, which, it is expected, will eventually be installed. The pipe-line pressure is 1000 lb.; main tank pressure, 800 lb.; initial pressure for the high-pressure cylinder, 250 lb., from which it is expanded to 50 lb. Before entering the low-pressure cylinder, the air is re-heated. It is stated that tests show that this mode of using the air gives a large increase of efficiency over the single-expansion type of locomotive. A series of tests recently made in Germany on compound compressed-air locomotives gave the following results: air preheated for both cylinders to 180°C.; length of run, from 0.62 to 1.16 miles; gross loads, 70 to 166 tons; air consumption per ton-mile, 26.3 to 32 cu. ft. for adverse grades of 0.13%. Aside from the question of relative economy of electric and compressed-air underground haulage, the latter has a distinct advantage for mines working ore-bodies of large lateral extent in which there are many secondary gangways and but few long continuous lines.

A Drill Tester

A few years ago the practice was begun of making efficiency tests on compressed-air rock-drill plants of large mines. The reasonableness and practical value of such tests have appealed more and more to progressive mine managers, and during 1913 series of tests have been made at several mines; for example, the North Star mine⁵ in California, and the Ojibway mine⁶

¹*Trans. Amer. Soc. Mech. Eng.*

²*Compressed Air Magazine*, Jan. 1913.

³*Mining and Scientific Press*, Aug. 2, 1913.

⁴*Eng. & Min. Jour.*, June 14, 1913.

⁵*Bull. No. 81, Amer. Inst. Min. Eng., and Mining and Scientific Press*, Nov. 2, 1912.

⁶*Mining and Scientific Press*, March 15, 1913.

in Michigan. Similar work, previously inaugurated, has been continued at the Franklin zinc mine, also at the mines of the Copper Range Consolidated Co., and other properties of the Michigan copper district. A drill-testing machine has lately been patented by W. D. Paynter, of Grass Valley, California, for making shop tests. Indicator cards are taken, air consumption recorded, and the strength of blow measured for different air pressures. Defective drills are thus readily detected and held for repairs, instead of being sent underground and causing loss of time. The effects of changes of air pressure and lubricants can be conveniently investigated. The apparatus is also useful for testing new equipment or for comparing the efficiencies of drills of different makes. It is adapted to both piston and hammer drills.⁷

A novel use of compressed air, for quarrying granite at Mount Airy, North Carolina, is described in *Mines and Quarry*, July-August, 1913. The granite lies in nearly horizontal sheets, forming a low hill. A hole three or four inches in diameter by five to eight feet deep is drilled near the centre of the area to be removed. The bottom of the hole is chambered out by half a stick of dynamite. In the cavity thus formed, a small charge of powder is exploded, which starts a horizontal cleavage. This is followed by a succession of charges of increasing size, the hole being plugged each time to confine the gases, until the cleavage reaches an area of say 75 to 100 ft. radius. Finally, a pipe is cemented in the original hole by melted sulphur, and connected to the compressed-air line. Air at 70 or 80 lb. is admitted, extending the cleavage over an area of several acres, thus affording a parting to which the quarrymen work in cutting the stone into blocks.

Portable Compressors

There has been a notable increase in the use of small, portable, independent air-compressors, driven by an electric motor or gasoline engine. In either case, the entire apparatus, including an air receiver, is mounted on a low truck. An electrically-driven compressor of this type, built by the Sullivan Machinery Co., has a 10 by 10-in. cylinder, and, at 20 r.p.m., compresses 181 cu. ft. of free air to 80 lb. gauge. A circulating pump is provided for cooling the air cylinder. The over-all dimensions, including truck, are about 8 ft. long by 5 ft. wide; total weight, 7200 lb.⁸ The compressor may be driven either by chain or gearing. These little plants are useful for a variety of underground service, where power is required temporarily at a distance from the main mine plant; for example, to operate one or two rock-drills, or a small pump, or a coal pick machine. Other designs of portable compressors are made by the Ingersoll-Rand Co. and the Clayton Works of the International Steam Pump Co. The Ingersoll-Rand Co. also supplies a number of dif-

ferent sizes of small, semi-portable, belt-driven vertical compressors.

Among the new gasoline-driven portable compressors are those of the Ingersoll-Rand Co., National Brake & Electric Co., and the Sullivan Machinery Co. One type, built by the last mentioned concern, is mounted on a heavy wagon truck for surface work, such as the operation of rock drills and contractor's machinery. Its rated capacity is 95 cu. ft. of free air per minute to 90 lb. at 165 r.p.m.; or 112 cu. ft. to 100 lb. at 193 revolutions. The gasoline engine is horizontal, and of 15 to 20 horse-power.

New York Law

The New York state law governing the conditions under which labor may be employed in an atmosphere of compressed air, has recently been radically amended by the Legislature. It is printed in the *Compressed Air Magazine*, October 1913, page 6998. A well known authority on compressed air engineering has called attention to two oversights in the amended law, in that it takes no account of the temperature nor of the breathable conditions of the air as determined chiefly by the volume furnished.

New designs of multiple-port, light disk air-valves are features of some recent compressors. They have a large port area and small lift. Among them may be mentioned those of Roby & Co., Ltd., Lincoln, and Walker Bros. of Wigan, England, the Iversen 'Automatic Plate' valve, made by the Mesta Machine Co., and the Rogler-Hoerbiger valve used in the Belliss and Morecom compressors, of England. All of these are spring driven, almost noiseless, and capable of working at high speed.

In 1908 the Rand Mines, Ltd., and Eckstein & Co., controlling large groups of the Witwatersrand gold mines, determined to adopt electric drive whenever applicable and to centralize their compressed-air plant. This led to the incorporation of the Rand Mines Power Co., the capital for which was furnished by the Victoria Falls & Transvaal Power Co., Ltd. The latter Company had been previously formed to supply power to the Transvaal mines, having in view the possible installation of a hydro-electric plant at Victoria Falls, on the Zambesi river, about 700 miles north of Johannesburg. This plant is still in abeyance and both companies, operating as a single engineering undertaking, are supplying power from steam turbine electric generating sets. The following is abstracted from the *Proceedings* of the Institute of Electrical Engineers, London, March 13, 1913:

The aggregate power of the plants thus far installed, or under construction, is about 180,000 kw. (241,280 hp.), while the total power now being used by the mines on the Rand is estimated at 400,000 hp. During the past year, an additional plant has been under construction and the main transmission lines extend nearly throughout the whole fifty odd miles of actively worked reef. There are four principal power-stations and two distributing stations. At two of these points,

⁷*Mining and Scientific Press*, Aug. 2, 1913, and *Eng. & Min. Jour.*, Nov. 1, 1913.

⁸*Coll. Eng.*, Nov. 1913, p. 260.

six miles apart—Rosherville (near Germiston) and Robinson Central Deep (east of Johannesburg)—are installed compressing plants supplying air to a 14-mile main pipe system. There are now in operation 12 rotary compressors of 3500 kw. each, and three new units of 7000 kw. each are now under construction; total, 63,000 kw., which is equivalent to 84,450 horsepower.

As a basis for determining a fair rate per unit to be charged to the consumers, a number of the separate mine compressors were tested. The average over-all efficiency of six of these sample compressors was 64.1%, and a commercial unit was fixed upon equivalent to 0.641 of the quantity of air which would be compressed isothermally by the expenditure of one kilowatt-hour of electric energy. The measurement of the compressed air was an important and difficult problem. A displacement meter of large size was designed, which

gave sufficiently accurate results for a flow of air through an orifice of 0.1 in. diameter. With this master unit as a standard, a series of orifices were calibrated for testing the sample mine compressors. For measuring the air used by the individual consumers, a meter working on the principle of the Venturi tube was adopted. The coefficient for the tube was fixed by a long series of tests, and measurements are now being made with extremely small limits of error. Of the air units supplied, 95% are recorded on the consumers' meters, 3% lost in transmission, and 2% unaccounted for. The delivery pressure is 100 lb., the average pressure drop from the generating plant to the consumer being not over 6 lb. The observed delivery pressure is found to vary not more than 2% from the calculated pressure. This remarkable installation of central and distributing plant is likely to be still further extended.

The Irving Leaching Process

By L. S. AUSTIN

Joseph Irving, of Salt Lake City, has patented a process* for the leaching of oxidized and sulphide ores of copper containing gold and silver. Essentially it consists in crushing mixed carbonates, oxidized, or sulphide ores of copper to 12 or finer mesh. The crushed ore is subjected in leaching vats to the action of the mother liquor containing ferric sulphate from a prior leaching, to which has been added some sulphuric acid and common salt. The ore and solution together is mechanically agitated and heated by injecting steam. Upon conclusion of the agitation the mixture is allowed to settle. It is then drained and washed, yielding a copper-bearing solution, which is passed through a filter consisting of sand and fresh iron pyrite, and then through the precipitation vats. Recovery of the metals may be accomplished by electrolysis and by passing solution over scrap iron. The remaining solution can be regenerated for further use; it is oxidized by a steam jet which agitates it violently, bringing it in contact with air. The solution is then reinforced with sulphuric acid and salt, and is ready to be again used for a fresh charge.

It would appear that the free sulphuric acid reacting on copper carbonate would give cuprous sulphate which would decompose the salt as follows:

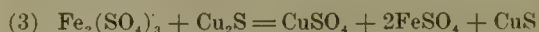


and the copper chloride, acting upon silver sulphide, would decompose it:

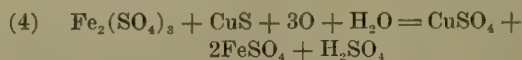


In presence of salt in the solution the silver chloride dissolves. Gold would be acted on in the same way.

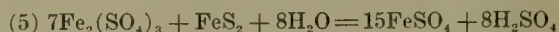
Ferric sulphate, acting on chalcocite, changes it to copper sulphate thus:



and the resultant CuS, as well as that in the same condition in the ore, would be changed as follows:



When the ore has been leached, the resultant solution, before going to the scrap-iron boxes for precipitation, must have the ferric sulphate changed to ferrous form, otherwise the consumption of scrap iron will be largely miscarried. This is done, as already specified, by running the solution through a filter containing fresh pyrite.



This ferric is changed to ferrous sulphate and sulphuric acid is regenerated.

After the copper, gold, and silver have been precipitated the barren liquor, being agitated by a steam jet, its contents ferrous sulphate is changed to ferric sulphate.

Fig. 1 is a plan of a 50-ton mill, designed for the effective carrying out of the process along lines suggested by the long experience of the inventor in the hydrometallurgy of copper.

The ore, after coarse crushing, goes to the 100-ton storage bin B, whence it is fed regularly to a Hardinge mill, being crushed in the iron sulphate solution flowing from the iron sulphate storage tank. The leaching vats E, E' are alternately filled with the pulp, being at the same time agitated by a four-arm stirrer. When two-thirds full the proper quantity of sulphuric

* U. S. patent 1048541, December 31, 1912, *Salt Lake Mining Review*, XV, 17; *Met. & Chem. Eng.*, XI, 160.

acid is run in from the acid storage tank or acid-bearing liquor from the dilute copper sulphate storage tank *D*. When a vat has been filled with pulp, the stirrer is stopped and the contents allowed to settle. The supernatant liquor is now decanted, going to the strong liquor storage tank *J*. The pulp left in the leaching vat is drawn off to the cone-classifiers *F* and *G*. In these classification is effected by aid of a rising current of wash-water, while the underflow from both cones goes to the concentrating tables in case it contains heavy sand of value, otherwise it is wasted. From the concentrating tables the tailing, if worth while, can be pumped back to the Hardinge mill for further treatment. The overflow from the second

cone *G* goes to the pulp storage tank *H*. From this, as much of the clear liquor as possible is decanted before the remaining slime is withdrawn at the bottom to one or other of the filter-tanks *I* and *I'*. The filter-tanks have false bottoms of porous tiles which will be unaffected by the acid liquid. The filtrate from either tank is withdrawn to either of the liquor storage tanks. One of the tanks is for the stronger, the other is for the weaker solution. From these the solution is delivered in regulated flow to the electrolytic-deposition boxes *K, K, K, K*, where most of the copper is precipitated electrolytically. The partly impoverished liquor then goes to a sump-tank *L* and to the iron precipitation tanks *M, M'*, where the remaining copper is recovered by scrap iron; or the solution at *L* containing a little copper, may be sent back by a centrifugal pump to the copper sulphate storage tank *D* to be again used. The barren solution in the second sump tank *N* is also sent back by a centrifugal pump to the high level iron sulphate tank *C* and is there agitated by blowing in steam, whereby the ferrous sulphate is changed into ferric sulphate, and is then ready for use on a fresh charge. The cycle of operations for crushing, filling tank, leaching, and washing contents, and finally emptying tank, will average 48 hours.

A number of laboratory tests in 1 to 5-lb. lots have shown an extraction of copper varying from 77 to 99% and with an average of 91.4%; while several ores which had appreciable amounts of gold and silver with the copper were also found amenable; for example:

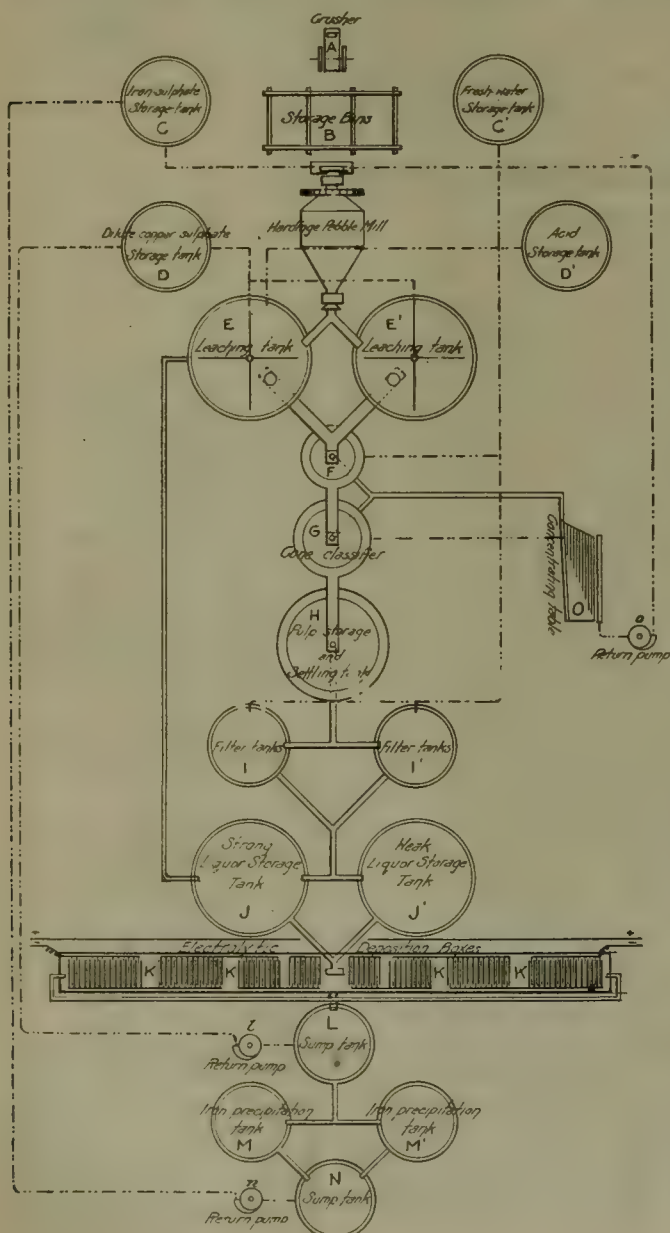
	Gold.	Silver.	Copper.
Utah ore: Original	0.06	0.56	1.60
Tailing	0.01	0.09	0.13

This amounts to an extraction of 75% of the gold, 83% of the silver, and 92% of the copper.

On a larger scale, using 700 lb. of copper ore containing 1.32%, an extraction of 79% was made; on another lot of 1500 lb. containing 1% copper there was a recovery of 74%. In precipitating the copper there was consumed 1.28 lb. iron per pound of copper recovered.

On these 50-lb. lots, some Utah copper ore, containing Cu 0.81%, together with 0.145 oz. Au, and 5.06 oz. Ag per ton, gave, as the result of three tests, an average extraction of 56% of the copper, 41% of the gold, and 60% of the silver with a copper precipitate containing 68.52% copper with 1 oz. of gold and 189 oz. of silver per ton.

On an operating scale, March 1913, on some Nevada ore a charge of 23.19 tons, containing 4.65% copper, gave the following results using decantation and leaching, the ore hav-



ing been crushed in the returned barren solution; there was actually extracted by the solution 93% of the copper. Precipitation was slow because all the iron was new. There was used 1603 lb. of acid; the milling time was 9½ hours.

On another charge, 30 tons dry weight, March 1913, the ore contained 2.86% copper. The ore was crushed in the barren solution, and after settling 12 hours the supernatant solution was decanted. Acid was then added and the whole mass was stirred and allowed to settle. The decanted solution contained 1.57% copper. The total copper dissolved was 1610.66 lb., equal to a 94% extraction and 3200 lb. of acid was used. This charge contained a very large portion of copper glance (chalcocite). It is interesting to note that ores containing copper glance leach slowly.

On copper carbonates and oxides, and with acid quoted at an average price of \$25 per ton, the acid consumption would be 2c. and average treatment costs 4 to 5c. per pound of copper. On heavy sulphide ores acid consumption would be 3c. and average treatment costs 5 to 6c. per pound of copper. It is estimated that a crushing and leaching plant to treat 100 tons per day would cost \$35,000. This includes building and equipment complete. Scrap iron delivered would cost \$15 per ton. The consumption of iron is placed at not to exceed 1.5 lb. per pound of copper recovered and of acid not to exceed 2 lb. per pound of copper, and it may be considerably less than that.

Gold-Dredging in Burma

Gold-dredging in the Irrawaddy river has been actively carried on for the past eight years by the Burma Gold Dredging Co., according to an article in the *Rangoon Times* recently quoted by the *Far Eastern Review*. Starting with one small dredge, the Company has increased the magnitude of its operations until it now has five boats on the river. The dredging is entirely confined to the bed of the Irrawaddy river, for there appears to be no beach-gravel or benches containing gold. The banks of the river are high and consist of solid rock. Dredging on the river is both difficult and hazardous, although the gravel, where accessible to the dredges, is said to be easy to dig and free from large boulders. The gold occurs in an extremely finely divided condition. It is stated that about 50 miles of the inner bed contains gravel which is profitable and suitable for dredging. The gold content is low, but the average per cubic yard is not stated. During the eight years of operation, the Burma company has made a total recovery of gold valued at about £150,000, but the earnings have been insufficient to permit of the payment of dividends. It is stated that the cost of operating is approximately 4c. per cubic yard. The management has found that the native laborers are quite competent to handle the dredges after they have been trained by white dredgemen, with the result that the expert white labor has been found unnecessary.

Flotation Processes During 1913

By EDWARD WALKER

In reviewing the progress of flotation processes of concentration during the past year, the subject naturally divides itself into two parts dealing with law-suits and technology, respectively. Never was any branch of metallurgy fraught with so many disputes, both legal and personal, and to an independent journalist it is no congenial task to have to write on the subject at all. Even now the last echoes of my article appearing in your pages in January last have not died away. I shall begin by recording the legal history of the year.

The appeal of the Elmores against the New South Wales judgment was heard in October before the Judicial Committee of the Privy Council, and after the arguments were completed the litigants were notified that the case was to be re-heard in January. The reason for this step was not given, and all sorts of wild guesses have been made on the subject. The less said by me on this occasion the better. The other litigation was in the Montana court where Minerals Separation sued James M. Hyde for infringement in connection with the plant at the Butte & Superior. The judgment was against Mr. Hyde, but it did not involve the Butte & Superior company, and so did not further the collection of royalties on the ore treated. A separate action was commenced in October with the latter object in view and was decided in November. The Butte & Superior entered a different defense from Mr. Hyde, and pleaded that it used more than 1% of oil, claiming thus a distinction from the Sulman-Picard-Ballot process, which refers to comparatively minute quantities of oil. It was held that there were no new issues involved in the case, and while a preliminary injunction was refused by the Court because of the industrial disturbance that would have resulted, the Butte & Superior was put under bond pending decision of the appeal of the original case. A year ago I mentioned that J. D. Wolf was intending to bring suit for infringement of his rapid-agitation method as applied to flotation. Nothing further has been heard of this, and the inventor is apparently waiting for the result of the Elmore-Minerals Separation suit.

As regards the technology of the subject, the Minerals Separation process continues to prove its effectiveness and cheapness, and its use is extending widely. It is not necessary to give details of the many plants erected or in course of erection, but it is opportune to say that the first part of the plant at the Inspiration copper mine in Arizona was ready for operation December 1, though actual commencement of operations has been delayed owing to failure of power. Work will doubtless begin in January with a capacity of 600 tons per day. Much has been heard recently of three processes developed at Broken Hill that may be described not unjustly as modifications of the Minerals Separation process adapted for special purposes; that

is to say, they are intended for selectively separating the galena and blende in the slime. Lyster's process in use at the Zinc Corporation plant and owned by Minerals Separation consists of floating the galena and leaving the blende to sink. This is effected without acid and with a small amount of eucalyptus oil, in water at the ordinary temperature and charged with salts such as the sulphates of lime and iron. The Owen and Bradford processes aim at floating the blende, using very high temperatures, and more acid and oil. The Owen process is being installed in the Sulphide Corporation, Broken Hill South, and De Bavay's plants. The Bradford process is being worked at the Proprietary and is a modification of the Potter-Delprat process, introducing oleic acid. The variations between these three processes are, of course, largely caused by the different constitutions of the ores to be treated. The Horwood process, involving a part roast to sulphatize the galena, is in use at the Zinc Corporation mill, and its value as compared with the Owen and Bradford has yet to be tested. The Elmore vacuum process is not being used to any great extent nowadays.

The other process that has potentialities is the Murrex, and probably its future will be in the treatment of carbonate copper ores. At the Whim Well, in Western Australia, excellent results are obtained, though a hitch has temporarily intervened requiring the substitution of dry crushing and dry screening instead of the wet-crushing plant. The cause of this trouble was the kaolin in the ore making a mud that would not pass the screens. The process is at work at Malines, in France, on a zinc-lead ore, and at the Grund mine, in the Harz mountains, Germany. The most recent plant built is one shipped to the Kahn copper mine in German Southwest Africa. It has a capacity of 200 tons per day and is to treat a mixed carbonate and sulphide copper ore. The plant at the Cordoba copper mine, in the south of Spain, is not giving satisfaction, and the directors are threatening to suspend its operation. This plant does not treat the whole output, but only the re-crushed jig-middling. The process was adopted on account of the large amount of calcite, which consumed the acid used by other processes. That was several years ago, and probably some modern modification of the Minerals Separation would be applicable. No doubt also some of the modern concentration tables would be of service. The dissatisfaction at Cordoba is, however, not associated entirely with the process itself; it is largely caused by the poor quality of the plant.

Application of flotation methods to treatment of copper ores made great strides in America in 1913. It is now being used from British Columbia to Chile and its applicability to Alaskan ores has been shown by test. Its importance in this connection is due to the fact that the copper ores are the ones that are now being worked upon large scale and at the same time the ones where wet-concentration is especially imperfect.

Mining Litigation—Review and Forecast

By ROBERT M. SEARLS

The year which is just passed has not been noteworthy for any number of important decisions in mining cases. Perhaps the overruling of the Yard decision by the new First Assistant Secretary of the Interior in the case of J. P. Nichols and Cy Smith before the Land Department, is entitled to the most important consideration. Although the effect of the Yard decision, as a precedent for the general interference of the Land Department in the matter of oil placer locations was largely nullified by the Act of Congress of August 24, 1912, it has remained for the present administration in the Interior Department to clear the horizon generally by flatly overruling this decision. If government lands have been illegally located or are being illegally held under the mining laws, the proper forum for determination of this fact is now admitted to be in the courts, not before the Land Department.

Only two cases of any importance involving extralateral questions reached the Appellate Courts, the Round Mountain case in Nevada and the Stewart-Ontario case in Idaho. In the first case, although the orebodies in dispute were in the extralateral segment of the vein, the case hinged on the right of the plaintiff to swing its location lines under an ambiguity in its patent so as to include a segment of defendant's extralateral sweep. The court permitted the defendant to go back of the patent and show from the record the relative rights as established by location priorities. The case is still pending on a re-hearing. The Stewart-Ontario case involved an attempt to claim an apex on the faulted edge of a vein, the court holding that no extralateral right could be predicated on such a showing as it would involve taking the right on the strike instead of on the dip of the vein. The decision also reaffirmed the rule that the end lines of the discovery vein are the end lines for all secondary veins having their apices within the claim. This case has been taken to the United States Supreme Court and is still pending.

Two interesting decisions by the Federal Courts in Wyoming and Idaho in the Duffield-Chemical Co. cases have upheld the jurisdiction of the courts to determine the character of the land involved in a suit brought on an adverse claim by lode claimants against applicants for a placer patent to the same ground, where such a determination is essential to a proper decision of the controversy. Incidentally it was held in these cases that rock phosphate is properly locatable as a lode and not as a placer deposit.

Distinction between bona fide and paper oil placer locations was made by the California Supreme Court in the case of *Smith v. Union Oil Co.* Neither plaintiff nor defendant had made an actual discovery of oil, but the junior locator was in actual possession and proceeding with due diligence to make a discovery

on the claim which the senior locator had held for 27 years without other evidence of title than a paper location. Upon such a showing the junior locator was allowed to quiet title against the senior. Work done on adjoining claims was not allowed to count as discovery work on the claim in dispute.

An interesting case arose in Utah involving the measure of damages where one of two co-tenants has extracted ore and failed to account to the other co-tenant for a share of the proceeds. In this case of Silver King Coalition Mines Co. v. Silver King Consolidated Mining Co., the court held that the defrauding co-tenant was liable only for the value of the ore less the cost of mining the same, on the grounds that the taking of the ore was lawful although the detention of the proceeds might be unlawful, and that hence the lesser measure of damages should prevail.

The escape of tailing from the Arizona Copper Co.'s mill into the Gila river was perpetually enjoined by the United States Supreme Court at the suit of riparian agriculturists whose lands had been injured by such deposits. In addition to the foregoing, a few cases on the question of conflicting location boundaries and a large number of suits involving the construction of oil, gas, coal, and other mining leases have been decided during 1913.

Decisions Expected

The coming year promises to bring some important decisions terminating cases of great national interest. Chief among these are the suits brought by the United States and private locators to test the validity of patents held by the Southern Pacific Railroad Co. covering a large acreage of valuable oil lands in California. The Kennedy Extension-Argonaut case in Amador county, California, involving extralateral ownership questions, should reach a decision in the trial court and the considerable sums which have been accumulating as the output of the Argonaut mine during this litigation be released. In Arizona there is a condemnation suit pending between the Inspiration and New Keystone Copper companies, the decision of which will settle for that state the question of whether mining is a public use in view of the existing constitutional and statutory provisions. In Alaska, the new territorial mining code will doubtless be productive of litigation, especially those provisions which require \$100 worth of labor to be performed annually on each 20-acre subdivision of an association placer location even though such location may have been made prior to the enactment of the code.

Outside of the field of litigation, interest in the mining world will centre on the movement which will doubtless crystallize into congressional bills looking to an entire revision of the mining law of this country. Just what will happen it is too early to predict, but there is already enough discussion on both sides of the question to insure its presentation to Congress from all points of view, and to warrant a fair consideration of the subject at the hands of the national legislature.

Quicksilver Production and Prices

By CLIFFORD G. DENNIS

During the past year the quicksilver producers have experienced not only a decrease in price for their metal, brought about by London sales and the effect of the new tariff schedule, but have suffered with all other industries through decrease of sales and corresponding increase in stock. Quicksilver is something that consumers do not buy because it is cheap, but because they absolutely need it in their business. Consequently a decrease in price does not mean increase in sales and increase in mine operations; instead, as in the past year, it means storing what surplus accumulates and curtailing production and expense where curtailment can be exercised without dangerous disorganization. The price of the metal is regulated by the London market absolutely, the only exceptions being those brought about by the zeal of the different agencies to do business. This zeal, for the past three years, has reduced the price received by the American producers from \$3 to \$5 per flask below the price indicated by the London market.

The production for the United States is estimated at 23,000 flasks, which is below normal. That for the past ten years has averaged 25,619 flasks. The average price actually received during 1913 was \$39.25 per flask. The average price for the past ten years was \$41.83 per flask. The gross value for 1913 was \$902,750; the average gross value for the past ten years \$1,071,650. Of the 23,000 flasks produced, California furnished 18,000; Nevada, 2400; and Texas, 2600. Oregon failed to report any production, as did also Utah and Arizona.

The New Idria mine, in San Benito county, California, continued to maintain the largest production in the United States. The Guadalupe mine, in Santa Clara county, California, ranked second, and the Chisos mine, in Brewster county, Texas, third. Operations at the New Idria mine continue to demonstrate the almost inexhaustible supply of mercury ores that occur in the oldest of Coast Range formations, early Cretaceous metamorphic, and of the consistency of this belt of material that extends from Lake county in the north to San Luis Obispo in the south. At the Oceanic mine, in the latter county, operations are proceeding with very satisfactory results. Murray Innes, of San Francisco, recently purchased this property from the Oceanic Quicksilver Co. of Los Angeles. Mr. Innes reports that during the past year he has developed 300,000 tons of ore with a tenor from 8 to 10 lb. of mercury per ton, that the ore is very even in grade, that the vein is from 20 to 40 ft. wide, and that the shoot is 800 ft. long. A shaft from the present fourth level is under way, the intention being to sink to a depth of 500 ft. It will be interesting to learn what the geologic conditions are, when the shaft at the Oceanic mine penetrates the sandstone and enters the

metamorphic formation. At the Gaudalupe mine in California the furnaces have been running continuously, and it is said that developments in the mine have demonstrated that there is more ore in sight than was extracted in 1913. At New Almaden, the Quicksilver Mining Co. ceased mining in June at the time of the reorganization of the Company. Since that time the furnaces have been operated from ore gleaned from old dumps by sorting. The Company contemplates an extensive development program during 1914. This development will probably consist of exploring that territory between Mine hill, where the old mine was situated, and the El Senidor mine about $3\frac{3}{4}$ miles distant. Most of the ore mined at New Almaden for the past few years has come from the El Senidor and the possibility of more ore in this mine is most promising. At the Helen mine, in Lake county, California, production has been curtailed while extensive development was proceeding.

The Chisos mine, in Brewster county, Texas, continued to operate throughout the year. Other activities in the Texas field consisted of prospecting and development only. In Arizona, the Cinnabar Development Co., operating the old Colonial mine in west central Yuma county, failed to report any production. It was rumored that a set of retorts was to be placed at this mine to work the rich ore that was found on the lower levels. The Sunflower Cinnabar Mining Co., with headquarters at Phoenix, Arizona, has taken over a property near Cline, in Gila county, and is expected to begin the erection of a furnace immediately.

The Mercury mine at Ione, Nevada, continued to operate its furnace throughout the year. The Nevada Cinnabar Mining Co. completed the erection of a 50-ton plant on the Ione property. The plant consists of a double, four-tile, Mirabel type, Scott furnace, and eight double condensers. The plant itself is one of the best ever built, but the situation and arrangement could have been more convenient and better adapted to the delivery of the ore from the mine. The common brick for the furnace was made on the ground from a comparatively weak clay full of sharp angular bits of rhyolite, the moulding was done with a soft-mud machine; the result was a hard, square, almost perfect brick far superior to the common slop brick. The Ruby mine, situated about five miles south of Imlay in the Humboldt range, erected a battery of twelve 12-in. pipe retorts during the year and had a satisfactory run. It is proposed to erect a furnace on this property in the spring. The Nevada Quicksilver or Goldbank Quicksilver mine, situated about 40 miles south from Winnemucca, Nevada, has done considerable developing and has exposed the largest single deposit of cinnabar in the state. There is not a great deal of high-grade ore, but a large quantity of commercial ore is exposed and so situated that it can be mined at a low cost per ton. The metal occurs generally in an imperfect agglomerate. The agglomerate lies quite flat in parallel bedding, varying in thickness from a foot to four feet. These 'reefs'

of agglomerate alternate with strata of altered rhyolite varying from a few inches to several feet in width and thoroughly saturated with cinnabar. At a distance of approximately 300 to 400 ft. is a strong fissure filled with opaline material that carries a little cinnabar. The evidence of hot-water circulation is very clear and the relation of this main fissure to the ore-bearing material will prove a most interesting study as the work progresses. Upon locating the points on the map where mercury occurs in Nevada, it is interesting to note the directness of the course between them. Beginning at the Pine Forest range (reported in 1899) in the north, thence to the Ruby mine just south of Imlay, thence to the Goldbank in the East Range, thence to the Mercury and Nevada Cinnabar at Ione, thence to the several deposits about Round Mountain, Manhattan, and Belmont, thence to a deposit reported as 20 miles east of Goldfield, thence to the Fluorine district, 5 miles east from Beatty in the south, they are practically in a straight line and include 90% of the reported occurrence of the metal.

Books of the Year

- CHARLTON, W. H. 'American Mine Accounting.' 367 pages. McGraw-Hill Book Co. \$5.
 DURHAM, E. B. 'Mine Surveying.' 390 pages. McGraw-Hill Book Co. \$3.50.
 EARL, T. C. 'Gold Dredging.' 208 pages. Spohn & Chamberlin. \$8.
 EMMONS, S. F. 'Ore Deposits.' 954 pages. American Institute of Mining Engineers. \$5.
 FAWNS, SYDNEY. 'Radium: Its Production and Uses.' 60 pages. *The Mining Journal*. \$1.
 FINLAY, G. I. 'Introduction to the Study of Igneous Rocks.' 228 pages. McGraw-Hill Book Co. \$2.
 HATSCHER, EMIL. 'Physics and Chemistry of Colloids.' 94 pages. P. Blakiston's Son & Co. \$1.
 HEATHER, H. J. S. 'Electrical Engineering for Mechanical and Mining Engineers.' 324 pages. D. Van Nostrand Co. \$3.50.
 HOPMAN, H. O. 'General Metallurgy.' 909 pages. McGraw-Hill Book Co. \$6.
 HOOVER, HERBERT C. and LOU C. 'Translation of De Re Metallica,' by Georgius Agricola (1556). 640 pages. *The Mining Magazine*. \$8.
 HOOVER, T. J. 'Concentrating Ores by Flotation.' 221 pages. *The Mining Magazine*. \$3.75.
 IDDINGS, J. P. 'Igneous Rocks.' Vol II, Descriptions and Occurrence.' John Wiley & Sons. \$6.
 JANIN, CHARLES. 'Mining Engineers' Examination and Report Book.' Two parts, 94 and 57 pages, respectively. *Mining and Scientific Press*. \$2.50.
 LEITH, C. K. 'Structural Geology.' 169 pages. Henry Holt & Co. \$1.50.
 LEWIS, J. V. 'Determinative Mineralogy, with Tables.' 151 pages. John Wiley & Sons. \$1.50.
 LINDGREN, W. 'Mineral Deposits.' 883 pages. McGraw-Hill Book Co. \$5.
 LORD and DEMOREST. 'Metallurgical Analysis.' 334 pages. McGraw-Hill Book Co. \$2.50.
 MCCULLOCH and FUTTERS. 'Winding Engines and Winding Appliances.' 452 pages. Edward Arnold. \$6.
 OF, CHARLES (Editor). 'Mineral Industry.' Vol. 21, 1090 pages. McGraw-Hill Book Co. \$10.
 PAINE and STROUD. 'Oil Production Methods.' 239 pages. Western Engineering Pub. Co. \$3.
 REDWOOD, SIR BOVERTON. 'A Treatise on Petroleum.' Third edition. In three volumes. 1198 pages. Chas. Griffin & Co. \$15.
 RICHARDSON, C. H. 'Economic Geology.' 320 pages. McGraw-Hill Book Co. \$2.50.
 RODENHAUSER and SCHOENAWA. 'Electric Furnaces in the Iron and Steel Industry.' 417 pages. John Wiley & Sons. \$3.50.
 SKINNER, W. 'The Mining Manual,' 1913ff. 1356 pages. Walter R. Skinner. \$5.25.
 VON BERNEWITZ, M. W. (Editor). 'Cyanide Practice, 1910-1913.' 732 pages. *Mining and Scientific Press*. \$3.

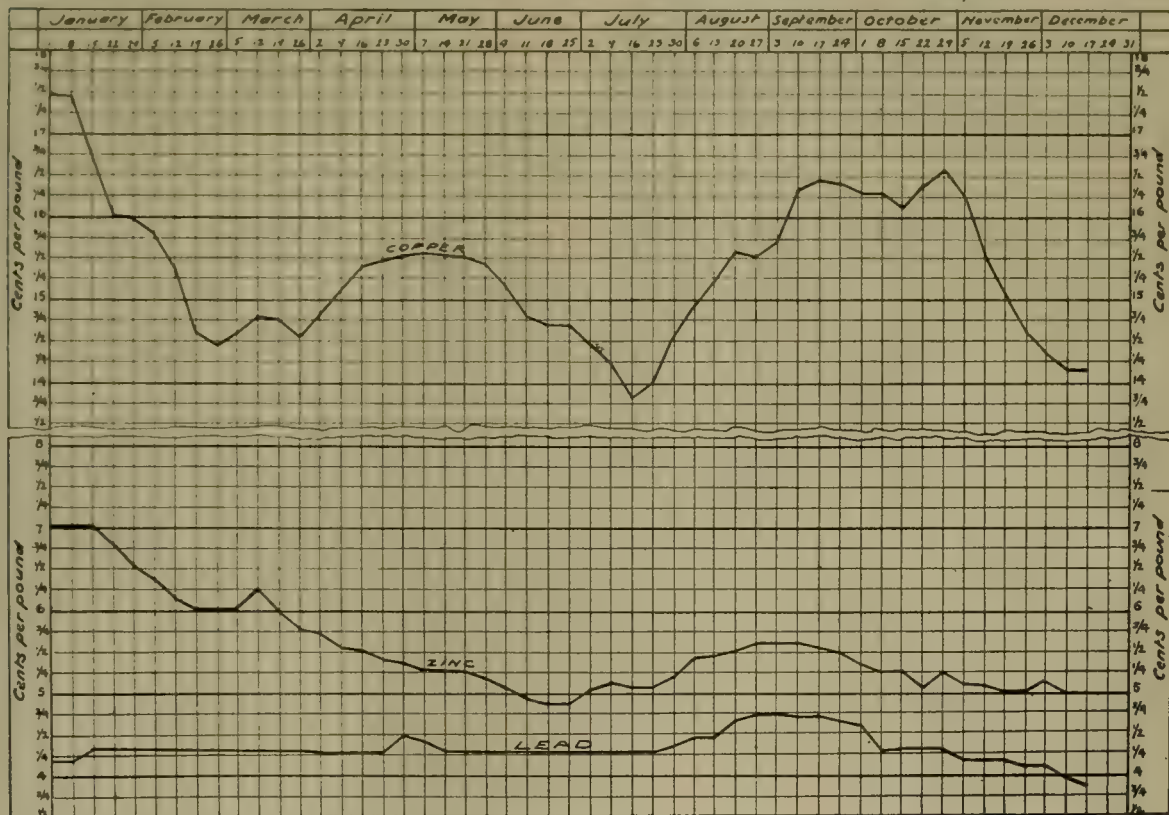
Metal Prices and Markets in 1913

SPECIAL CORRESPONDENCE FROM NEW YORK

METAL PRICES AND MARKETS IN 1913

In 1913 the metals slumped in price, apparently in line with the statement that the times call for a readjustment of the cost of raw materials. The declines were helped along, of course, by the lessening of business activity in the last four months of the year. The year was notable for the low points reached by copper stock, at home and abroad. Exports were good. Lead touched the lowest figure since February, 1912. The feature of antimony was the oversupply. Pig tin declined about 14c. in the year. Aluminum was greatly affected by the new tariff and suffered also from the slower activity of the automobile industry.

of the month having been greater by 5,302,928 lb. than that of February. The domestic consumption showed a marked increase in the month. In April there was another large decrease in stock, that on May 1 being 28,720,162 lb. less than that on April 1. The big reduction was due chiefly to a increase in deliveries of nearly 10,000,000 lb. over those of March, about 8,000,000 lb. of the increase being for export. In May the stock decreased 8,074,883 lb. leaving on hand at the end of the month 67,564,225 lb. May production ran 5,986,914 lb. over that of April, while domestic deliveries increased about 3,000,000 lb. and those for export decreased 17,608,749. In June there was a decline in production of nearly 19,500,000



GENERAL COURSE OF METAL PRICES PLOTTED FROM WEEKLY QUOTATIONS IN THE MINING AND SCIENTIFIC PRESS.

COPPER PRODUCTION AND DELIVERIES

The production in January—143,479,625 lb.—was the largest ever known for that month and resulted in an increase of 17,885,750 lb. in the domestic stock of surplus marketable copper. In February, for the first time since the preceding August, the figures of the Copper Producers' Association showed a decrease in stock. The decrease was only 896,134 lb., but it marked the turn, after which the stock continued to dwindle until October. As the table herewith shows, the low point with only 29,793,094 lb. on hand was reached October 1. Production fell off in February, but total deliveries increased 6,251,140 lb. A falling off in surplus stock was expected in March, but that it would decrease 18,032,928 lb. as it did, was a surprise and the more noteworthy because of the production

pounds as compared with May, which caused a decrease in stock of 14,659,619 lb., despite the fact that domestic consumption was about 12,600,000 under that of May and that export deliveries fell off slightly also. The lessened production was in part due to the strike at the Nichols refinery on Long Island. August 1 there was an increase in stock of 690,339 lb., domestic consumption in July having fallen off nearly 10,000,000 lb., while foreign deliveries increased 10,000,000 lb. September 1, the stock had dropped to 38,314,037 lb., a decrease of 15,280,908 lb. from that of August 1. The nearest previous low record was 44,335,004 on July 1, 1912. Production in August declined nearly 7,000,000 lb., while domestic deliveries were 14,745,609 lb. over those of July; with foreign deliveries over 5,000,000 less. The September production was 131,401,

229 lb., about the same as that for August, but at the end of the month the stock had decreased to 29,793,094 lb., the smallest for any month since the first publication of the figures of the Copper Producers' Association about five years before, the nearest previous low stock having been that of September 1, 1913. The figures of the Copper Producers' Association coupled with those of Henry B. Merton & Co. Ltd., London, England, showed the world's visible supply on October 1, 1913, to be 41,119 tons, a reduction of 10,030 tons as compared with September 1 and the lowest supply on record. From October 1, the stock increased, gaining in the month 2,773,288 lb. Production in October increased 7,669,252 lb., and domestic deliveries increased 1,336,823 lb., while foreign fell off 4,961,802 lb. November brought a decrease of 4,982,773 lb. in production, but nevertheless an increase of 15,363,047 lb. in stock was shown December 1, because of the heavy falling off in domestic deliveries. They decreased 19,516,862 lb. from those of October and totaled but 48,656,858 lb., the lowest in any one month for nearly two years, the previous low record having been in January 1911, when about 42,000,000 lb. was delivered. Deliveries for export in November were 70,067,803 lb. or 1,944,330 lb. over those of October. Following tables show the United States production and deliveries, and the domestic surplus stock at the beginning of each month as presented by the monthly statements of the Copper Producers' Association:

	Production.	Domestic Deliveries.	Deliveries for export.
Total for 1911	1,431,938,338	709,611,943	754,932,733
December, 1912	143,354,042	58,491,732	65,713,796
Total for 1912	1,581,920,287	819,665,947	746,396,453
January, 1913	143,479,625	65,210,030	60,383,845
February	130,948,881	59,676,492	72,168,523
March	136,251,849	76,585,471	77,699,306
April	135,333,402	78,158,837	85,894,727
May	141,319,416	81,108,321	68,285,978
June	121,860,853	68,452,571	68,067,901
July	138,074,602	58,904,192	78,480,071
August	131,632,362	73,649,801	73,263,469
September	131,401,229	66,836,897	73,085,275
October	139,070,481	68,173,720	68,123,473
November	134,087,708	48,656,858	70,067,803
		Domestic surplus.	
December 1, 1912			86,164,059
January 1, 1913			105,312,582
February 1			123,198,332
March 1			122,302,198
April 1			104,269,270
May 1			75,549,108
June 1			67,564,225
July 1			52,904,606
August 1			53,594,945
September 1			38,314,037
October 1			29,793,094
November 1			32,566,382
December 1			47,929,429

The total of copper exports from the United States in eleven months of 1913 as compiled by C. Mayer, secretary New York Metal Exchange, was 352,157 tons, against 298,491 tons in the same period of 1912. In the first 11 months of 1913 Germany took 134,585 tons as against 107,172 tons in the same period of 1912. In 12 months of 1912 total exports were 327,965 tons; in 1911, 336,801 tons; in 1910, 301,935 tons, and in 1909, 301,657 tons. Mr. Mayer figured the total importations in 10 months of 1913 by steamers and railroads, including ores, matte, and regulus reduced to fine copper, to be 152,000 tons, against 148,000 tons in the same period of 1912.

COURSE OF COPPER PRICES IN 1913

January was ushered in with the market quiet, but strong, at 17.75c. cash for Lake and 17.60c. to 17.62½c. for electrolytic.

The closing days of 1912 had seen good buying. The metal was tightly held by the large interests, but could not withstand the unfavorable showing of the Copper Producers' statement for December. With the appearance of these figures which showed an increase in stock on January 1 of 19,000,000 lb. over December 1, 1912, a decline set in which was helped along by the unsettled Balkan condition and violent fluctuations of copper abroad and by January 20, Lake was selling down to 16.25c. cash and electrolytic at 16c. Then came a turn upward and at the end of the month, 16.25c. cash was quoted for electrolytic and 16.50c. for Lake. Large sales were made in the month. Early February was unsettled and there were predictions that the price would drop to 15c. and at the end of the month, Lake was quoted at 15c. cash and electrolytic at 14.75c. The lower prices stimulated buying and one of the best movements of the year resulted. In the first few days of March a better demand from Europe started prices upward and by March 31 successive advances carried Lake to 15.37½c. cash and electrolytic to 15c. An additional cause of strength was the Copper Producers' statement showing that stock in February had fallen off nearly 900,000 lb. Unsettled political conditions abroad, the Balkan war then being in full swing, tended to restrict European buying, but toward the end of the month, the tension abroad eased up and foreign consumers came into the market strong along with domestic buyers, which caused prices to take an upward trend which they pursued throughout April. At the end of the latter month, Lake was quoted at 15.75c. cash and electrolytic at 15.62½c. The March report of the Producers' Association which showed a further reduction in stocks of 18,000,000 lb. was a strong bull influence. The buying, especially for Europe, continued good until almost the middle of April. Lake was becoming scarce and about this time the labor troubles in the Lake Superior District began to attract attention. European uneasiness caused by unsatisfactory conditions in southeastern Europe resulted in electrolytic dropping a few points in the early part of May, but it soon recovered and by May 10, 15.75c. was quoted, but it did not hold and at the end of the month electrolytic was quoted at 15.50c. and Lake at 15.75c. On a basis of 15.62½c. cash there was fair dealing in electrolytic early in May. The producers' statement for April, showing a reduction in stock of over 28,000,000 lb. greatly strengthened the market. June set in with Lake at 15.75c. cash and electrolytic at 15.25c. cash, but the month brought weakness and it closed at 15c. cash for Lake and 14.62½c. cash for electrolytic. The brass mills about this time began to note a decline in new orders. Toward the middle of June there was good buying, followed by quiet to the end of the month. Prices of brass and copper products weakened in June. The course of July was downward, though prices strengthened in the last week of the month. They dropped to 14.50c. cash for Lake and 14.12½c. cash for electrolytic (July 15) then turned upward and July 31 were 15.25c. cash for Lake and 15.12½c. cash for electrolytic. The last week of July brought activity in electrolytic, but Lake was nominal. In August the trend was upward and at the end of the month Lake was quoted at 16.12½c. cash and electrolytic at 16c. Lake copper continued hard to secure because of the strike in Michigan and tight holding of the available supply, but there was some buying of it in the second week of the month, which was checked by advancing prices. Late in August, the Lake situation began to clear up slowly. In September the range of prices was from 16.25c. to 17c. cash for Lake and 16.12½c. to 16.75c. cash for electrolytic. Prices were at their highest in the third quarter of the month, after which they declined and October began with Lake at 16.62½c. and electrolytic at 16.50c. The strength which was gained was almost entirely due to the diminishing stocks. Good buying attended the rise in prices, while Lake became harder to obtain than ever. In the latter part of October it became apparent that the big agencies were well sold up and second hands tried to force action by offerings at concessions but they aroused no inclination to buy. Prices fluctuated in a

lively way in October, but near the end of the month settled at 16.87½c. cash for Lake and 16.62½c. for electrolytic. From this time until near the end of the year there was little buying of copper, although the statistics were strong. Quotations declined steadily until 15.28c. cash for Lake and 14.62½c. for electrolytic were quoted. It had been believed that consumers would be forced to buy for December, but the hopes did not materialize and the big agencies as well as second hands came down in prices. There was some business, but not nearly as much as had been looked for. In the latter part of November it was no longer a secret that new orders for brass and copper products had fallen off sharply with the general decline in all metal lines and reductions in prices were a result. Some of the mills went on four and five day time and their stocks of copper on hand were sufficient to carry them along without the necessity of buying. In December there was little buying and December 23, Lake was 14.62½c. and electrolytic 14.37½c. cash.

The average prices paid for copper by the brass mills in the Naugatuck Valley (Waterbury average) in 1913 were as follows:

	Cents. 1		Cents.
December, 1912	17.75	June	15.37½
January, 1913	17.00	July	14.75
February	15.50	August	15.62½
March	15.12½	September	15.87½
April	15.75	October	16.87½
May	15.87½	November	16.25

SPELTER

This metal began the year at 7.30c. New York and 7.17½c. St. Louis, and at the end of November was about 5.15c. New York and 5c. St. Louis. It dropped to 6.80c. New York in January. In that month German spelter was imported and sold at or near 7.05c. on the Atlantic seaboard. Fears as to results the new tariff might cause was an unsettling influence on the market in the greater part of the year. In February, prices dropped to 6.25c. New York and 6.10 St. Louis. In March, demand was good, the trend turned upward and prices advanced to 6.40c. New York, and 6.25c. St. Louis, but the strength did not last long and the month closed at 5.85c. New York and 5.70c. St. Louis. In April, prices declined further, demand having been satisfied, and the market in consequence, being quiet. In this month large quantities were being delivered against old contracts to both brass mills and galvanizers. In May quotations had dropped until near the end of the month they were about 5.35c. New York, and 5.20c. St. Louis, and dullness was the principal feature. In June, when quotations touched 5.10c., New York, and 4.95c., St. Louis, business was slow, but it picked up at the end of the month and the New York prices advanced to 5.30c. In early July there was good buying and in that month prices mounted to 5.60c. New York, and 5.45c. St. Louis. In August, business was fair and quotations advanced to 5.90c. New York and 5.75c. St. Louis. The advances were accelerated by strike troubles in the West and higher prices of ore. Not until about the middle of September did prices begin to decline again, but after that time they came down steadily and on September 30, the New York price was 5.60c. In September, foreign spelter was again offered but found few purchasers and this time it was said that consumers preferred the domestic metal with the qualities of which they were more familiar. October saw a continuance of the decline, and the month closed with the New York quotation at 5.40c. Steady declines and little business were the features of November and on December 1, quotations were 5.15c. New York and 5c. St. Louis. These held to December 23, up to which time business was light.

LEAD

Throughout January, February, March, and until April 22, lead quotations were 4.35c. New York and 4.20c. St. Louis. On the date named the A. S. & R. Co. advanced quotations to

4.50c. New York and 4.37½c. became the price for St. Louis. Prior to the advance the routine demand was maintained and, intermittently, good buying occurred although it was repeatedly said that uncertainty over the approaching changes in the tariff had the effect of restraining big business. Yet when the terms of the new tariff bill, so far as they pertained to lead, became more concrete, they had little effect on the market. It was pointed out that the tariff would only serve to prevent prices from soaring. The advance to 4.50c. was accompanied by the statement that the price had been too low. The 4.50c. price held until May 5, when there was a reduction to 4.35c. New York and 4.20c. St. Louis again, the reason announced for the change being that demand had slackened. At 4.35c. New York, the price was stationary through the remainder of May, June, and until July 29, when quotations went to 4.50c. New York, and 4.35c. St. Louis, again. The St. Louis price had varied 2½ points at times. In June the metal was high and going higher and fear was entertained of London coming to New York and upsetting this market. It proved, however, that the London market was bolstered up by a corner which did not hold. Meanwhile domestic buyers proceeded slowly. In early July, consumers began complaining of their new business showing a falling off, but latter in the month they bought more freely their stocks having become very small. The 4.50c. New York price announced July 29, held until August 15, when the A. S. & R. Co. advanced its New York price to 4.75c. At St. Louis 4.65c. was quoted at this time. Rumors of labor troubles in Missouri which culminated in a strike in August strengthened the situation, as did a good demand that came about the middle of August. When the strike was declared, August 15, the A. S. & R. Co. withdrew from the market for a few hours, then announced its advance to 4.75c. The price held until September 25, when independent interests came down to 4.70c. New York, and 4.55c. St. Louis. Meanwhile the aspect of the lead situation had been changed by the settlement of the strike in the latter part of August. Demand began to subside and finally came the reduction by independents. On October 1, the A. S. & R. Co., which had been feeling the underselling by other companies came down to 4.60c. New York and 4.45c. St. Louis. The competition continued and October 8, the big interest came down to 4.50c. New York and 4.35c. St. Louis again. Further cuts followed, in the anxiety to get business, and on October 16, the A. S. & R. Co. reduced its quotations again, this time to 4.35c. New York and 4.20c. St. Louis. Outside producers followed. With other metals declining on every side, lead held its own through the remainder of October and to November 26 when the A. S. & R. reduced its prices to 4.25c. New York and 4.10c. St. Louis. Business was light at the time and keenly competed for. December 2, the price came down to 4.00c. New York. Toward the end of the month greater strength developed.

ANTIMONY

In January both dealers and consumers were overloaded with antimony owing to a more or less frenzied buying on a rise late in 1912 and there was on all sides pressure to sell at about 9.75c. for Cookson's, 9.37½c. for Hallett's and 9c. for other grades. By February, Cookson's had weakened to 9.45c. The market continued lifeless through February and March brought no betterment, and some dealers were inclined to withdraw from the market rather than force sales. In April Hallett's dropped to 8.50c., and Chinese and Hungarian brands to 7.50c. Second hands, anxious to sell, offered Hallett's at 8.12½c. in April. May brought still lower prices, Cookson's being offered at 8.70c., Hallett's at 8.20c. and Chinese and Hungarian grades at 7.50c. The decline continued in June, but the market was otherwise featureless. In July the inactivity continued and prices were lower. In this month government statistics showed that there was in bonded warehouses about 4,500,000 lb. of antimony, which had been imported in anticipation of lower tariff duties. This amount approximates a

year's supply. August closed at 7.75c. for Hallett's, 8.35c. for Cookson's and 7.37½c. for other grades. Prices in September were unchanged. Toward October dealers were withdrawing from warehouse only metal which they had actually sold. After the new tariff became effective on October 4, the big supply in government custody was more freely drawn upon and the market slumped. The low quotations for October were 7.25c. for Hallett's, 7.62½c. for Cookson's, and 6.50c. for other grades. In November there was a further decline of about 12½ points for all grades, with business extremely slow. Conditions were unchanged in December.

PIG TIN

On January 2, pig tin for prompt delivery sold at 50.60c. and while it mounted to 51c. and dropped to 49.85c. in the next 30 days, the month closed at 50.15c., quotations which were partly sustained by the scarcity of spot metal. At, or near, the high prices a good business was done. Toward the end of the month the shortage was relieved by heavier importations. At the auction of 2500 tons of Banca tin in Holland January 29, the price obtained was 137¼ florins, equal to about 50c., c. i. f. New York. January deliveries totaled 3700 tons. In February prices weakened throughout the month, 49c. being touched February 3, followed by fluctuations in which declines were greater than the recoveries, until on February 28 the price was 47.55c. Business was fairly good in the early part of the month and the chief cause of the reduction in price was the decline in London prices. In February a shortage of spot supplies was again feared and stimulated buying to cover short contracts. It developed at this time that American consumers were overbought and many of them were embittered by the fact that prices began to decline as soon as they had loaded up, not in itself a new story. February deliveries were 3500 tons. In March the metal declined from 47.75c. on the third day of the month to 45.70c. on the 17th, then gradually picked up again until 47.90c. was quoted March 31. London early in the month was erratic, reflecting anxiety over the Balkan situation. Through March buying was intermittent and not extremely heavy at any time. About the middle of the month about 320 tons of Chinese tin arrived on vessels from Chinese ports which was unusual for this port. Deliveries in March reached the record breaking total of 5900 tons, the nearest previous high figures having been 5400 tons in April, 1912. April ushered in a rising market again and on the 14th of the month tin touched 50c. On April 17, 50.10c. was quoted, after which it declined gradually until April 30, when the price was 49.87½c. Foreign influence caused the rise. It was a market in which consumers had little faith and consequently they did little buying. Deliveries in April totaled 3450 tons. In May, prices hovered around the 50c. level until the middle of the month when a decline set in, and May 31 the price was 47c. As a rule business was dull throughout the month. The sale of 2500 tons of Banca, in Holland, May 28, realized 135½ florins equivalent to about 49.45c., c. i. f. New York. Deliveries in May were 3350 tons. June prices ranged between 46.60c. at the opening of the month and 42.50c. at the close, the decline being practically without a break. Excepting at intervals the market was quiet in June and speculation was evident in what buying there was. In the second week of the month 100 tons of Banca for which sale could not be made was returned to London. In the third week liquidation in tin holdings was forced in London because Vienna speculators could not obtain extensions of loans wherewith to finance their operations and this brought about lower prices. In 4 days, tin declined £12 in London. June deliveries were 3800 tons. In July prices came to 39.35c. (July 14) after which they rallied and crept up to 40.60c., at which August opened. In July consumers were using metal for which they had paid up to 48c. Now and then there was a day of good buying. The July sale of Banca in Holland, when 2500 tons were disposed of, brought 111½ florins, equal to about 40.60c. c. i. f. New York. The low price caused weakness both abroad and here.

July deliveries were 3900 tons. Throughout August tin was steady at about 41c. The lack of any considerable fluctuation was unusual. Trading was not heavy in the month, although on a few days fair buying was reported. Deliveries against old contracts were heavy. In August, 3600 tons were delivered to consumers. In September prices mounted to 43.80c., but they were more irregular than in the previous month and September 30, stood at 41c. again. Features were lacking, except that the September sale of Banca realized 116¼ florins equal to about 42.30c., c. i. f. New York. September deliveries were 3100 tons. In October prices again pursued a rather even course and at no time were far above or below 40.35c., while business was light, and it was conceded generally that consumption was falling off. October deliveries were 3700 tons which exceeded all estimates for the month. In November, the downward course of prices continued, 39.25c. being touched early in the month, which closed at 39.50c. At no time in November was 40.25c. exceeded. Business was fair at times, but not satisfactory and it was apparent that consumers had plenty in stock, adding their purchases to the stock which they were enabled to carry over because of the smaller demand for their products. The November Banca sale brought an average price of 109¼ florins, equal to about 40c. c. i. f. New York. Deliveries were light, amounting to 2800 tons. With little trading, December presented few features. By December 23, the price dropped to 36.62½c.

ALUMINUM

At the beginning of 1913, the market was about 26.50c., whereas late in December it was 18.50c. to 19c. for prompt delivery domestic. Consumption was good in the early part of the year and prices went up a few points in March, 26.87½c. to 27.12½c. being quoted for prompt shipment domestic. From this month on, the course of prices was downward; the lowest of each month being approximately as follows: 26.75c. in April, 25c. in May, 23.50c. in June, 23c. in July, 21.50c. in August and September, 19.75c. in October and 18.50c. in November. In May there were especially heavy deliveries, and these led to resales and lower prices, the decline being helped along by apprehension over the then impending tariff changes, an influence which was felt until the new duties became operative. Pending the inaction of the bill there was accumulated in bonded warehouses a large quantity of the metal and this had a depressing effect upon the trade. The imports in August were 1,336,835 lb. as compared with 576,252 lb. in August, 1912. Later in the year a further depressing influence was the slower extent to which automobile manufacturers were purchasing. Throughout the year prices of foreign and domestic were close together and often on the same level. The slight difference, when there was any, was in favor of domestic. In late December, both foreign and domestic prompt metal were quoted at 18.75c. to 19c.

The Metal Markets

LOCAL METAL PRICES

San Francisco, December 31.

San Francisco is not a primary market for the common metals except quicksilver. The prices quoted below therefore represent sales of small lots and are not such as an ore producer could expect to realize. Ore contracts usually call for settlement on the basis of Eastern prices, less freight and treatment charges. The prices quoted are in cents per pound, except in the case of quicksilver, which is quoted in dollars per flask of 75 pounds.

Antimony	9	— 9¾c
Electrolytic copper	15 ½	— 15¾c
Pig lead	4.40	— 5.35
Quicksilver (flask)		\$40
Tin	41	— 42 ½c
Spelter	6 ½	— 6¾c
Zinc dust, 100 kg. zinc-lined cases, 7½ to 8c. per pound.		

EASTERN METAL MARKET

(By wire from New York)

NEW YORK December 31.—The general tone of the market is strong and the feeling in general is optimistic. The copper market is strong and advancing and a large domestic business is reported. The lead market is also strong and the tendency is toward an advance the sellers are holding back. The spelter market is quiet but firm. The Tennessee Copper Co. reports an estimated output for the month of 1,000,000 lb. copper and a total for the year of 13,200,000 lb. The price movements in the share market have been irregular during the greater part of the day and trading has been confined to but a few stocks. Operations are generally quiet awaiting the developments of the new year, which are looked upon as promising.

SILVER

Below are given the average New York quotations in cents per ounce of the silver

Dec. 25 Holiday		Average week ending	
" 26	57.50	Nov. 19	59.26
" 27	57.62	" 25	58.20
" 28 Sunday		Dec. 3	57.22
" 29	57.62	" 10	58.23
" 30	57.50	" 17	57.79
" 31	57.37	" 24	57.77
		" 31	57.52

Monthly averages.

	1912	1913		1912	1913
Jan.	56.25	63.01	July	60.67	58.70
Feb.	59.06	61.25	Aug.	61.32	59.32
Mch.	58.37	57.87	Sept.	62.95	60.53
Apr.	59.20	59.26	Oct.	63.16	60.88
May	60.88	60.21	Nov.	62.73	58.76
June	61.29	59.03	Dec.	63.38	57.73

COPPER

Quotations on copper as published in this column represent average wholesale transactions on the New York market and refer to electrolytic copper. Lake copper commands normally 1-5 to 1-6c per lb. more. Prices are in cents per pound.

Date		Average week ending
Dec. 25	Holiday	Nov. 19.....15.08
" 26		" 25.....14.62
" 27		Dec. 3.....14.41
" 28	Sunday	" 10.....14.13
" 29		" 17.....14.17
" 30		" 24.....14.28
" 31		" 31.....14.56

Monthly averages.

	1912	1913		1912	1913
Jan.	14.09	16.54	July	17.19	14.21
Feb.	14.08	14.93	Aug.	17.49	15.42
Mch.	14.68	14.72	Sept.	17.56	16.23
Apr.	15.74	15.25	Oct.	17.32	16.81
May	16.03	15.42	Nov.	17.31	15.08
June	17.23	14.71	Dec.	17.37	14.25

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date		Average week ending
Dec. 25 Holiday		Nov. 19 4.18
" 26 4.15		" 25 4.13
" 27 4.15		Dec. 3 4.15
" 28 Sunday		" 10 4.00
" 29 4.15		" 17 3.90
" 30 4.15		" 24 4.02
" 31 4.15		" 31 4.15

Monthly averages.

	1912	1913		1912	1913
Jan.	4.43	4.23	July	4.71	4.35
Feb.	4.43	4.33	Aug.	4.54	4.60
Mch.	4.07	4.32	Sept.	5.00	4.70
Apr.	4.20	4.36	Oct.	5.08	4.37
May	4.20	4.34	Nov.	4.91	4.16
June	4.40	4.33	Dec.	4.20	4.02

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date		Average week ending	
Dec. 25 Holiday	5.13	Nov. 19	5.05
" 26	5.13	" 25	5.08
" 27	5.13	Dec. 3	5.00
" 28 Sunday		" 10	5.00
" 29	5.13	" 17	5.00
" 30	5.13	" 24	5.15
" 31	5.13	" 31	5.13

Monthly averages.

	1912	1913		1912	1913
Jan.	6.42	6.88	July	7.12	6.11
Feb.	6.50	6.13	Aug.	6.96	5.51
Mch.	6.57	5.94	Sept.	7.45	5.55
Apr.	6.63	5.52	Oct.	7.36	5.22
May	6.68	5.23	Nov.	7.32	5.09
June	6.88	5.00	Dec.	7.09	5.07

TIN

New York prices control in the American market for tin, since the metal is almost entirely imported. San Francisco quotations average about 5c. per lb. higher. Below are given average monthly New York quotations, in cents per pound:

Monthly averages.

	1912	1913		1912	1913
Jan.	42.53	50.45	July	44.25	40.70
Feb.	42.96	49.07	Aug.	45.80	41.75
Mch.	42.58	46.95	Sept.	48.64	42.45
Apr.	43.92	49.01	Oct.	50.01	40.61
May	46.05	49.10	Nov.	49.92	39.77
June	45.76	45.10	Dec.	49.80	37.57

QUICKSILVER

The primary market for quicksilver is San Francisco, California, being the largest producer. The price is fixed in the

open market and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below.

Week ending	Dec. 18	Dec. 24	Dec. 31
Dec. 1	40.00	40.00	40.00
" 11	40.00	40.00	40.00

Monthly averages.

	1912	1913		1912	1913
Jan.	42.75	39.37	July	41.00	41.00
Feb.	46.00	41.00	Aug.	42.50	40.50
Mch.	46.00	40.20	Sept.	42.12	39.70
Apr.	42.25	41.00	Oct.	41.50	39.37
May	41.75	40.25	Nov.	41.50	39.40
June	41.30	41.00	Dec.	39.75	40.00

NEW YORK METAL MARKET REVIEW

Copper was quiet in December and prices declined. Spelter was not active, but gained strength. Lead saw much competition, and there were repeated reductions by the large interest which were followed by the independents. At the end of the month a change toward higher prices was indicated. Antimony was without feature. Pig tin dropped to the low figure of 36.62½c. for prompt and sales were light. Aluminum dropped a few points and showed but little life.

Copper was quiet from the first to December 23 and there were no indications on the latter date of any heavy business before 1914. Prices continued their course downward, the month opening with Lake at 15.12½c. and electrolytic at 14.62½c., while on December 23, Lake was 14.62½c. and electrolytic 14.37½c. European deliveries were better than the domestic. Exports to December 22 were good, totaling 24,999 tons.

Spelter prices held up in December better than did the others, quotations standing from December 1 to 23 at 5.15c. New York and 5c. St. Louis and gaining strength as the month came near its end. There were no features of special interest.

Lead prices on December 2 were reduced by the A. S. & R. Co. from 4.25c. New York to 4.10c. New York, the former price having been established on November 26. On December 9, the big interest announced a reduction to 4c. New York at which figure it stood throughout the month. The principal reason for the series of reductions was that independent companies had been steadily underselling the big company and getting most of what business there was to be had. The metal had not been on the same level before since February, 1912. At 4c. the A. S. & R. Co. took practically all of the business, but there was not much stirring. Late in the month greater strength developed in St. Louis and the price there crept up to 3.95c. In the early part of the month it was reported that the A. S. & R. Co. had ordered the closing of all its smelters in Mexico, including the Monterey smelter, employing over 2000 men. In all 7000 employees were said to be affected.

Antimony markets were glutted in December, otherwise devoid of feature. Prices were practically stationary at 7c. to 7.25c. for Hallett's, 7.40c. to 7.50c. for Cookson's and 6c. to 6.60c. for other grades.

Tin prices became lower in December until on December 23 the quotation was 36.62½c. for prompt deliveries. London was very weak toward the end of the month and the news from that city was pessimistic. On only a few days in December was there good buying. The total visible supply November 30, 1913, was 14,470 tons against 12,348 tons November 30, 1912. In the eleven months of the year there was a decrease of 4650 tons in deliveries, as compared with the same period in 1912.

Aluminum in the early days of December for both domestic and foreign delivery was quoted at 19c. The demand was poor, though the month was said to have brought an improvement to the automobile trade and consequently a better demand was expected to develop for aluminum. About the middle of the month prices, with domestic and foreign still on the same level, were 18.75c. to 19c. where they stood as the month was nearing its close.

The Stock Markets

SAN FRANCISCO STOCKS AND BONDS (San Francisco Stock and Bond Exchange.)

BONDS

December 30.

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Associated Oil 5s.....	\$ 97½	—	General Petroleum 6s	49	49½
E. I. du Pont pfd.....	84	—	Natomas Dev. 6s.....	—	100
Unlisted.			Pac. Port. Cement 6s.	99½	—
Ass. Oil 5s.....	—	85	Santa Cruz Cement 6s	83½	90

STOCKS

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Amalgamated Oil.....	74	77	Noble Electric Steel...	—	3
Associated Oil.....	39½	39½	Natomas Consol.....	2	—
Glant.....	84	—	Riverside Cement.....	60	—
Pac. Cat Borax, pfd.....	65	—	Santa Cruz Cement...	—	45
Pacific Crude Oil.....	—	35c	Stand. Port. Cement...	19½	—
Sterling O. & D.....	—	1½			
Union Oil.....	66	—			

NEVADA STOCKS

(By courtesy of San Francisco Stock Exchange.)

San Francisco, December 31.

Atlanta.....	\$.15	Mizpah Extension.....	\$.31
Belcher.....	.64	Montana-Tonopah.....	1.25
Belmont.....	7.50	Nevada Hills.....	.45
Big Four.....	.10	North Star.....	.38
Cash Boy.....	.08	Ophir.....	.14
Florence.....	.20	Pittsburg Silver Peak.....	.36
Goldfield Con.....	1.42	Round Mountain.....	.38
Goldfield Oro.....	.08	Sierra Nevada.....	.11
Halifax.....	1.25	Tonopah Extension.....	1.75
Jim Butler.....	.76	Tonopah Merger.....	.62
Jumbo Extension.....	.14	Tonopah of Nevada.....	7.00
MacNamara.....	.09	Victor.....	.30
Mexican.....	1.15	West End.....	1.27
Midway.....	.38	Yellow Jacket.....	.30

COPPER SHARES—BOSTON

(By courtesy of J. C. Wilson, Mills Building.)

December 31.

	Bid	Ask		Bid	Ask
Allouez.....	\$ 35	35½	Nevada Con.....	\$ 14½	15½
Ariz. Commercial.....	4½	4½	North Butte.....	28	28½
Butte & Superior.....	31½	32	Old Dominion.....	50½	51
Calumet & Arizona.....	63½	64	Osceola.....	77	78
Calumet & Hecla.....	425	430	Quincy.....	60	61
Copper Range.....	37½	38	Shannon.....	6½	6½
Daly West.....	2	2½	Superior & Boston.....	2½	2½
East Butte.....	11	11½	Tamarack.....	29½	30½
Franklin.....	34	34	U. S. Smelting, com...	40	40½
Granby.....	74	74½	Utah Con.....	8½	8½
Greene Cananea.....	30	30½	Winona.....	3	3½
Isle-Royale.....	18½	18½	Wolverine.....	44	45
Mass Copper.....	2½	2½			

NEW YORK CURB QUOTATIONS

(By courtesy of E. F. Hutton & Co., Kohl Building.)

December 31.

	Bid.	Ask.		Bid.	Ask.
Braden Copper.....	7	7½	McKinley-Dar. . .	1	1½
Braden 6s.....	143	148	Mines Co. Am.....	2	2½
B. C. Copper.....	2½	2½	Nipissing.....	7½	8
Davis-Daly.....	1½	2½	Ohio Copper.....	¾	¾
Dolores.....	2	4	San Toy.....	15	20
El Rayo.....	1	2	Sioux Con.	1	1
Ely Con.	1	2	So. Utah.....	¾	¾
First Nat.	2½	2½	Stand. Oil of Cal.260	262	
Glroux.....	¾	1	Tri Bullion.....	¾	¾
Iron Blossom... .	1½	1½	Tuolumne.....	¾	¾
Kerr Lake.....	4½	4½	United Copper... .	¾	¾
La Rose.....	1½	1½	Wetlaufer.....	7	8
Mason Valley... .	3½	3½	Yukon Gold.....	2	2½

NEW YORK STOCK EXCHANGE

(By courtesy of J. C. Wilson, Mills Building.)

December 31.

	Bid	Ask		Bid	Ask
Amalgamated.....	73½	73½	Quicksilver, com.....	\$ 1½	2
Anaconda.....	35½	35½	Ray Con.....	18½	18½
A. S. & R.....	63½	64½	Tenn. Copper.....	3½	3½
Calif. Pet.....	18½	19½	U. S. Steel, pfd.....	105½	106½
Chino.....	39½	39½	U. S. Steel, com.....	58½	59
Mexican Pet.....	46	46½	Utah Copper.....	50½	50½
Miami.....	21½	22			

Mineral Statistics for 1913

South Dakota mines produced gold worth \$7,200,000 in 1913, against \$7,891,370 in the previous year. Silver output fell from 206,460 to 164,800 oz. A small quantity of lead and copper was produced, according to Charles W. Henderson, of the U. S. Geological Survey.

Michigan copper mines produced 105,000,000 lb. of metal, or at the rate of 210,000,000 lb. per year, during the first half of 1913; but on account of the miners' strike, which began on July 23 and is still partly on, the year's output will be only about 145,000,000 lb., according to R. H. Maurer. The average price received for copper was 15.5c. per pound, making the gross value of \$22,500,000. Nine companies distributed \$8,344,788 in dividends during the term. The principal producers in 1913 were as follows: Calumet & Hecla, 53,420,000 lb.; Osceola, 11,686,000 lb.; Champion, 11,448,000 lb.; Quincy, 10,894,800 lb.; Ahmeek, 9,100,000 lb.; Baltic, 8,686,000 lb.; and Mohawk, 5,369,000 pounds.

New Mexico made increases in its mineral production during 1913, according to Charles W. Henderson, of the U. S. Geological Survey. The output of gold showed an increase of \$100,000 over the \$784,446 in 1912; that of silver, an increase of 100,000 oz. over the production of 1,536,701 oz. in 1912; lead, a decrease of 800,000 lb. from the yield of 5,494,018 lb. in 1912; copper, an increase of 20,000,000 lb. over the yield of 34,030,964 lb. in 1912; and zinc (figured as spelter or zinc in zinc oxide), an increase of 8,000,000 lb. over the output of 13,566,637 lb. in 1912. Despite lower average yearly prices for copper and zinc, the total value of the output was \$11,620,000, an increase for 1913 of over \$3,000,000.

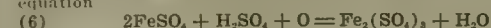
Alaskan mines produced \$18,900,000 in minerals during 1913, according to Alfred H. Brooks, of the U. S. Geological Survey. The value of the gold output is estimated at \$15,450,000; that of 1912 was \$17,145,951. There was a marked decrease in copper production, that of 1913 being estimated to have been 19,700,000 lb., valued at about \$3,014,000, while that of 1912 was 29,230,491 lb., valued at \$4,823,031. The silver output is largely a by-product of gold and copper mining, and showed a decrease in value from \$316,839 in 1912 to about \$220,000 in 1913. Other minerals, including marble, gypsum, tin, etc., are estimated to have been produced to the value of \$220,000, or about the same as that of 1912.

California's mineral production during 1913 was valued at over \$95,600,000, according to the State Mining Bureau. This is an increase of \$4,000,000 compared with the previous year. The petroleum output was approximately 93,000,000 bbl., valued at \$43,500,000, increases of 3,500,000 bbl. and \$1,500,000 respectively. Deep mining, dredging and higher operating efficiency keeps up the gold yield to about \$20,000,000 per annum. There have been few changes in the copper mines, whose metal was worth about \$5,500,000. The cement output increased in value by \$2,000,000 to \$8,000,000. Crushed rock and granite production was \$6,000,000; brick, \$3,000,000; natural gas, \$1,250,000; borax, \$1,000,000; silver, \$800,000; and quicksilver, \$750,000. The minor mineral products showed normal activity and growth.

Coal production of the United States in 1913 was between 565,000,000 and 575,000,000 short tons, against 534,466,580 in 1912, according to the U. S. Geological Survey. Of the increase, about 4,500,000 tons was from the anthracite mines. There were a few labor disturbances in 1913, but they were local in extent and effect. The most pronounced labor disaffection was in Colorado, where a general strike was called about the middle of September, and coal production in that state during the last quarter of the year was but little more than 50% of normal. There was general complaint, particularly in the Eastern states, of shortage of labor and inability on the part of the operators to keep their mines working at full capacity. This was probably the reason for less than the usual complaint of the inadequate or insufficient transportation service. Coal-mining, like all other industries in the Ohio Valley states, was seriously interfered with by the floods in that region during the spring of 1913.

ERRATA

Referring to the description of the Irving process on page 77, Mr. Austin adds that the ferrous sulphate may be regarded as being changed to ferric sulphate according to equation



He corrects the analysis of original ore on page 78 to read: gold, 0.04%; copper, 1.63.

In November 1909, the House of Lords, England, delivered a unanimous judgment in favor of the Minerals Separation, Ltd., in an action brought by the Elmore Process. A similar judgment was given July 24, 1911, by the New South Wales Court in an action brought by the same plaintiff.

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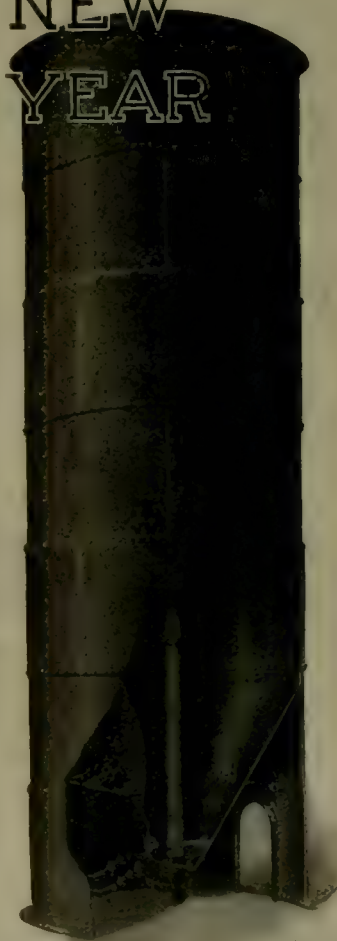
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Chief Engineer: E. H. Nutter, Merchants Exchange Bldg., San Francisco.

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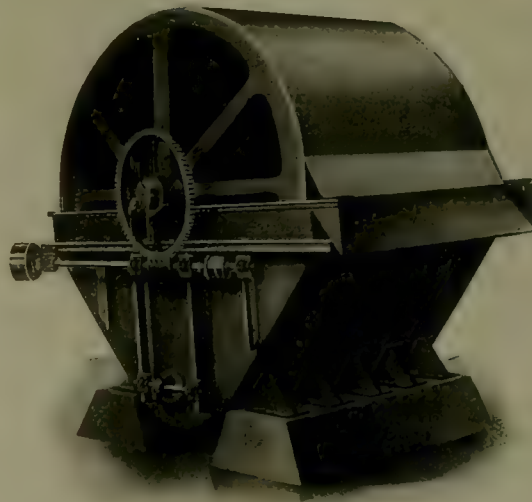
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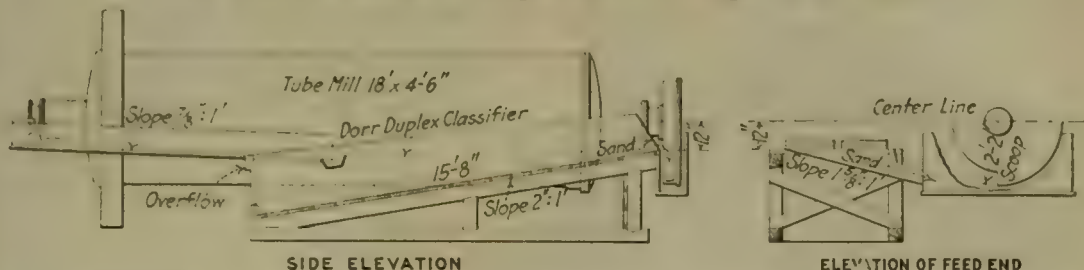
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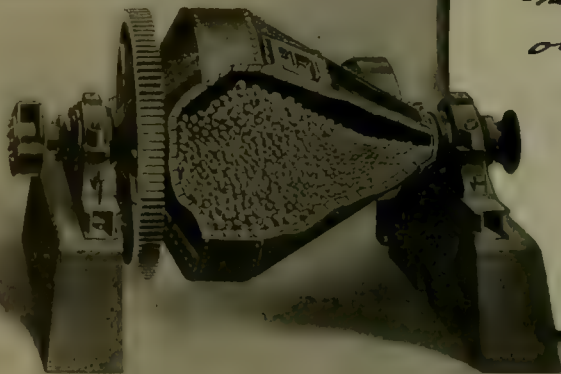
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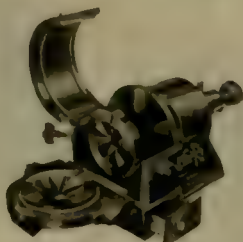
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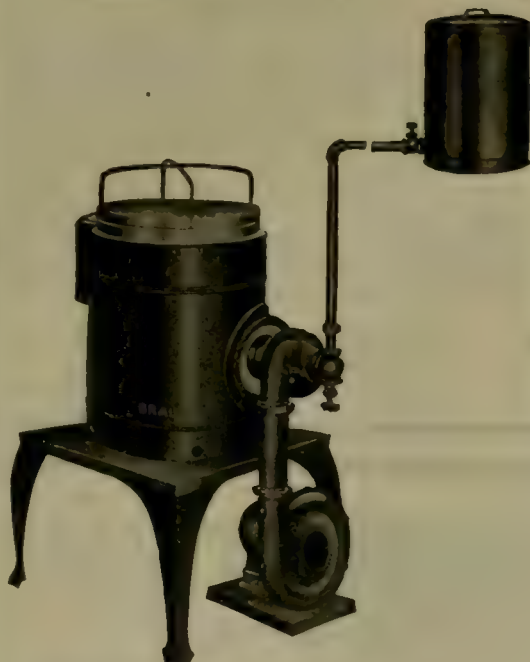
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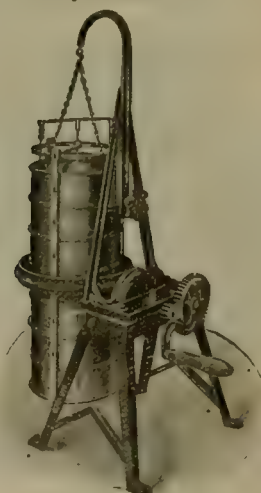


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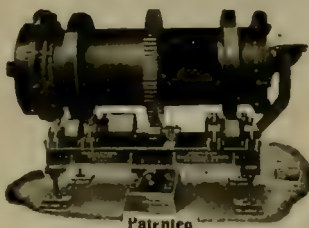
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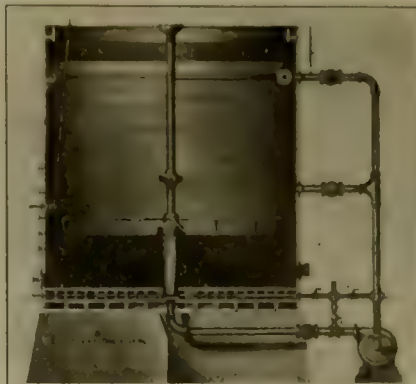
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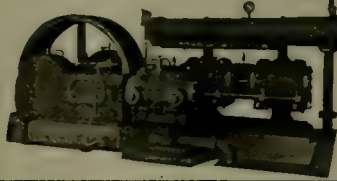
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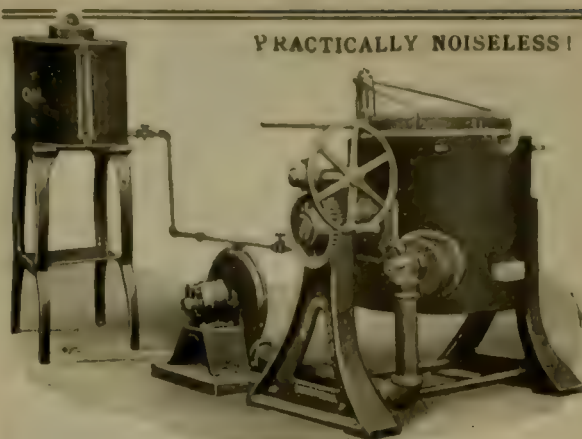
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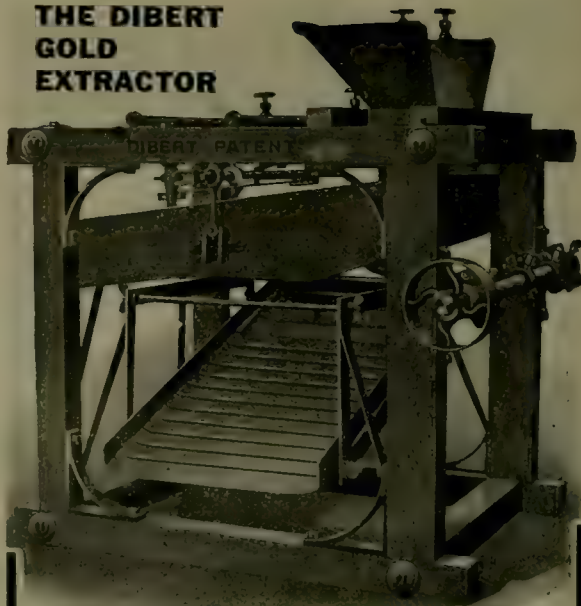
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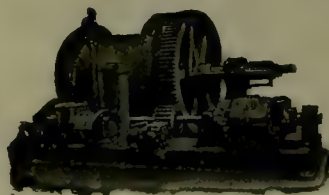
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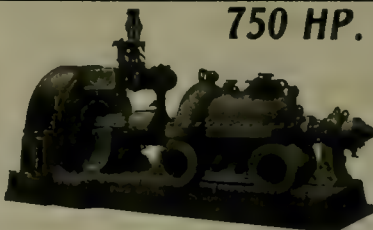
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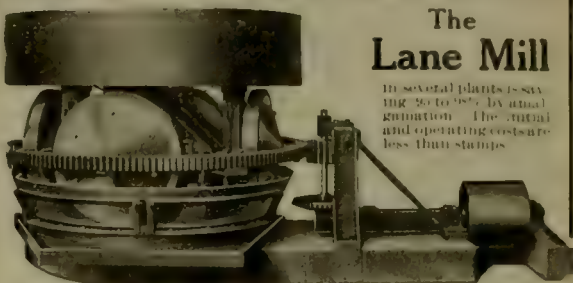


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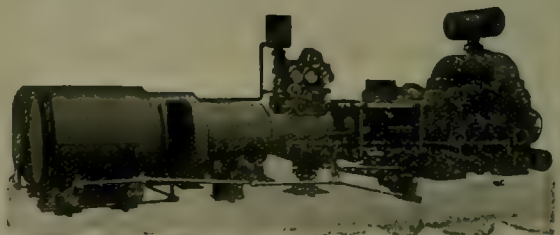
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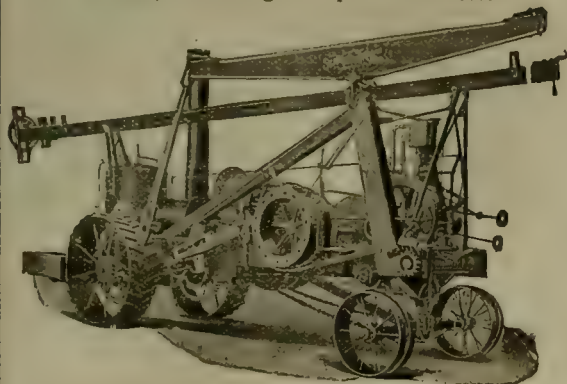
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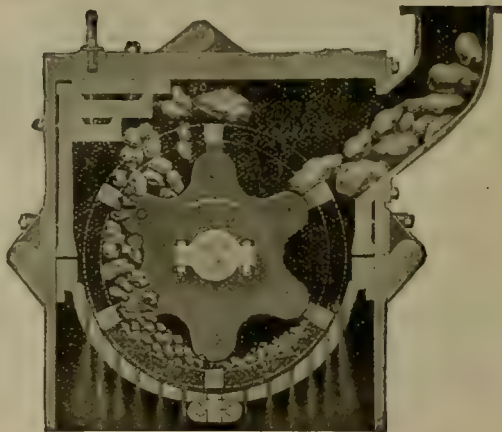
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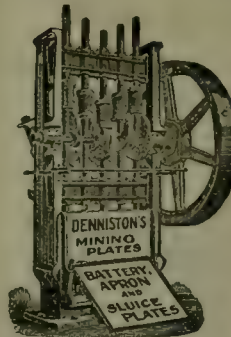
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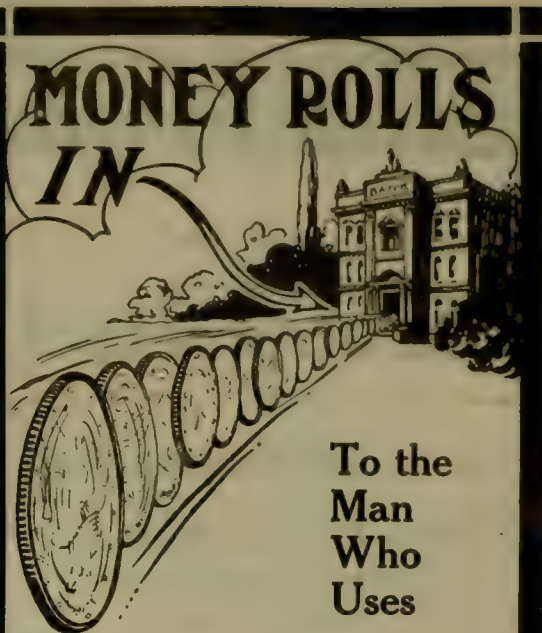
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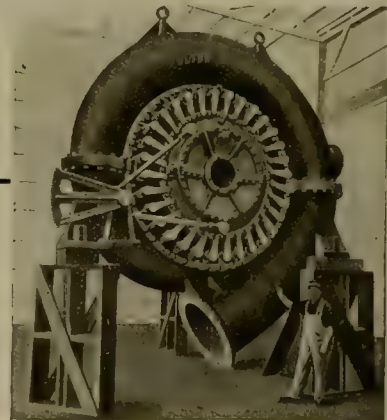
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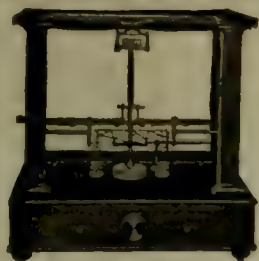
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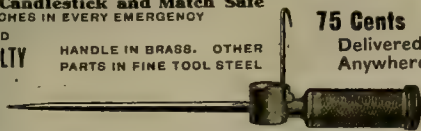
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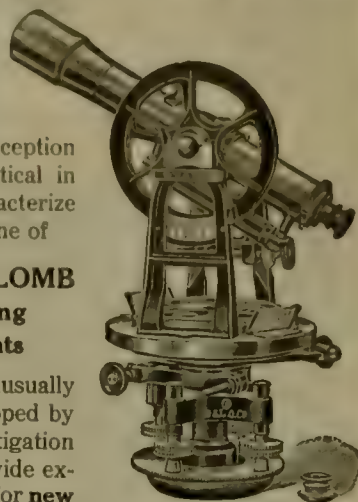


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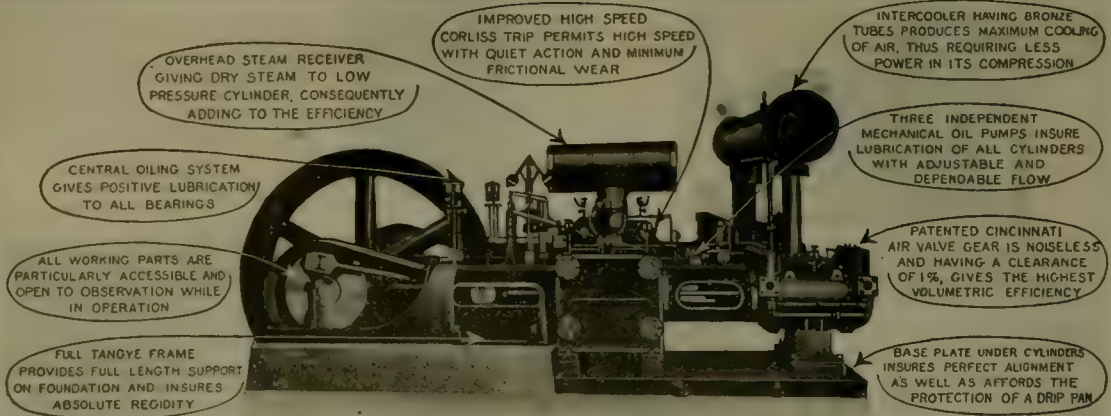
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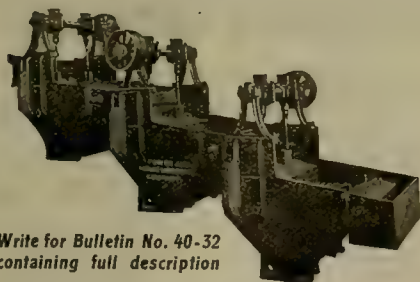
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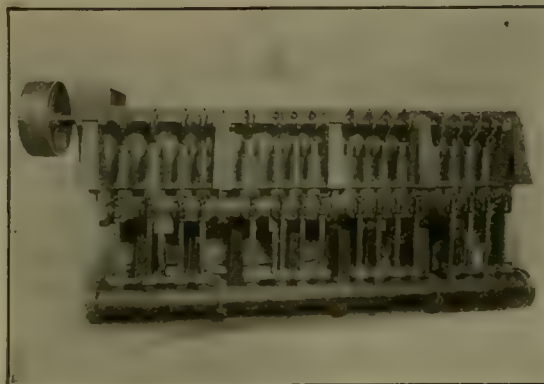
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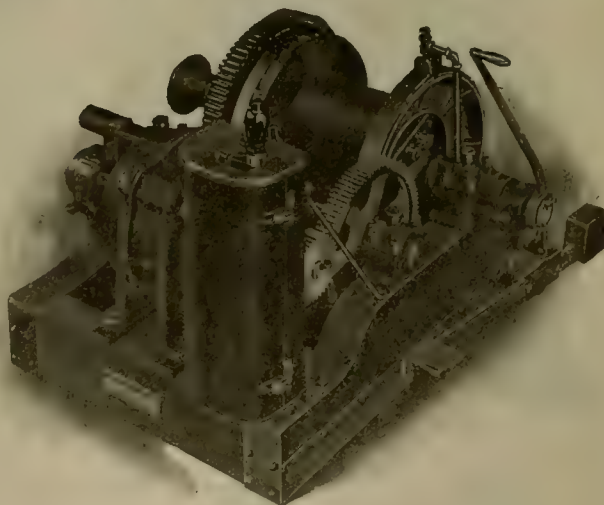
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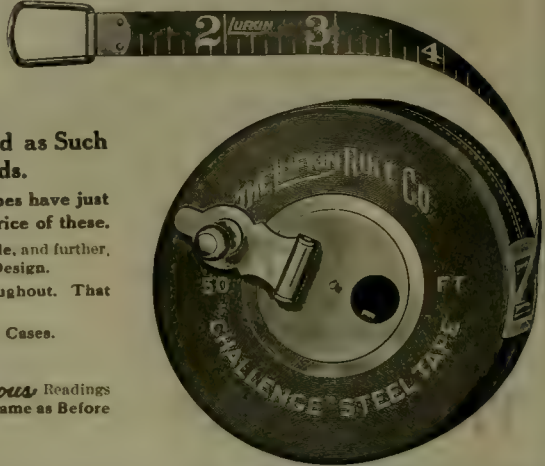
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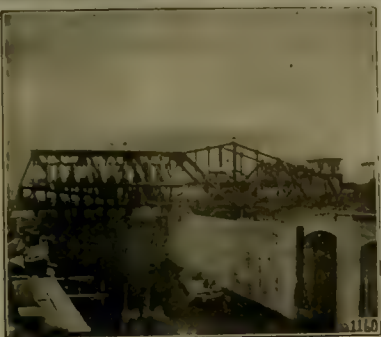
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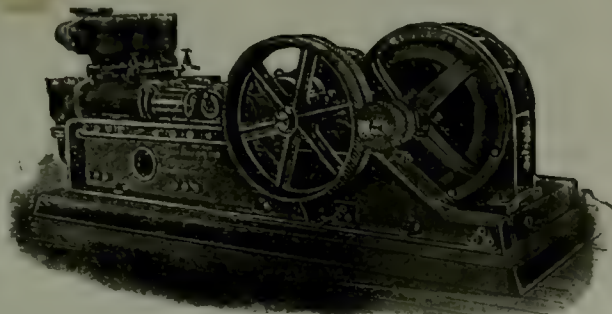
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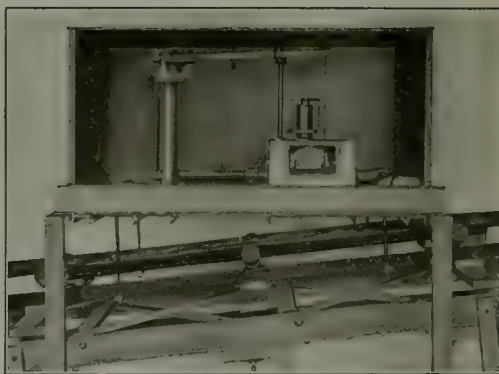
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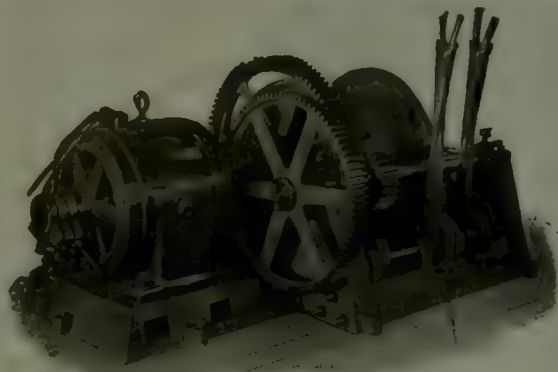
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EDITORIAL

SANTA DOMINGO goldfields have attracted attention from time to time, and there have been many tales of riches to be found there by dredging. Mr. Henry F. Le Fevre has recently returned from an eight months' investigation of the country and permits us to quote him to the effect that there are no gold placers there suitable for dredging.

GOVERNMENT aid to prospectors by the Commonwealth government of Australia, which controls the Northern Territory, an area of 523,620 square miles, goes to lengths unknown in the United States. The government is erecting a five-stamp mill for the benefit of prospectors in the Maranboy tinfield. The erection and operation of government mills in Western Australia and Victoria has, on the whole, been a great aid in stimulating prospecting and developing new districts. Whether such means are either necessary or advisable elsewhere is less certain.

STATISTICS are interesting as approximations showing the general trend of metal production, and when estimates are presented that the calamine production of the Joplin district for the year 1913 was 40,346,251 pounds, valued at \$491,243, such figures cannot be claimed as being exact to the last digit. In the current issue we present the well known production statistics of Mr. Otto Ruhl, of Joplin, and in the Special Correspondence columns will be found figures covering the same district, compiled by our Joplin correspondent. While differing somewhat, the totals show a decided activity in the mining of the lead and zinc deposits of this district.

ARBITRATION as a means of preventing industrial troubles has not been entirely successful. A commission in New South Wales, Australia, has recently investigated the operation of that state's industrial laws covering a period of twelve years. The object of arbitration is to stop strikes and lockouts, but the Commission found that the strike is still used by labor unions. Threats of strikes are indeed more frequent than ever, and it seems that agreements by peaceful methods, such as arbitration, are still far from universal. During the nine months that ended on December 1, 1913, there have been 148 disputes in the Commonwealth, involving 41,737 employees. The number of working days lost was 529,642, and the loss in wages \$1,110,000.

FROM Malaguit in Paracale, Philippine Islands, comes the news that the village churchyard has been located as a most promising piece of placer ground and negotiations are afoot for mining it. While the churchyard has generally been consecrated to other purposes than the dredge, gold is where you find it, and who knows but what other *padres* might well turn prospectors.

AS an undesirable citizen, Charles H. Moyer, president of the Western Federation of Miners, has been forcibly deported from Calumet by the 'Citizens Alliance.' This action on the part of the 'Alliance' should meet with the approval of both strikers and operators as little good could be expected from the efforts of one so ill-reputed in the district as the present president of the Western Federation of Miners.

MEMBERS of the American Institute of Mining Engineers residing in northern and central California will meet at the Engineers' Club, in the Sutter hotel, of San Francisco, on the evening of January 12, to act upon the report of the Committee on Organization. Preceding the meeting a dinner will be served at 6:30. The subject for consideration is one of particular interest to the local engineers, and an interesting meeting is anticipated.

FURTHER argument to the effect that the mining law needs revision in more than incidental particulars is advanced on another page by Mr. Grafton Mason, who has most courteously answered our Macedonian cry for help. His arguments are not only sound in themselves, but coming as they do from one who as attorney for the land department of the Northern Pacific railroad, has seen much of the practical application of the mining law, they are entitled to consideration even from those who affect to believe that as to law no opinion is final save that of a lawyer.

FRANKNESS in discussing the situation is not easy when the grade of ore is going down. We have frequently commended the full and frequent statements given out by the Goldfield Consolidated Mines Company, and are sure that our readers will read with interest the following from a speech made by Mr. Albert Burch at a recent public dinner held at Goldfield to inaugurate a movement designed to make that city a more livable place. "So far as the Goldfield Consolidated is concerned, everyone knows that the cream has been skimmed and that we are now doing our best to subsist on skimmed milk; but at that we are doing fairly well. It can probably never be the profit-earner that it once was, nor can its present scale of operations be continued indefinitely; but on some basis the Goldfield Consolidated will be running for several years yet. We are now working a low-grade mine, and in order to make it pay we do not plan to reduce wages; nor to ask any man to break his back doing an unusual day's work; but we do ask him, if he is

our friend, to bend his back to pick up a dollar's worth of drill steel if he sees it being buried in the muck, and in any other way that he can, use his brains as well as his hands to help stop leaks." We trust that the appeal made by Mr. Burch will evoke the answer it deserves, and we hope with him that the great mine may run for many years yet.

INCOME TAX questions have been worrying officials of a good many American mining companies. Not that they are so excessively wealthy, but because of the difficulty of determining depreciation in the case of a wasting asset, such as ore in the ground. Many have been puzzled by the decision of the Supreme Court in the case of Stratton's Independence, Limited. The matter is really very simple. Mining companies will be allowed a depreciation charge of 5 per cent on their gross output, and all other possibilities are swept away. This covers the past as well as the future, and opens the way to corresponding rebates and additional collections where any other basis was used in figuring.

The Secretary and the West

The report of Mr. Franklin K. Lane, as Secretary of the Interior, for the fiscal year that ended June 30 last, was made public Christmas eve. It is a straightforward readable brief, rather than the usual dry and formal departmental document. The Secretary has had the good sense to concentrate his attention upon one of the groups of questions now before his Department, and he has presented his recommendations and the argument for them so simply, as to increase greatly the chances for securing favorable Congressional action. Many phases of the problem of further disposition of the public lands, which is what chiefly concerns the Secretary, have been the cause of acute and acrid controversy. A number are even now bitter fighting ground, and yet it is fair to say that already differences of opinion are disappearing, and there is undoubtedly a sufficient agreement as to policy to warrant Congress settling at least a few of the many vexed questions. We believe that Mr. Lane is absolutely right when he says, and the italics are his, "The West no longer urges a return to the hazards of the 'land is land' policy. *But it does ask action.*" We sincerely hope that enough of the spirit of fair compromise may obtain at Washington this winter to permit determination of at least the more pressing matters.

Speaking in general terms, the Secretary favors a leasing system for the coal lands, not only of Alaska but of the rest of the United States, and for the oil, phosphate, and potash lands. Further than that he does not go, and in this we believe him wise. What may be proper as to further disposition of other mineral lands, no one can certainly say at this time, but as regards coal, oil, phosphate, and potash lands, there is sufficient knowledge to permit intelligent action. Our own views regarding this are too well known to

require lengthy re-statement. While not prepared to endorse every detail of the Secretary's proposed form of lease, we heartily favor the general plan, and we have no fear that any bill which gets past Congress will not be sufficiently liberal. In later numbers we shall speak of particular proposals.

Another of the recommendations made by the Secretary is that the various activities of the United States Government in Alaska be placed under the charge of a single board or commission and that this board be given large freedom of action. As he truly says, "there can be no satisfactory administration of land laws, or any other laws, at a distance of 5000 miles from the point of action. The eye that sees the need should be near the voice that gives the order." It will be remembered that Mr. Taft, when president, favored a commission form of government for Alaska and that his proposal raised a storm of dissent. Since then an elective government has been constituted for the Territory and to it has been delegated the local political power. As we understand Mr. Lane's suggestion, what is now proposed is a Board of Directors to manage the property in Alaska that belongs to the United States. There is an important difference, and, while there would seem to be room for much friction between such a board and the local Legislature, the proposal merits careful consideration. Certainly there is need for bringing the administration closer to the local needs of the people, and, without pretending any great sympathy for the 'black bear which is in the care of one department while the brown bear is in another,' we are quite prepared to agree that the organization of administration in Alaska could be greatly improved.

As a whole, the report is a plea for the West: a demand that means be found, without undue sacrifice of national interests, to permit the continuance of the great work of building there homes for the people of the Nation. It is written by a man who honors and loves the West, and it rings true.

Mill Construction and Operations

In 1913 no country was especially conspicuous in the construction of new plants. In the United States, several interesting mills began work and others are well on toward completion. During October, the Commonwealth mill, at Pearce, Arizona, started work. This mill consists of 30 heavy stamps, Hardinge mills, Pachueca agitators, and Oliver filters, and has a capacity of 350 tons per day. Interesting work is being done at the Tom Reed, Gold Road, and Vulture mills, and in Texas the Presidio Mining Company has converted its pan-amalgamation mill to cyanide with a gratifying increase in capacity. In California there are four all-sliming plants, the latest being the Globe 20-stamp mill at Dedrick, Trinity county, and in a few months a 300-ton mill will be erected at the Plymouth mine, California, embodying the best Mother Lode practice together with several new features. In the meantime,

the nine mills containing 400 stamps dropping on ore in Amador county are doing satisfactory work, as described in the last issue, and elsewhere along the lode there were few changes. Small stamp-mills and cyanide plants in Oregon have continued in operation. At Fairbanks, in Alaska, 16 small mills are in operation, and at Juneau proposals for new mills to treat ore worth only \$1.50 per ton are interesting in that stamps and rolls will be tested side by side. The work here has been described for our readers by Mr. F. W. Bradley and Mr. Grant Tod. The current year should see the first units in operation.

In Nevada a 300-ton mill, containing some novel features, is under construction for the Buckhorn company. There will be no stamps, but crushers, rolls, Hardinge and tube-mills, Akins classifiers, agitators, and Oliver filters. The ore is clayey and crushes easily. At Aurora, in the same state, a large stamp-mill is being erected for the Aurora Consolidated Mining Company. In Nevada the Goldfield Consolidated treated its 950 tons per day, with the usual good results. The seven mills at Tonopah continued literally to pour out silver bullion, the production being nearly 35 tons per month. More stamps are being added to the West End mill. In Colorado the Stratton's Independence, Portland, Camp Bird, Tomboy, and many small plants have been improved and were in continuous operation. In South Dakota the Homestake company added 20 to its existing complement of 1000 stamps; the Wasp No. 2 treated ore as cheaply as ever, although circumstances prevented its operation during the full time.

At Poreupine, in Ontario, Canada, both the Dome and Hollinger mills are being enlarged. Several plants for treating gold-bearing ores have begun work in adjoining districts. At Cobalt the Northern Customs 40-stamp mill is being duplicated; the McKinley-Darragh extensions were finished; and the Nipissing high and low-grade mills continued their highly interesting work, the refinery output being about 17 tons of silver per month. Canadian authorities are now experimenting with the object of saving the cobalt from the ores of the district. Two valuable contributions to metallurgical knowledge came from the Nipissing mills: desulphurizing of the ores by aluminum, described by Mr. J. J. Denny in our issue of September 27, and precipitation of silver from cyanide solutions on aluminum dust.

Although Mexico has been in the throes of a revolution through the year, and many mining men have temporarily left the country, the mills at El Oro, Pachuca, and Guanajuato have worked without interference. Parral has had a troublesome year, and at present little is being done there. In Jalisco, El Favor plant is being enlarged, and mills of big capacity are under construction at the Cinco Minas and San Pedro Analeco mines, also at the San Martin in Oaxaca, and a 500-ton concentrator at the Teziutlan Copper Co. in Puebla. La Blanca mill, at Pachuca, Hidalgo, is being enlarged

and the agitation system altered. During the past financial year the Santa Gertrudis mill treated 263,554 tons of ore yielding 21,800 ounces of gold and 4,243,000 ounces of silver. Improvements have been made to the El Tigre mill, which treats a complex ore under numerous difficulties. Experiments with the manganese-silver ores of Jalisco are still under way. In Honduras the Rosario, in Costa Rica the Abangarez, in San Salvador the Butters Salvador, and in Brazil the St. John del Rey mills have been in continuous operation.

The Indian group of gold mines at Kolar increased its output slightly, and improvements are being made at several plants, notably in slime treatment. There were apparently no important developments in the mills of West Africa. Rhodesia has been of interest on account of the new mills under construction, or about to start work, these being the Shamva, Cam & Motor, Falcon, Antelope, Bell, Kimberley Reef, and New Found Out. Antimony has been one of the main sources of trouble in gold recovery in this country, and it will be interesting to watch results from the Cam & Motor plant where the practice includes dry-crushing in Krupp ball-mills, roasting in Edwards furnaces, leaching sand, and filtering the slime. It has been designed from the best practice at Kalgoorlie, and has a capacity of 15,000 tons per month. On the Rand, an average of 9982 stamps and 287 tube-mills have been at work crushing 2,100,000 tons of ore per month. There have been several enlargements of plant in additional stamps and tube-mills, also three new Butters filter-plants at the Randfontein Central, Van Ryn Deep, and Geduld, with daily capacities of 1500, 900, and 500 tons, respectively.

The Oriental Consolidated stamp-mills and cyanide plants in Korea have operated continuously, and crushed an average of 25,000 tons per month. The gold and silver mills in Japan have run their usual even course. In Sumatra, Redjang Lebong and Ketahoen mills treated the gold and silver ores according to their customary methods, there being no changes of importance. Going south to Australia, a new cyanide plant was erected at the Scottish Gympie mine in Queensland. This is interesting, as at Gympie there is a large amount of graphitic slate, and, like the Mother Lode of California, there has been trouble from this mineral causing premature precipitation of gold. The ore is also low grade, and care is necessary in all departments. In New South Wales, there have been improvements to the equipment at the Mount Boppy stamp-mill and cyanide plant, which treats 6000 tons per month. From the Cassilis mine in Victoria a very refractory ore is extracted, and after several years' experiments a new treatment plant, consisting of stamping, concentration, cyanidation of pulp, and roasting and other treatment of the concentrate, is soon to be completed. At Kalgoorlie, Western Australia, the dry and wet processes for treating sulphotelluride ores gave their usual satisfactory results.

and profits were made at the Perseverance and South Kalgurli from ore worth from \$5 to \$6 per ton. In this journal of September 13, Mr. A. W. MacLeod discussed the metallurgical tendencies in the state. While the development of oil-engines has expanded in other countries, the great advance made in the use of suction-gas plants in Australia, especially in the western states, has surpassed the progress made elsewhere. Grinding pans are still much in favor. Two plants have been built wherein the sand is first removed from the pulp by cones, the slime being thickened, and the sand, after being continuously agitated, rejoins the slime, both being then treated in the one vacuum-filtration plant. The Sons of Gwalia mill, 13,000-ton capacity, was remodeled; the Queen of the Hills mill, of Holman pneumatic stamps, is doing excellent work; as is the Bullfinch stamp-mill and vacuum-filtration plant. One of the most interesting mills, the success of which was doubtful at the end of 1912, was that at the Victorious mine, 40 miles from Kalgoorlie. Four Huntington mills, two pans, an agitation plant, and three Ridgway reciprocating filters treated 95,640 tons of ore in 12 months to September 1913. This ore averaged \$5.26 per ton, and the profit totaled \$173,000. The failure of the Howe volatilization process, as described in this journal of October 4, 1913, was unfortunate. As a result, two mines with large ore reserves are now shut down indefinitely. After a serious decline of the state's gold output since 1903, the past year in Western Australia has shown a considerable increase.

In New Zealand, the Grand Junction at Waihi is adding 20 to its existing 40 stamps; the Waihi company only operated its 200-stamp mill, treating 14,600 tons, yielding \$120,000 per month; at Karangahake, the Talisman continued treating its high-grade silver-gold ore, the average yields of late being 4300 tons returning \$106,000. Recovering the old tailing from the river 6 to 15 miles below the Karangahake and Waihi districts, and treating it by tube-milling, agitation, and vacuum-filtration continued with interesting success at the Waihi-Paeroa Gold Extraction plant. To date a total of 219,700 tons of tailing has yielded gold and silver worth \$340,000.

In connection with new processes, it may be said that attempts to use the Clancy system of regeneration of solutions have stopped at Cripple Creek. There is an increasing interest in the electrolysis of solutions. The new process of precipitating gold on zinc wafers does not seem to have met with success, as at Waihi and on the Rand results were not satisfactory. The litigation of the year included the Moore-Butters vacuum-filtration dispute; the Brown system of crushing in cyanide solution and concentration *versus* the Tonopah Mining Company; and the London & Hamburg Gold Recovery Company *versus* the Golden Horse-Shoe Estates Company, in connection with the bromocyanide process, and trial of issues regarding flotation as discussed elsewhere. All of these subjects received extended reference in this journal from time to time.

Gold Dredging in the United States

By CHARLES JANIN

California

Figures of dredge production in 1913 are not available as yet but are not likely to vary greatly from those of 1912 when the production of gold won from dredging operations in California was \$7,429,951; this was a decrease of \$236,506 compared to 1911. As pointed out in my review of last year, the production of gold from dredging in this state reached its zenith in 1911 with \$7,666,461, and a gradual decrease may be expected. A number of dredges, notably in the Oroville district, have exhausted, or nearly exhausted, the ground for

months out of commission, have been working steadily, and the yardage results will closely approximate those of 1912. No. 13 dredge, built in 1912, has averaged about 250,000 yd. per month from deep ground, and one month had an output of 310,000 yd. While this yardage does not equal that of the Idaho dredge, mentioned elsewhere, considering the difference in the ground handled, it marks without question just as good work. No. 14, the new steel dredge being built for this Company, and an excellent boat, began work late in December. Some delay was experienced in getting



YUBA No. 14, THE LATEST ALL-STEEL GOLD-DREDGE.

which they were built, and, except in a few instances where the machinery from these boats can be profitably transported and used on other areas, the boats will be dismantled and the equipment used for repairs.

The most successful dredging enterprise in the state and in the world for that matter, is that of the Yuba Consolidated Gold Fields in Yuba county. With 11 dredges operating part of the time until No. 2 was dismantled, the profits from dredging operations for the year that ended on February 28, 1913, were \$1,640,848 from 164.8 acres. The depth varied from shallow ground dug by No. 9 in working to new ground, to ground 70 feet deep handled by some of the other dredges. The average amount recovered was practically the same as the year previous, 16.78c. per cu. yd., but the working cost was 5.34c. or an increase of 0.67c. per yard. The results of operations for 1913 are not yet available, but the 10 dredges of the Company, with the exception of No. 5, which sank July 31 and was two

steel shipments from the East, or the dredge would have been completed sooner. A matter of some interest to the general reader, but of more importance to those acutely concerned, is the fact that the Yuba Consolidated has distributed over \$8,000,000 in dividends among its shareholders; no phantom profits there.

The Natomas Consolidated operates 10 dredges in Sacramento county and 3 in Butte. The Company had a fair year as far as its dredging operations were concerned, though net profits fell somewhat short of estimates. The dredges handled during 1912 a total of 22,155,162 cu. yd. with an average recovery of 9.12c., and an operating cost of 4.46c. per cu. yd. The net result from dredging operations for the year was \$1,031,804. For the eight months that ended August 31, 1913, the net result from dredging was a little in excess of \$791,000, and it is expected that a total approximating nearly 24,000,000 yd. will be handled during the year. During 1913 dredge No. 7 was entirely reconstructed

OPERATIONS OF GOLD DREDGES IN CALIFORNIA*

County, district, and name of company.	Name of dredge.	Cap. of buckets.	Manager or superintendent.
BUTTE COUNTY —20 dredges operating; approximate total yardage for 1913, 17,000,000.			
<i>Oroville District:</i>			
Oroville Dredging, Ltd.....	Boston 4.....	7	W. P. Hammon, general manager, Alaska-Commercial Bdg., San Francisco.
	Exploration 2.....	5	
	Exploration 3.....	7	
Natomas Consolidated, Feather River division.....	Feather 1.....	8	S. L. G. Knox, general manager, Alaska-Commercial Bdg., San Francisco.
	Feather 2.....	8	
	Feather 3.....	15	
Pacific Gold Dredging Co. ²	Pacific 4.....	7	O. C. Perry, manager, Oroville.
Oro Water, Light & Power Co.....	Lava Bed 2.....	6	C. G. Leeson, manager.
	Empire.....	5	
	Victor.....	5	
	Hunter.....	5	
Indiana Gold Dredging Co. ²			O. C. Perry, manager, Oroville.
El Oro Gold Dredging Co.....	El Oro 2.....	5	W. S. Noyes, president, Mills Bdg., San Francisco; C. Helman, superintendent.
Ophir Gold Dredging Co.....	Ophir ¹	5	F. S. Mayhew, manager, Clunie Bdg., San Francisco.
Pennsylvania Gold Dredging Co.....	Pennsylvania ¹	6	Sam Cheyney, manager, 237 First St., San Francisco.
VII Oro Syndicate.....	VII Oro.....	7	W. James, superintendent, Oroville.
Gardella.....	Oro Vista.....	5	L. Gardella, manager, Oroville.
<i>Butte Creek District:</i>			
Butte Creek Con. D. Co.....	Butte Creek.....	11	H. D. Gallihan, superintendent, Chico.
Drexler Dredging Co.....	Wade.....	4	John Ross Wade, superintendent, Chico.
<i>Horncut District:</i>			
Kentucky Ranch G. D. Co.....	Kentucky.....	5	L. Gardella, manager, Oroville.
Gardella.....	Horncut.....	5	L. Gardella, manager, Oroville.
YUBA COUNTY —13 dredges operating; approximate total yardage for 1913, 20,000,000.			
Yuba Con. Gold Fields.....	8 dredges.....	7½	Hammon Engineering Co., San Francisco.
	Yuba 13.....	15	
	Yuba 14 ³	15½	
Marysville Dredging Co.....	Marysville 3 and 4.....	8	Bulkeley Wells, general manager, Marysville.
SACRAMENTO COUNTY —11 dredges operating; approximate annual yardage for 1913, 26,000,000.			
Natomas Consolidated.....	Natomas 1.....	13½	S. L. G. Knox, general manager, Alaska-Commercial Bdg., San Francisco.
	Natomas 2 and 3.....	8½	
	Natomas 4.....	13½	
	Natomas 5, 6, and 7.....	9	
	Natomas 8, 9, and 10.....	15	
Union Dredging Co.....	Union 1.....	9	A. Turner, superintendent, Folsom.
CALAVERAS COUNTY —3 dredges operating; approximate total yardage for 1913, 3,500,000.			
Calaveras Gold Dredging Co.....	Calaveras ⁴	5	S. A. Moss, manager, Alaska-Commercial Bdg., San Francisco.
Isabel Gold Dredging Co.....	Isabel ⁴	5	F. L. Estep, superintendent, Jenny Lind.
Oro Water, Light & Power Co.....	Mokelumne.....	9	C. G. Leeson, manager, First National Bank Bdg., San Francisco.
Butte Dredging Co.....	Butte ⁴	3	L. N. Parks, superintendent, Jenny Lind.
SHASTA COUNTY —2 dredges operating. ⁵			
Shasta Dredging Co.....	Shasta.....	5	R. F. Lewis, secretary, Mills Bdg., San Francisco.
U. S. Gold Dredging Co.....	Redding.....	3	C. A. Westenberg, manager, Berkeley.
PLACER COUNTY —4 dredges operating.			
Gaylord Mining Co.....	Gaylord.....	6	E. C. Gaylord, manager, Auburn.
El Dorado Placer G. M. Co.....	Cache Rock.....	..	A. W. Copps, superintendent.
Beaver Gold Dredging Co.....	Beaver.....	4	N. J. Martin, superintendent, Loomis.
El Dorado & Placer Co. G. D. & M. Co.....		3½	A. Tredidgo, manager, Foxcroft Bdg., San Francisco.
Yukon Gold Co.....		7½	O. C. Perry, manager, Oroville.
TRINITY COUNTY —2 dredges operating. ⁵			
Alta Bert Dredging Co.....	Alta Bert.....	7½	M. Ashley, superintendent, Trinity Center.
Trinity River Dredging Co.....	Trinity.....	9	Baker, superintendent, Minersville.
SISKIYOU COUNTY —1 dredge operating. ⁵			
Siskiyou Dredging Co.....	Siskiyou.....	5½	George C. Carr, president, Hammonton.
MERCED COUNTY —1 dredge operating. ⁵			
Yosemite D. & M. Co.....	Yosemite.....	3½	James H. White, manager, Snelling.
Total—56 dredges operating; approximate yardage for 1913, 70,000,000.			
The number of dredges given refers to those in operation at the end of 1913, eight boats having completed their ground.			

*Nearly worked out its ground.

²Indiana dredge to go to Michigan Bar, Sacramento county. Pacific No. 1 was moved to Auburn, Placer county.³Yuba 14 started December 18.⁴Three dredges in Calaveras county short of water during the fall.⁵Total approximate yardage, Shasta, Placer, Trinity, Siskiyou, and Merced counties, 3,500,000.*Table prepared by Mr. Janin for use in the *Mining and Scientific Press*, January 1913, revised by M. W. von Bernewitz.

with new steel hull, and re-commissioned in Blue Ravine May 12. No. 5, which sank June 8, was uprighted and ready for repairs early in July. Natomas No. 2 had a narrow escape from sinking July 3, but a bad leak was stopped by promptly putting cement between the outer and inner walls of the hull. Recent work by the Natomas dredges is described in the *Mining and Scientific Press* of December 27. The other operations of this Company have not attained the success contemplated, and it is undergoing reconstruction at the time of this writing.

The operations of the Oroville Dredging, Ltd. at Oroville are gradually coming to an end, though the Company expects about five years' life for two dredges. Five dredges operated during 1912 and part of 1913, and for the 18 months ending January 31, 1913, handled 7,062,528 cu. yd. averaging 10.29c. per yd. at a profit of 5.2c. The profit for 1913 is estimated at approximately \$160,000, and from 1914 to 1918 at about \$65,000 annually, though it is questionable if both of the boats will be in operation that length of time. Exploration No. 1 sank during the year, and after investigation it was decided not to repair it. At the end of the year there will be only two dredges operating. Meanwhile the Company's holdings in Colombia are becoming productive, as mentioned elsewhere, and payment of dividends, which have been long deferred on account of financing the Colombian property, will, it is expected, be resumed early in 1914.

The other companies in Oroville have, in general, had an uneventful year. A fire destroyed a sub-station of the Pacific Gas & Electric Co., and caused a temporary shut-down of a number of dredges. Shortage of water also caused some lost time. The Vil Oro has had a good year, and has several years more to run. The Pennsylvania dredge finished its ground and is to be used to dig a small piece of ground left by the Oroville Dredging Co.'s dipper dredge. The boats that ceased operations in the Oroville field in 1913 were, Pacific 1, Boston and California No. 2, Baggett 1, Leggett dredge near Palermo, El Oro No. 1, and Exploration 1. Exploration 2 will cease operations about the last of the year, and Indiana Gold Dredging Co.'s boat will finish about January 1. The machinery from Pacific No. 1 was removed to a new hull on the American River near Auburn. The transportation and erection of the boat was completed and the new boat put in commission in less than four months, which was good work.

A New Form of Tumbler

Satisfactory trials have been made during the year with a round tumbler in place of the six-sided tumbler in general use. The new tumbler is made a little larger than actual size required for holding six buckets. This prevents buckets from striking the same point on the tumbler, and insures uniform wear both on tread faces and side or cheek faces. With a tumbler of this description the slipping of buckets is obviated, and much wear and jar is eliminated. Some dredges are using tumblers made entirely of manganese steel, except

the shaft. Other tumblers are made of carbon steel for the base, with wearing plates of manganese steel.

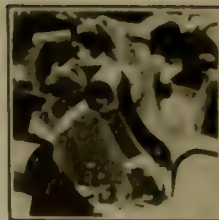
The re-dredging of some of the dredged areas has been advocated to some extent, but nothing has yet been attempted in this line, except as mentioned in previous reviews.

In Sacramento county the Ashburton dredge has exhausted the Company's holdings and has been shut down. The Company was negotiating, with results unknown to me at the present writing, to secure the dredge and land of the bankrupt Union dredging company having the adjoining property. The method of promotion and of financing the Union dredging company was criticized in my previous review.

An Ambitious Scheme Fails

The Tarr Mining Co., near Smartsville, after spending a large sum of money in building a complicated plant expected to handle the gravel from the old Blue Point mine, and to dispose of the tailing without objection from the Debris Commission, decided to investigate the value of the gravel that the plant was to handle; which, needless to say, should have been one of the first things, not the last done. The superintendent reported that the ground did not contain sufficient gold to warrant further development, or to finish payments on the property, so the Company retired, and the big plant which was always looked upon with amusement and suspicion by engineers familiar with the district and with gravel working, was never started. The whole business is a striking example of how an enthusiastic promoter can secure capital for an unstable enterprise, and also of the folly of going into mining without proper engineering advice. Had the services of a competent engineer been secured, much money would have been saved the shareholders.

In Calaveras county, the Mokelumne dredge, described in the *Mining and Scientific Press* of December 13, is doing good work. Construction of this dredge was commenced by the Mokelumne Dredging Co., which formerly owned the property, but owing to financial troubles, it was unable to complete the boat. The property was taken over by the Oro Water, Light & Power Co. in 1912, and the dredge, which is equipped with 7½-ft. buckets, was completed and commenced operation in February, 1913. The Isabel dredge, near Jenny Lind, has been equipped with new bucket line and a new steel bow-gantry. The Calaveras dredge in the same field has about worked out its profitable ground. The Butte dredge is said to be doing excellent work. All dredges around Jenny Lind lost considerable time in the fall from lack of water, and were obliged to shut down early in October. In Placer county the Yukon Gold Co. has built a dredge on the American river near Auburn, con-



WEAR ON BUCKET WORKING
ON A ROUND TUMBLER

structing a new hull and using the machinery from Pacific No. 1, an Oroville boat. The Eldorado & Placer Company has a dredge at Poverty Bar, and the dredge at Loomis, belonging to the Beaver Gold Dredging Co. has undergone some changes to facilitate handling the tailing and reclaiming the land after dredging. The ground being dredged is shallow, averaging 12 to 15 ft. deep, and was formerly an orchard. Ground of this depth can be easily leveled behind the boat, which would not be possible with dredges operating on deep ground. The Yosemite Dredging & Mining Co. expects to rebuild its dredge in 1914, if some investigations now being made are successful.

During the year the dredging interests in the state were jeopardized by some proposed regulations and restrictions of gold-dredging operations, which were the object of attack in a bill introduced in the state legislature, and which found some favor among the legislators. Prompt action on the part of the dredge companies, and by the supervisors of the counties in which dredging has proved such a benefit, defeated the bill. The matter was discussed in detail in the *Mining and Scientific Press* of March 8 of last year, so it is unnecessary to go into it further at this time.

Idaho

The principal gold dredging operation in Idaho is conducted by the Boston & Idaho Gold Dredging Co. near Idaho City. The 15-cu. ft. boat of this Company made a remarkable record during 1912, handling 3,775,398 cu. yd. of material, or an average of over 314,000 cu. yd. per month. The largest yardage, 361,190, was handled during October. The ground is light and easily handled, which accounts for the high yardage, which is a world's record for any dredge. The working costs also constitute a world's record, but cannot be used in comparison with dredges in other districts. The dredge at Pierce, Clearwater county, was destroyed by fire, probably caused by a short circuit, on September 25. Insurance of \$10,000 was carried by the Company on the dredge, which was several years old. The Yuba Construction Co. has built a dredge near Salmon for interests connected with Pabst Brewing Company of Milwaukee.

Montana

The fleet of the Conrey and Poor Farm companies, working at Ruby, Montana, now consists of two boats with $7\frac{1}{2}$, one with $9\frac{1}{2}$, and one with 16-cu. ft. buckets. In 1913 these handled about 4,750,000 cu. yd. with a return of something over \$650,000. The big 16-ft. dredge was overhauled in July and a new screen installed. It is thought to be the strongest in use in the world, the whole screening surface being made of one-inch perforated manganese steel plates with agitating bars cast on them. It weighs nearly 100 tons. It has worked most satisfactorily. A 500-hp. motor was put in use on the bucket-chain drive and overhauling and adjusting it led to some delay. While the dredge has handled 270,000 cu. yd. in single months, even better

duty is expected. It is to be remembered that the gravel at Ruby is more thoroughly cemented than at Yuba and Oroville, and this accounts for a lower dredge duty and higher cost. Manganese steel buckets are now used on all the Ruby dredges and are giving excellent satisfaction.

Colorado

Besides the dredges operating in the Breckenridge district, a dredge and power-plant has been completed by the Tin Cup Gold Dredging Co. in Gunnison at a cost of \$180,000. Operations commenced during the last week in October, but an accident necessitated shutting down for the winter. Details are lacking as to conditions of operations, and particulars of dredge construction, which has a capacity of about 2600 cu. ft. per day. The Company owns 1900 acres of property, which is said to average 45c. per cubic yard.

Seward Peninsula

An exceptionally dry year was responsible for reducing the average yardage and output of the dredges by 30% of what it otherwise would have been had the rain conditions been normal.

The winter frost penetrated to a greater depth than usual during the preceding winter, due to the light snowfall, which afforded little protection to the ground from freezing. From June to the middle of September there was practically no rainfall, and as the summer rains and running water are the best thawing agents, a considerable part of the dredging ground, as a result, was in a semi-frozen conditions until the middle of the season. Some of the flume dredges ran successfully, and there is still, in my opinion, a future for that type of boat on the Peninsula where care and judgment have been exercised in carefully selecting the ground before building the boat. I have previously pointed out the all too frequent practice in that country of building a dredge on a property before it was known if the ground was suitable for dredging operations and if the gold content was sufficient to justify the enterprise.

Four new dredges were constructed this year. A $3\frac{1}{2}$ -cu. ft., close-connected bucket, flume dredge was constructed on the Kugruk river for Iver Johnson and associates by the Union Construction Co. The dredge was completed on August 23 and operated to October 10. The average daily yardage was over 2000. The labor and fuel costs were 9c. per cubic yard; the average fuel consumption being 200 gal. per day of No. 1 engine distillate. This dredge is equipped with two 50-hp. Union marine type gas-engines. A 14-in. centrifugal pump discharges 500 inches of water per minute into a steel flume 42 in. wide, 75 ft. long, with an undercurrent at the outer end 7 ft. wide and 12 ft. long. This undercurrent is lined with cocoa matting and expanded metal. About 4% of the total gold recovery was made from the undercurrent.

The Union Construction Co. dismantled the Arctic Gold Dredging Co.'s $2\frac{3}{4}$ -ft. dredge on Saunders creek.

The machinery was moved to Hobson creek and installed in a new hull. Kimball and Soupe installed a 2½-cu. ft. flume dredge on Melsing creek in the Council district, which is reported to be successful. The American Dredge Building & Construction Co. built and erected a small 1½-cu. ft. flume dredge on the present beach near Nome. After running a short time, it was closed down, as it was found that the ground had been worked out by the miners at the time of the discovery was made when the present beach was rich in gold. The Anglo Alaska Gold Dredging Co. erected a 2-cu. ft. flume dredge on Sunset creek in the Teller district. This dredge was fairly successful on a creek where a hydraulic equipment, costing over \$350,000, had made a complete failure. The total cost of the dredge was less than \$40,000. The steam dredge on Osborn creek sank during the winter, and as it never had been a success, the machinery was dismantled and sold to satisfy claims for hauling. The Johnstone dredge on Windy creek in the Port Clarence mining district suspended operation in midsummer on account of frozen ground. There is supposed to be good ground ahead of the dredge, but it will be necessary to remove tundra covering the ground for a distance of 1000 ft. The owners are planning to do this in the spring. The Inmachuck Dredging Co.'s dredge closed down on October 7 after a fairly satisfactory season. The Arctic Gold Dredging Co. had considerable trouble handling large flat boulders on its ground on Hobson creek. The machinery on this boat was moved from the former dredge of the Company on Saunders creek and put in a new hull. The Ernst dredge on the beach is said to be working successfully.

The York dredge (tin) had a short season on account of lack of water, and was also obliged to cut through some of the old tailing piles to new ground. The output for 1913 has been estimated at 75 tons of concentrate. The Ruby dredge closed down on October 12. Operations during the year disclosed a greater number of large boulders in this ground than had been expected. The Solomon dredge has almost worked out the Company's holdings, and the Nome Montana dredge has exhausted its ground. The owners are now trying to dispose of the boat. The Seward dredge underwent another overhauling. The crown sheet blew down in one of the boilers and a make-shift arrangement had to be used for the rest of the season. Two old small boilers were obtained at Solomon and a small gas engine was also added. The fuel consumption is high and, while the digging end of the boat does exceptionally well, the high power cost and low efficiency of the engines add greatly to the operating cost and prevent the success that under different conditions might have followed operations. The dredge started May 20 and closed down November 20. During the first part of the season practically all of the ground was thawed with steam. The ground was from 9 to 11 ft. deep. The points were driven 9 ft. apart, and after driving were left in the ground for 12 hours.

Thawing operations were started on April 20. The boilers on the dredge were used to supply steam until the dredge started May 20, 500 ft. of ground ahead having been thawed when the dredge started operations. A 24 hp. boiler was then used, supplying steam to 24 points. The thawing costs were 12½¢ per cubic yard, which included all costs of steam, hose, points, labor, and fuel. Oil delivered in a tank at Solomon cost \$1.70 per barrel of 42 gal.; freight to the dredge cost \$3.75 per barrel.

The Blue Goose dredge, operating on Ophir creek, had a successful season. This is one of the first dredges constructed on the Peninsula. It was originally a 5-cu. ft., open-connected bucket, steam-driven dredge, built at Portland, Oregon. Its present owners, in the last five years, have practically remodeled the dredge. This season they changed the bucket line from a 5-cu. ft., open-connected, to a 3-cu. ft., close-connected line, and increased their yardage 40 per cent.

The Wild Goose dredge engine was changed and some trouble and delay was experienced at first with the new one. The Shovel Creek Dredging Co. was obliged to dig considerable bedrock, as the ground is shallow. This cut down the expected yardage. Difficulty was also experienced with the engine breaking a shaft. This was successfully welded by use of thermite. Good reports come from the Flodine and Kimball dredges, which are said to be working successfully.

Altogether 1913 has not been a banner year for dredging on the Seward Peninsula, but that does not prove that other areas will not be found and, after correct prospecting, be properly equipped and successfully handled in the future. Indeed there is no doubt a chance, if suitable areas are developed, to buy some of the dredges which were improperly placed at a fraction of their first cost and move the machinery. I need only repeat what I have said in former articles, that I believe there is a field for small boats in the Seward Peninsula, but better judgment must be used, to first see that the conditions for operation and that the gold content of the ground to be handled, justify the venture.

The value of minerals exported from Broken Hill, New South Wales, during September was \$1,930,000. This included silver-lead concentrate, 30,158 tons; zinc concentrate, 35,881 tons; silver-lead ore, 2614 tons; silver-lead slime, 1384 tons; and zinc slime, 299 tons. The Central mine has opened its orebody at 1300 ft., and the North, at 1400 ft., has drilled through 112 ft. of ore. According to the *Australian Mining Standard*, recent developments show the following results:

	Level, ft.	Lead, %.	Silver, oz.	Zinc, %.
North	1400	17.5	10.0	15.0
Central	1300	14.0	12.0	17.0
British	1100	19.6	13.0	13.3
Junction	1000	20.0	...	...

Statistics of exports of mineral products from Guatemala during 1912 show only 30,840 lb. of material worth \$2737.

Revision of the Mining Law

By GRAFTON MASON

Revising the mining law or leaving it intact without considering the opinions of Mining Congresses, Directors of Geological Surveys, or Secretaries of the Interior is like passing a currency bill without hearing the Comptroller of the Currency, commercial organizations, or the Secretary of the Treasury. Giving entire control of mineral legislation to those engaged in practical mining rests in the beneficiaries power to measure the extent and conditions of the Government's benefactions in disregard of the interests of the non-mining public.

If the mining law were as simple as the statement of the article, 'Revision of the Mining Law—A Protest, copied in the *Press* of October 18, 1913, the practical miner might be presumed to be content; but the author admits that he is not, and concedes that there is a general feeling that 'something is wrong.' He then brushes aside all that is supposed to be wrong by a consideration of existing statutes which are said to contain certain provisions, and these statutes are epitomized by the omission of the important terms which create the feeling that something is wrong and cause the demand for revision.

The free grant of valuable minerals in the public lands to anyone who may find them makes no provision to cover the search. Only mineral lands are open to mineral entry, and the question whether any particular parcel of public land is mineral or non-mineral is an open one until it has been judicially determined. The miner may be in possession and looking for valuable minerals with all diligence, but he is subject to contest by the Government, by claimants under any of the agricultural land laws, or by the State, or by railroad grantees of non-mineral land on the ground that the land is non-mineral. These contests involve long expensive hearings before the local land officers followed by appeals to the Commissioner of the General Land Office and then to the Secretary of the Interior. What the result will be is conjectural, for these questions appear to fall within a twilight zone of interpretation.

The question 'what is mineral land' has disturbed many tribunals, official and judicial. A proper definition was once thought to be: Land that is more valuable for mineral than for agricultural purposes; and this must appear as a present fact "from actual production of mineral, and not from any theory that it may produce it." (*Dughi v. Harkins*, 2 L.D., 721.) The generally accepted definition, however, is that given by the Supreme Court of the United States in *Davis' Administrator v. Webbald*, 139 U. S., 507-519, not "all land in which minerals may be found, but only those where the mineral is in sufficient quantity to add to their richness and to justify expenditure for its extraction." Two recent cases in the Federal

Courts illustrate one of the embarrassments of this question. In the case of *United States v. Diamond Coal & Coke Co.*, 191 Fed., 787, the Circuit Court of Appeals for the Eighth Circuit held land to be coal land, where the presence of coal in paying quantities was not shown, but geological conditions were convincing that the dip of a well known outcrop on near-by land, and traced for many miles, would carry the coal to the land in suit. Judge Bourquin in *United States v. Kostelak*, 207 Fed., 447-452, another coal case, questions the correctness of that decision, believes this is a construction and application of the law not warranted and never before arrived at by any court, nor by the Land Department of the United States; and points to the agricultural entries of lands adjoining the mines at Butte toward which their veins dip and strike, made and patented after the great value of the mines was common knowledge, with the query: "If presumption is to be indulged that a vein or lode extends under lands two miles distant from the outcropping, why not five, ten, or an indefinite number of miles; where will be the limit and how and by whom will it be determined?" It must be conceded, however, that there is greater reason for locating coal measures, by projection than the metalliferous veins at Butte.

Occupancy of Public Land

The 'Protest' asserts that present statutes grant a conditional right of exclusive occupancy of public land for the purpose of exploration for minerals. The conditional feature is said to be that the law shall be the rules, customs, and regulations of the miners of the district, who, however, cannot make a lawful rule under which exclusive occupancy for exploration may be had without a precedent discovery of the lode or vein of the rock in place which *might* contain the valuable mineral. The language of the statute is: "All valuable mineral deposits in lands belonging to the United States * * * are free and open to exploration and purchase and the lands in which they are found, to occupation and purchase * * * under regulations prescribed by law, and according to the local custom or rules of miners in the several mining districts," etc., and "the locators of all mining locations * * * on any mineral vein, lode, or ledge situated on the public domain * * * shall have exclusive right of possession and enjoyment of all the surface included within the lines of their locations."

The miner's right of possession prior to location appears to be limited to the ground actually occupied *pedis possessio*. The location is the important step; and to make a valid location there must be discovery, marking on the ground, posting, and recording. The true interpretation of these provisions does not give the

result advanced in the 'Protest' of a conditional right of exclusive occupancy of public lands for purposes of exploration, but is rather a grant of the right to continue work after finding a lead to work upon, or after discovery.

The definition of 'discovery' has not been stated uniformly with the accuracy of mathematics; but after these many years of practical application of the statute the Protestant is convinced that it means only the finding of a vein or ledge of quartz, for he asserts that there has been an erroneous supposition that the statutes required a discovery of the mineral.

The Supreme Court of the United States in *Erhardt v. Boaro*, 113 U. S., 527-536, has given an interpretation of this provision as follows: "a mere posting of a notice on a ridge of rocks cropping out of the earth or on other ground, that the poster has located thereon a mining claim, without any discovery or knowledge on his part of the existence of metal there, or in its immediate vicinity, would be justly treated as a mere speculative proceeding and would not of itself initiate any right. There must be something beyond a mere guess on the part of the miner to authorize him to make a location which will exclude others from the ground, such as the discovery of the presence of the precious minerals in it, or in such proximity to it as to justify a reasonable belief in their existence. Then protection will be afforded to the locator to make the necessary excavations and prepare the proper certificate for record."

Again in *Chrisman v. Miller*, 197 U. S., 313-323, "there must be such a discovery of mineral as gives reasonable evidence of the fact either that there is a vein or lode carrying the precious mineral, or if it be claimed as placer ground, that it is valuable for such mining."

Discovery Requirements

The 'Protest' says that the plain reason for requiring discovery of a lode, and not minerals in the lode, is that it may afford the measure to determine extralateral rights, but the Secretary of the Interior holds a different view. In paragraph 8 of the Mining Regulations, he states that the object of the provision "is evidently to prevent the appropriation of presumed mineral ground for speculative purposes, to the exclusion of *bona fide* prospectors, before sufficient work has been done to determine whether a vein or lode really exists."

The 'Protest' asserts that "there is no requirement in the statutes that there shall be a precedent discovery to make a lawful claim of occupancy of public land as placer." The Secretary of the Interior and the Courts appear to hold otherwise. See the case of *H. H. Yard et al*, 38 L. D., 59, where the Secretary cites the case of *Steele v. Tanana Mines R. Co.*, 148 Fed., 678, in which the Circuit Court of Appeals of the Ninth Circuit, said: "Although in some instances courts have questioned the necessity of an actual discovery of mineral upon gold placer ground, it is established by the de-

ended weight of authority that appropriate discovery is as necessary to the location of a placer claim as to the location of a lode claim." That case also throws some light on the nature of the 'discovery' required to support a location. The Court uses the following language: "Doubtless colors of gold may be found by panning in the dry bed of any creek in Alaska, and miners upon such encouragement, may be willing to further explore in the hope of finding gold in paying quantities. But such prospects are not sufficient to show that the land is so valuable for mineral as to take it out of the category of agricultural lands and to establish its character as mineral land when it comes to a contest between a mineral claimant and another claiming the land under other laws of the United States."

In *Waskey v. Hammer*, 223 U. S., 85-90, a placer case, the United States Supreme Court on January 22, 1912, held: "The mining laws * * * make the discovery of mineral 'within the limits of the claim' a pre-requisite to the location of a claim, whether lode or placer, the purpose being to reward the discoverer and to prevent the location of land not found to be mineral."

It is not clear what the protest means by the great mass of court decisions where the good faith of the location was not in issue being in line with the letter of the statutes in confirming rights of exclusive occupancy for purposes of exploration without there being a precedent discovery of the mineral; but it is surmised that the basis for this assertion is no more than the principle announced in *Chrisman v. Miller*: "It is true that when the controversy is between two mineral claimants the rule respecting the sufficiency of a discovery of mineral is more liberal than when it is between a mineral claimant and one seeking to make an agricultural entry, for the reason that where land is sought to be taken out of the category of agricultural lands the evidence of its mineral character should be reasonably clear, while in respect to mineral lands, in a controversy between claimants, the question is simply which is entitled to priority."

The "grant of free timber from unappropriated public land" proved a snare to one Plowman, of Idaho, who came to grief when he attempted justification of timber cutting on the public domain under the Act of June 3, 1878. His position was sustained by the Circuit Court of Appeals, but the Supreme Court of the United States held him accountable for trespass (216 U. S., 372). Plowman and the lower courts thought "the law cannot be construed to limit the cutting of timber simply to ground that is known to contain mineral" and that "the law includes as mineral lands not only those tracts in which mineral has actually been discovered and which has been or could be legally located as mining location, but also all other lands lying in reasonably close proximity to or in the general neighborhood of such known mineral tracts." The Supreme Court held that too little regard had been paid to the words of the act defining the land on which it permits timber to be cut as "mineral, and not sub-

ject to entry under existing laws of the United States, except for mineral entry." The Court holds that the right to cut is exceptional, that the only lands excluded from any but mineral entry "are lands 'valuable for minerals' or containing 'valuable mineral deposits,'" and again defines 'mineral land' in the language of *Davis v. Webb*.

These few cases lead us to believe that there is something wrong with the mining law. These cases, at least, do not warrant the conclusion that all there is about the matter is that there is a free grant of minerals, with a free occupancy for the purpose of exploring for them and the free use of timber for mining purposes, and all the miner has to do is to take what has been so generously offered him, controlled only by such regulations as he may make for himself in conjunction with his fellow workers.

The order of grant is not: Free occupancy for exploration and then minerals if you find them; but is: Free minerals that have been found and then possession to recover them. This is conclusively shown by the decision of the United States Supreme Court in the case of *Belk v. Meagher*, 104 U. S., 284, wherein the court said: "The right to the possession comes only from a valid location. Consequently, if there is no location there can be no possession under it. Location does not necessarily follow from possession, but possession from location."

Ore Production of Joplin District for 1913

By OTTO RUHL

	Zincblende, tons.	Calamine, tons.	Lead, tons.
Webb City, Missouri.....	79,639	4	22,066
Joplin, Missouri.....	73,690	1,611	6,949
Miami, Oklahoma.....	21,934	.....	7,892
Galena, Kansas.....	18,182	85	3,107
Duenweg, Missouri.....	17,659	2,194	3,514
Alba Neck City, Missouri.....	15,046	407	210
Oronogo, Missouri.....	12,703	.....	1,344
Carl Junction, Missouri.....	10,856	.....	115
Lawton, Kansas.....	3,450	.....	36
Granby, Missouri.....	3,136	10,854	680
Cave Springs, Missouri.....	3,444	.....	197
Spring City, Missouri.....	2,192	2,178	1,275
Carthage, Missouri.....	2,017	.....	18
Sarcoie, Missouri.....	1,782	73	.....
Quapaw, Oklahoma.....	519	.....	91
Aurora, Missouri.....	516	1,743	146
Wentworth, Missouri.....	452	313	.....
Springfield, Missouri.....	404	32	14
Badger, Kansas.....	45	1	7
Total.....	267,666	19,498	47,661
Values.....	\$11,523,497	\$441,530	\$2,492,976

PRODUCTION BY STATES FOR 1913

	Zincblende, tons.	Calamine, tons.	Lead, tons.
Missouri.....	223,546	19,399	36,528
Oklahoma.....	22,442	.....	7,983
Kansas.....	21,677	89	3,150

Total value of production of the district, \$14,458,003.

AVERAGE PRICES PER TON OF BLENDE, CALAMINE, AND LEAD ORES FOR 1913

1913.	Blende.	Calamine.	Lead.
Jan. 4.....	\$53.38	\$30.11	\$52.13
Jan. 11.....	53.57	30.95	52.56
Jan. 18.....	53.35	31.66	53.00
Jan. 25.....	52.63	31.86	53.81
Feb. 1.....	47.37	29.25	53.34
Feb. 8.....	46.25	25.26	53.10
Feb. 15.....	46.26	30.14	52.80
Feb. 22.....	46.41	26.79	53.88
Mar. 1.....	45.42	26.83	52.89
Mar. 8.....	45.72	25.43	53.29
Mar. 15.....	47.67	18.73	52.58
Mar. 22.....	48.32	25.59	53.68
Mar. 29.....	40.36	28.49	53.18
Apr. 5.....	40.31	18.88	53.45
Apr. 12.....	41.50	21.89	52.44
Apr. 19.....	40.70	23.46	51.85
Apr. 26.....	40.77	22.56	52.04
May 3.....	40.07	24.73	52.92
May 10.....	39.85	22.10	52.86
May 17.....	40.00	21.81	53.22
May 24.....	41.29	21.62	51.58
May 31.....	45.76	23.10	51.45
June 7.....	39.83	22.60	50.35
June 14.....	39.06	22.61	51.40
June 21.....	40.27	18.63	51.89
June 28.....	41.00	19.50	52.00
July 5.....	40.07	24.25	50.35
July 12.....	40.02	21.65	51.93
July 19.....	41.00	26.26	51.90
July 26.....	39.30	22.63	52.02
Aug. 2.....	40.08	22.44	52.37
Aug. 9.....	43.69	21.98	53.50
Aug. 16.....	44.00	23.74	53.95
Aug. 23.....	47.00	23.86	54.00
Aug. 30.....	48.00	24.89	56.00
Sept. 6.....	47.50	24.90	57.38
Sept. 13.....	46.50	24.65	57.62
Sept. 20.....	44.10	23.00	56.47
Sept. 27.....	43.50	22.52	57.02
Oct. 4.....	43.50	21.00	53.50
Oct. 11.....	40.50	21.95	52.50
Oct. 18.....	39.50	20.00	51.78
Oct. 25.....	39.41	24.08	51.15
Nov. 1.....	39.43	22.40	51.39
Nov. 8.....	40.88	22.74	51.19
Nov. 15.....	40.49	21.99	51.51
Nov. 22.....	41.00	23.32	51.07
Nov. 29.....	37.70	20.00	51.40
Dec. 6.....	37.00	20.14	48.61
Dec. 13.....	37.00	21.34	46.75
Dec. 20.....	36.92	22.00	47.54
Dec. 27.....	37.43	22.23	47.45
Year.....	43.05	22.64	52.09

The carnotite shipped from the Paradox Valley region in Colorado in 1911 aggregated 1515 tons, containing 26 tons of uranium oxide; in 1912 the output was 1092 tons, containing 22 tons of uranium oxide. The decrease was due partly to inactivity of two corporate operators during part of the year, and also because many of the rich surface pockets of carnotite had been worked out. The output for 1913 will be about 1200 tons, containing about 25 tons of uranium oxide. Efforts are being made to bring about a better extraction and consequent conservation of these ores.

Iron and Steel Production in France

PARIS CORRESPONDENCE

In view of the immense progress made by Germany, the French are taking stock of their present and future in respect to iron and steel production. Although here iron and steel production cannot be said to compare in point of quantity with that of Germany or England, history attests that in point of quality France can hold her own with either. About the end of the last century, production was fairly distributed between the centre and the north of the country. The works in the east only possessed at the time a secondary importance. The discovery of the Thomas process, which made it possible to utilize the high-phosphorous ores of the Meurthe-et-Moselle, completely revolutionized the steel metallurgy of the country, and brought about the creation of France's most important metallurgical works close to the raw material. The basin of the east soon occupied a leading position, and it is there today that France produces most of her iron and steel. At the same time as the eastern basin was being developed, the centre one, handicapped by higher costs, underwent a gradual evolution, and the greater portion of its furnaces went out of blast, the district becoming a steel producer. Naturally, it retained some specialities for which it was well equipped, and in the making of which the works in the east showed no disposition to compete.

The Normand-Angevin Basin

The north, which is favorably situated with regard to coal and not too far removed from the iron ore de-

posits of the Meurthe-et-Moselle, was able to stand competition, and is equipped for using the Lorraine ores which have thus become the foundation of France's iron and steel industry. For some years, therefore, a new iron ore basin, that is the Normand-Angevin basin, has been undergoing development, and it appears destined to play an interesting part in France's metallurgical economy. This basin already supplies ore to two large works in the north: those of Isbergues and Denain, and also supplies the Trignac works. In two years the iron ore from this district will be used by the Caen blast-furnaces, and most of the metallurgical companies of the east have been exploring in this region and have solicited concessions.

The Normandy ore is considerably richer than that of Lorraine; it contains 50 to 53% of iron against 33 to 38%. But it appears that at present the iron ore beds, for area, contain less than those of the Lorraine basin. At the moment the metallurgical situation in France may be drawn as follows: In the east there are the large producers of iron, steel, and common goods. In the north are large producers, but of less tonnage, which, on the other hand, put out products of higher finish. In the centre, quantity is sacrificed for quality.

The following table indicates the position of the various companies with blast-furnaces in France on June 30, 1913 and will give a fairly complete idea of the producing capacity, in tons, per day, of the great French iron works:

Names of houses.	Number of blast-furnaces.		Thomas iron.	Refined cast iron.	Moulding iron.	Total production per day.
	existing.	In blast.				
Acieries de la Marine	11	10	1,200	175	30	1,405
De Wendel et Cie	8	8	1,200	...	...	1,200
Longwy	9	7	1,100	...	60	1,160
Micheville	6	6	1,100	...	...	1,100
Pont-à-Mousson	9	9	...	...	840	840
Denain-Anzin	8	7	650	180	...	830
Chatillon-Commentry	5	5	800	...	...	800
Forges du Nord et de l'Est	7	6	410	110	225	745
Senelle-Maubeuge	5	4	700	...	...	700
Acieries de France	6	6	360	320	...	680
Pompey	4	4	600	...	...	600
De Saintignon	5	4	190	...	325	515
Basse-Loire	5	5	200	200	100	500
Providence	3	3	500	...	...	500
Espérance	4	3	360	110	...	470
Creusot	5	4	160	100	100	360
La Chiers	12	2	320	...	...	320
Montataire	4	3	300	...	...	300
Commentry Fourchambault	6	4	240	...	30	270
Forges d'Alais	5	4	...	200	...	200
Lorraine Industrielle	2	2	...	...	200	200
Maxeville	3	2	...	105	75	180
Chasse	2	2	...	160	...	160
Paris-Outreau	3	3	...	80	60	140
Metallurgique du Perigord	2	2	...	...	110	110
Ariège	3	2	...	75	25	100

In central France the works for producing metal for guns, armor plates, nails, automobile parts, and special steels are situated. In the southwest there are some small plants working for local clients, but seeking particularly to specialize. Finally there are on the sea coast the two works known as the Boucau and the Trignac, which are the chief source of supply for the neighboring consumers.

On June 30, there was a total of 48 works in France producing pig iron, with 159 blast-furnaces, of which 133 were in blast, with a total daily producing capacity of 15,660 tons of iron. The largest French producer today is La Société des Aciéries de la Marine, it having, however, only recently come into this premier position, which used to be disputed between the houses of Longwy and Micheville. It will be observed that the house of Creusot, once France's premier metallurgical house, now occupies a relatively humble position in the list. It has devoted itself to specialization, and has an undisputed superiority in all that refers to the metallurgy of war material. It is hinted that the house purposes struggling again for a higher position as to quantity in the list of producers, and plans to construct a model works on the eastern frontier, where it holds the concession of Droitaumont.

Output Increasing

In 1912 France produced 4,959,000 tons of iron, divided as follows: Thomas iron, 3,324,000 tons, or 67.2%; foundry pig iron, 865,000 tons, or 17.5%; refined cast iron, 536,000, or 10.9%; bessemer iron, 156,000, or 3.1%; special iron, 68,000, or 1.3%. There is scarcely any need to point out the importance of the item Thomas iron, which 30 years ago was practically only a product of the laboratory. On the other hand, refined cast iron, which in the olden times played a preponderating part when puddling was the only method known for producing iron, is annually dwindling in importance; because of the difficulty of finding good puddlers and the gradual disappearance of puddling furnaces. According to basins the production in 1912 was as follows: East, 3,455,000 tons, or 70.2%; north, 816,000 tons, or 16.4%; southwest, 260,000 tons, or 5.2%; centre, 187,000 tons, or 3.7%; southeast, 185,000 tons, or 3.3%; west, 66,000 tons, or 1.2%. The east stands easily first and does not seem in danger of having its position challenged; but it is expected that in the course of perhaps three years the order of importance of some of the other basins will be changed. For example, the west, which stands last, is expected to stand third; for the blast-furnaces of Caen will begin to produce over 300,000 tons of iron per year. And the southwest, which will have the advantage of the extension of the Trignac works, should follow close.

In 1912 the French production of iron increased by 479,000 tons compared with 1911. This is an improvement of a little over 10%. It is known that in 1913, current year, this progress has been maintained, and statistics of the first 6 months show that the average daily production has been 15,565 tons as against 14,130

tons during the first 6 months of 1912. This is a further increase of about 10%. If thus the production continues at the same rate during the second half of the year, the 1913 production may be estimated at 5,500,000 tons of cast iron in round figures. The question then arises whether France's producing activity is not about to ease off. Up to November, when this is written, the French works have been working full time, but have been living on the orders of 1912; for since the beginning of this year very few new large orders have been booked. Only large corporations such as railways, shipbuilding companies, and the war department have kept a good current business in existence; but this does not alone suffice to support the national steel industry. The country is about, then, to enter on a period when the large iron works will have to obtain fresh orders, and it is reasonably hoped that the clearer political atmosphere will permit this. It may be that the iron works will have to reduce prices in order to encourage buyers, but as far as can be judged at present the year will terminate with a good volume of business in existence. Some French authorities say that the construction of new works is being overdone, that overproduction will be the result, and a similar situation be created to that of Germany, where the iron works are said to be in a state of permanent overproduction.

Furnace Building

Coming now to the question of the future, it may be noted that in the north the Aciéries de France is going to transfer the production of hematite iron to the Calais works, and transform the two small blast-furnaces of Isbergues into larger ones for the production of Thomas iron. In this region the Forges du Nord et de l'Est is to have three blast-furnaces at the new Valenciennes works instead of the two existing. Further, in the north the Denain-Anzin concern is going to construct two new blast-furnaces at Escandain near its present Denain works; and the end of 1914 will no doubt see the Pont-a-Vendin subsidiary of the Lens concern at work. It is designed to produce 300,000 tons of iron annually. In the east the Aciéries de la Marine is planning the construction of a new set of three blast-furnaces at the Homécourt works. These works are now considered the model works of France. The Chatillon-Commentry Co. has now completed two new installations at its Neuves-Maisons works. The Ougree-Marihay concern has re-equipped the blast-furnaces of the Chiers. The Micheville house is going to increase the capacity of its blast-furnaces by 200 tons. The Longwy concern is going to construct a blast-furnace, No. 7, of the greatest known capacity. In the southwest, the Aciéries de la Marine is repairing the two blast-furnaces of the Boucau works in order to increase their capacity, and the Basse-Loire has recently lighted its Thomas blast-furnace. In the west the Caen blast-furnaces should begin work by the end of 1915, and will produce 300,000 tons of iron per year; and finally, the special cast iron works of Paris-Outreau

is constructing a third blast-furnace; and the blast-furnace works of Rouen is preparing to produce 100,000 tons of iron per year. The total of these different projects, most of them in process of realization, means the creation of 13 blast-furnaces, not to speak of the repairing of old ones, nor of the works of Pont-a-Vendin or of Caen. These blast-furnaces will be of large capacity, and it may be calculated that the producing power of France will therefore day by day increase in three years by 1,200,000 to 1,500,000 tons; that is to say, that the annual production of the country will approach 7,000,000 tons. Hitherto the domestic demand has afforded a sufficient market for France's iron works, which have done very little as exporters. This can be seen from the following table:

	Production of cast iron.	Home consumption.	Foreign trade.	
	Tons.	Tons.	Imports.	Exports.
			Tons.	Tons.
1903	2,841,000	2,672,000	27,000	195,000
1904	2,974,000	2,810,000	26,000	191,000
1905	3,077,000	2,882,000	25,000	220,000
1906	3,314,000	3,313,000	46,000	147,000
1907	3,590,000	3,369,000	36,000	257,000
1908	3,401,000	3,278,000	36,000	179,000
1909	3,574,000	3,451,000	31,000	154,000
1910	4,038,000	3,964,000	42,000	116,000
1911	4,470,000	4,414,000	57,000	116,000
1912	4,949,000	4,788,000	68,000	229,000

It is difficult to imagine that the French market will be able to absorb the increase of 1,500,000 tons in three years' time. It will be requisite, therefore, to find buyers abroad, not for cast iron, but for middle and finished products; for all the new metallurgical works under construction will have steel plant and rolling mills, and all those that are increasing their production of iron are enlarging their steel plants in proportion. The Balkan States and Morocco are expected to take up a portion of this extra production, also Central and South American countries which are indebted to France for cash, and no doubt will require again to appeal to the French money market. The danger of overproduction, which to a certain extent is already discounted by the increasing requirements of railways and naval demands, apparently does not frighten those now engaged in the iron and steel industries of France.

Oregon Metal Production

The mines of Oregon made a somewhat unexpected large increase in gold yield for 1913, compared with 1912. The mine report of 1912 showed a production of \$770,041, but the preliminary estimate for 1913, made by Charles G. Yale, of the United States Geological Survey, shows that the gold output nearly doubled in 1913, amounting to \$1,393,322, or \$623,281 more than in 1912. The mine output of silver in 1912 was 57,081 fine ounces, while the estimate for 1913 shows a yield of 218,949 oz., an increase of 161,868 ounces.

The copper output in 1912, according to mine returns, was 260,429 lb.; the estimate for 1913 is 144,796 lb., or 145,633 lb. less than in 1912. The mine report of 1912, showed a yield of 39,317 lb. of lead, but for 1913 the estimate is 96,743 pounds.

Uranium-Vanadium

Deposits of uranium and vanadium in the United States have recently been investigated by Messrs. R. B. Moore and K. L. Kithil for the Bureau of Mines. According to their preliminary report,* the carnotite deposits of Colorado and Utah are the most important uranium-bearing ores and they constitute the largest supply of radium-bearing minerals known in the world. Austria is the only other country in which large deposits of uranium-bearing ores are known; and the Austrian government considers them of such importance that it has taken entire charge of them. The deposits of carnotite in this country are much larger than those in Austria, and the output is larger also, but the deposits have been exploited and mined by rather crude and wasteful methods. Nearly all of the carnotite ore mined in the United States has been shipped to Europe for the purpose of extracting the radium contained. During the year 1912 the carnotite ores produced contained 28.8 tons of uranium oxide, which should yield 8.8 grams of radium chloride. There is only one American company that has been preparing radium salts of a high degree of radioactivity. It owns carnotite mines in Colorado and operates its own plants for the extraction and refining of radium salts.

The principal deposits of carnotite in the United States are found in western and southwestern Colorado, and in eastern Utah. The deposits in Colorado have been chiefly found along the Dolores and San Miguel rivers and their tributaries in Montrose, San Miguel, and Dolores counties, although carnotite has also been found in Rio Blanco and Routt counties. Numerous bodies of uranium and vanadium ore have been discovered in eastern Utah, principally in the Green River and Thompsons districts, but also at Split Mountain and Table Mountain. The Utah deposits contain smaller amounts of uranium and vanadium than do those in Colorado, but the properties in Utah are more accessible and have the advantage of lower transportation charges. In both cases the mineral deposits are so distant from railroads and so unfavorably situated that only the deposits of high-grade ore have been mined. In most of the localities the lack of water has made the use of the ordinary methods of milling impossible for the concentration of these ores. As a consequence, only the higher grades of ore have been exploited, the mining has resulted in much waste of medium or low-grade ore, and the shipments have been chiefly made from the small pockets of ore which contain comparatively large amounts of uranium oxide. The employment of such wasteful methods of mining and rough hand-sorting is to be deprecated, because the pockets of high-grade ore may soon be exhausted, leaving large quantities of ore containing less than 2% U_3O_8 which it might be impossible to utilize.

*U. S. Bureau of Mines, Bulletin No. 70.

The production from the Utah fields has been small on account of the low grade of the ore. During the year 1912 a total of 346 tons was shipped from Green river, Thompsons, and Cisco—the only places in Utah from which uranium ore was shipped. This ore probably averaged less than 2% U_3O_8 . The ore occurs in strata of coarse sandstone overlain with fine conglomerate. The ore-bearing portions vary in thickness from a few inches to about five feet. The carnotite occurs in cracks or fissures, in small pockets or vugs, or impregnating the sandstone. Small pockets of red vanadium ore, probably calcium vanadate, are found in some places in the sandstone. The Thompsons deposits are almost flat bedded. Mining there has been confined to the best outcrops, and the low-grade ore from hand sorting was thrown on the dump.

The principal production of carnotite ore in Colorado has come from Paradox valley and surrounding districts in Montrose and San Miguel counties. In Rio Blanco and Routt county the cost of transportation has been too high to permit of shipping ore at a profit. In the Paradox Valley region the typical ore is a sandstone so impregnated with yellow carnotite that the color is quite noticeable. A considerable part of the ore is composed of small kidneys of brown sandy clay which contain vanadium. High-grade carnotite often occurs in vugs, and this ore is so soft that it can be molded in the fingers. In places the sandstone is impregnated along the lines of stratification, and in alternate layers of carnotite and dark vanadium ore. The deposits are usually pockets of ore, many of which are large, however, as the extraction of 50 tons of shipping ore from a single claim is not unusual. The ore is found in the McElmo formation (Jura-Trias). This is a light-colored sandstone overlain in places with shale and conglomerates. Beneath it lies the La Plata sandstone, and below that the Dolores red sandstone.

Some desultory work was done in these districts from 1886 until 1909, and a considerable amount of uranium oxide was shipped from time to time. Mining in Paradox valley was not actively carried on until the formation of the General Vanadium Co. in 1909. In 1910 the Standard Chemical Co., of Pittsburgh, began work in this district, and these two companies are now the largest operators there. In 1912 the American Rare Metals Co. bought the Dolores mill in the McIntyre district. The General Vanadium Co. has about 60 claims, and the Standard Chemical Co. about 90; most of these claims are in the Long Park, Club Ranch, and East Paradox districts. The Radium Extraction Co., Crucible Steel Co., and Primos Chemical Co. have done some work on several claims in Long Park, but no large shipments have been made. The principal mine in Saucer basin is the Cliff, which has been one of the heaviest producers in the history of the industry. Much high-grade ore has been mined from pockets or vugs, but a large quantity of low-grade ore is left in the mine. In one place this deposit is 14 ft. wide. On the north side of East Para-

dox valley are the Jacobs and McKeever claims, from which 13 tons was recently shipped, which contained 3.43% U_3O_8 and 13.66 V_2O_5 . The main camp of the General Vanadium Co. is on the south side of East Paradox valley. The Company has mined nearly all of the high-grade ore, but there is a large quantity of low-grade ore in place in the mine and on the dumps. Nearby is the Joe Dandy claim, until recently a heavy producer. The American Rare Metals Co., of Denver, has large deposits of rather low-grade ore in the McIntyre district, where its plant is situated.

The price paid for uranium and vanadium ore in 1912 were approximately \$1.30 per pound of uranium oxide for 2% ore; \$1.40 for 2.5% ore; and \$1.50 for 3% ore, f.o.b. New York. For the vanadium content, 30 to 35c. was paid per pound of vanadium oxide. The high-grade ore from vugs, carrying 12 to 20% U_3O_8 , bring about \$3 per pound of oxide, f.o.b. New York. On account of the high costs of mining and transportation, it was not profitable to ship any ore containing less than 2% U_3O_8 . At present the price of carnotite ore has advanced at least 33%, and ore as low as 1% is being shipped.

Pitchblende has been found in several localities in the United States, but the only deposits which have been productive are in Gilpin county, Colorado, where five mines near Central City have shipped considerable quantities of ore.† During 1905 and 1906 the Kirk mine produced about 20 tons of pitchblende ore having an average content of 35% U_3O_8 , and over 100 tons of ore containing 3 to 4% uranium oxide. In recent years the production has been small. The German and Belcher mines during 1911 and 1912 shipped 240 lb. of ore containing more than 70%, 220 lb. containing 20%, 5 tons of 2.6% ore, and 1 ton of ore containing 2% of U_3O_8 .

The largest deposits of vanadium in the United States are near Placerville, Newmire, and Sawpit, in San Miguel county, Colorado. These deposits are in the McElmo formation. This consists of two beds of light-colored sandstone separated by a thin bed of limestone, the vanadium-bearing rock being in the lower bed of sandstone. The Primos Chemical Co. is mining extensive deposits on Bear creek, and has done a large amount of work, especially on the east side of the creek. The vanadium-bearing rock is a light to dull green fine-grained sandstone which is easily mined. The average content of the ore is only about 1.5% V_2O_5 , but it is possible to mine and treat this ore at a profit on account of the size of the deposits, the ease with which they can be mined, and the good transportation facilities. The Company has a treatment plant $2\frac{1}{2}$ miles from the mine. Other vanadium deposits of minor importance have been found in Huerfano and Eagle counties, Colorado, at Cutter, New Mexico, and in a few other localities, but no vanadium oxide has been marketed as yet.

†See Forbes Rickard, *Mining and Scientific Press*, June 7, 1913.

Mineral Production Statistics for 1913

Production of Lead

An estimate of the production of refined lead in the United States in 1913 has been compiled by C. E. Siebenthal, of the United States Geological Survey, from reports made by all lead refineries and soft-lead smelters in operation during the year. These reports cover actual production for the first ten or eleven months and an estimate for the remainder of the year, and from them the figures of production are made up **without change**. The statistics of imports, exports, and lead remaining in warehouse have been taken from the records of the Bureau of Foreign and Domestic Commerce for eleven months, the figures for December having been estimated.

The total production of refined lead, desilverized and soft, from domestic and foreign ores in 1913 was approximately 466,843 short tons, worth at the average New York price, \$41,082,184, compared with 480,894 tons, worth \$43,280,460, in 1912, and 486,979 tons in 1911. These figures do not include an estimated output of 16,338 tons of antimonial lead, against 13,552 tons in 1912 and 14,078 tons in 1911. Of the total production, desilverized lead of domestic origin, exclusive of desilverized soft lead, is estimated at 256,458 tons, against 221,480 tons in 1912; and desilverized lead of foreign origin at 54,372 tons, compared with 88,377 tons in 1912. The production of soft lead, mainly from Mississippi Valley ores, is estimated at 156,013 tons, compared with 171,037 tons in 1912.

The final figures of production of soft lead are likely to show an increase of a few thousand tons over those given here, for the reason that the argentiferous lead smelters and refineries undoubtedly treated more or less soft lead from the Mississippi Valley which is not distinguished from silver-lead ores in their preliminary estimates. It may be, with these additions, that Missouri will retain first place in the year's output of refined lead. In the mine production of lead, Missouri lost first place to Idaho. The imports of lead are estimated at 9878 short tons of lead in ore, valued at \$490,060; 46,888 tons of lead in base bullion, valued at \$2,347,148; and 41 tons of refined lead, valued at \$3655; a total of 56,717 tons, compared with 83,560 tons in 1912.

The amount of lead available for consumption during 1913 may be estimated by adding to the stock of foreign lead (domestic stocks are not known) in bonded warehouses at the beginning of the year (10,492 short tons) the imports (56,717 tons) and the domestic production (412,471 tons), making an apparent supply of 479,680 tons. From this is to be subtracted the foreign lead exported from warehouse (44,000 tons), the foreign lead exported in manufactures under drawback (7214 tons in nine months), the deduction by liquidation (391 tons), and the stock in bonded warehouses at

the close of the year (assumed to be the same as at the close of November, 6301 tons), leaving as available for consumption 421,774 tons, which by comparison with 388,148 tons in 1912, with 385,319 tons in 1911, and 379,196 tons in 1910 seems to be an excessive figure, making it seem probable that in lead, as in zinc, there has been a large increase in smelter stocks.

Production of Copper

Statistics and estimates received by the United States Geological Survey from all plants known to produce blister copper from domestic ores and from all Lake mines indicate that the copper output of the United States in 1913 will show a considerable decrease from the record production of 1912.

Decreases in production were shown by Michigan, Montana, and Alaska, and notable increases by Arizona, Utah, and New Mexico.

The figures showing smelter production from domestic ores, which have been collected by B. S. Butler, of the Geological Survey, represent the actual production of most of the companies for eleven months and an estimate of the December output. The November figures for a few companies were not available and these companies furnished estimates for the last two months of the year. According to the statistics and estimates received, the output of blister and Lake copper was 1,223,700,000 lb. in 1913, against 1,243,268,720 lb. in 1912. At an average price of about 15.3c. per pound the 1913 output has a value of about \$187,200,000, against \$205,139,338 for the 1912 output.

Figures published by the Copper Producers' Association show an output of refined copper of 1,483,480,408 lb. for the first eleven months of 1913 and indicate that the production of marketable copper by the regular refining plants from all sources, domestic and foreign, will amount to 1,618,000,000 lb. for 1913 if the December output is equal to the monthly average for the first eleven months. This compares with 1,568,104,478 lb. in 1912.

According to the Bureau of Statistics, imports of pigs, bars, and ingots for the first ten months amounted to 246,785,319 lb., and the copper content of ore, matte, and regulus imported amounted to 88,306,732 lb. If the imports for November and December were equal to the average monthly imports for the first ten months, the amount of copper entering the United States for the year was about 402,000,000 lb., against 410,240,295 lb. for 1912. Considerable of the copper imported as blister had been previously exported as ore or concentrates.

Estimates based on figures published by the Bureau of Statistics and also by the Copper Producers' Association indicate that the exports of copper for 1913 will show a marked increase over those for 1912 and

may equal 865,000,000 lb. Stocks of refined copper held in the United States January 1, 1914, are considerably less than on January 1, 1913. Foreign stocks also show a considerable decrease.

Spelter Production

The annual preliminary statement just issued by the United States Geological Survey shows that the output of spelter in 1913 established a new record, exceeding that of 1912 by a fair margin, though falling far short of the figure indicated by the phenomenal production of the first half of the year. The increase was altogether from domestic sources, as the production from foreign ores was the smallest since 1906, due, of course, to the strife in Mexico. The production during the first half of the year kept on at an increased rate over that of 1912, and somewhat exceeded the demand as shown by the increase in stocks from 4522 tons on January 1 to 21,856 tons June 30. The production slowed down materially during the last half of 1913, but the demand failed to even a greater extent, as shown by the increased spelter stocks of 36,393 tons, the greatest perhaps in the history of the industry. The extent to which production was curtailed is shown by the fact that only about three-fourths of the retort capacity available for ore was in active operation during December.

The following figures have been compiled without change by C. E. Siebenthal, of the Geological Survey, from reports furnished by all operating smelters of zinc ores, showing their output for the first eleven months of the year and their estimated production for December. Figures showing the imports and exports for eleven months were obtained from the Bureau of Foreign and Domestic Commerce, and to these figures estimates for December have been added.

The production of primary spelter from domestic ore in 1913 is estimated at 336,667 short tons and from foreign ore at 8908 tons, a total of 345,575 tons, worth, at the average St. Louis price, \$39,395,550, compared to a total of 338,806 tons in 1912, worth \$46,755,228 and made up of 323,907 tons of domestic origin and 14,899 tons of foreign origin.

The total production of spelter is equivalent to the output of 81,312 average retorts operating continuously through the year on 60% zinc concentrates. The retort capacity, available for ore, of plants active in 1913 was, at the beginning of the year, about 101,000 retorts. Many of them, of course, were used on low-grade ores, lessening their capacity. To these were added during the year 5850 retorts, making about 107,000 retorts available for ore during the latter part of the year.

Imports of zinc ore were approximately 28,541 short tons, containing about 13,036 tons of zinc, compared with 43,940 tons of ore, containing 17,567 tons of zinc, imported in 1912. Of the zinc ore imported, 18,110 tons, about 63%, came from Mexico, compared with 35,925 tons, or 80%, imported from Mexico in 1912. The ex-

ports of domestic zinc ore were 17,713 short tons, valued at \$632,000, compared with 23,349 tons in 1912. The imports of spelter are estimated at 6056 short tons, valued at about \$656,600, compared with 11,115 tons in 1912.

The apparent domestic consumption of spelter in 1913 may be computed as follows: The sum of stock on hand at smelters at the beginning of the year, 4522 tons, plus the imports, 6056 tons, and the production, 345,575 tons, gives the total available supply, 356,153 tons. From this there is to be subtracted the exports of domestic spelter, 7714 tons, the exports of foreign spelter, 5802 tons, the exports under drawback, 5751 tons, and the stock on hand at smelters at the close of the year (to be exact, on December 15), 36,395 tons, a total of 55,662 tons, leaving a balance of 300,491 tons as the apparent domestic consumption. This calculation takes no account of the stocks of spelter held by dealers or consumers. On comparing the consumption in 1913 with the previous year, it appears that the consumption has returned to the normal after the phenomenally large consumption of 1912.

Arizona's Record Production

In 1913 there was a record mine production of gold, silver, copper, lead, and zinc in Arizona, according to preliminary figures of the United States Geological Survey. The total value of the mine output was about \$71,000,000, an increase of nearly 6% over the value of 1912, which was \$67,050,784. The copper output was valued at nearly \$64,000,000; the gold at about \$3,948,000; the silver at more than \$2,263,000; the lead at \$612,000; and the zinc at \$510,000.

The mine yield of gold in Arizona in 1913 was more than 191,000 oz., an increase of 5% over the output of 1912, which was 181,996.91 fine ounces. Of this total, over 42% was taken from silicious ores and most of the remainder came from copper ores, which are undoubtedly the source of the increased gold output in 1913.

The mine production of silver increased about 8%, amounting to more than 3,773,000 oz., against 3,490,387 oz. in 1912. Most of the silver was derived from copper ore, but in 1913 the increase was due largely to shipments of lead ore and concentrates from Cochise and Mohave counties. Much silver also comes from silicious ore.

With a mine production of about 414,593,000 lb. of copper in 1913, Arizona led all other copper-producing states. The output in 1913 shows an increase of more than 49,000,000 lb., or about 12% over that of 1912, which was 365,038,649 lb. As the price of copper was slightly lower in 1913, the value of the metal increased only about \$3,500,000. There were 11 active copper smelting plants in the state, and ore and concentrate were also sent to six copper and lead plants in other states.

With an increase of more than 104%, the mine production of lead was larger than in any other year. The total output was nearly 14,000,000 lb., valued at

about \$612,000, as against 6,806,443 lb., valued at \$306,290 in 1912. The mines at Bisbee produced much lead ore, and in 1913 there was a large increase.

The mine production of recoverable spelter was about 9,100,000 lb., valued at \$510,000, which was an increase of about 340,000 lb., or nearly 4%, over the production of 1912. On account of the lower price paid for the metal, the total value decreased more than \$90,000.

California Mineral Production

California shows an increase in output of gold, silver, copper, lead, and zinc in 1913, compared with 1912, according to preliminary figures compiled by Charles G. Yale, of the United States Geological Survey. The mine figures for 1912 were \$19,713,478 in gold and 1,300,136 oz. of silver; the estimates for 1913 indicate an output of gold valued at \$20,013,374 and 1,606,261 oz. of silver, an increase for 1913 of \$299,896 in gold and 306,125 oz. of silver. There are about 1100 producing metal mines in the state, and the deep mines are yielding about 2,700,000 tons of ore annually. It is probable that the increase in gold has come mainly from the deep mines, while the added quantity of silver has come from increased output of copper and lead-silver ores.

The producing deep gold mines of the state, which yield about 56% of the total gold output each year, are between 450 and 500 in number and are situated in 26 counties. They have nearly 200 reduction plants, with a daily capacity of over 12,000 tons. The largest production from this source is derived from the five Mother Lode counties, where about 1,300,000 tons of ore is annually treated with an average recovery of \$3.70 per ton. During the year 1913 several of the old mines along the foothills and in the mountain counties have been reopened and equipped after lying idle for years, and some new 'prospects' have been opened.

In placer mining in California the dredges continue to furnish about 86% of the gold derived from the auriferous gravels. Of the total gold yield from all sources, deep and placer mines, the dredges produce about 38%. As yet there are no special signs to indicate any diminution of the total yield of gold from dredging operations, but some of the older fields are on the decline, the best ground having been worked out. A few of the companies have entirely worked out the paying ground in their holdings and have ceased operations.

Dredging has the advantage over most forms of placer mining that it requires less water in proportion to the quantity of gravel handled, and dredge miners are not materially affected by dry seasons, which occur occasionally in California. The winter of 1912-13 was very dry and there was a scarcity of water for mining operations. As a result the output of the hydraulic, drift, and surface placer mines of the State was restricted. The hydraulic mining industry suffered most and many of the mines had only a few weeks' water

supply to wash the gravel, and others only a few months' supply. The hydraulic mines now produce only about 8% of the placer gold yield in California.

Contrary to expectation, the copper output of California in 1913, according to preliminary estimates, exceeded that of 1912, when the mine production was 33,451,672 lb. The estimate for 1913 shows an output of 36,700,430 lb., an increase of 3,248,758 lb., notwithstanding continued agitation by farming communities against the damage claimed to be done by smelter fumes and the fact that several of the larger copper-smelting plants, idle from that cause in 1912, still continue unproductive.

Lead mining in the state made a marked advance in 1913. The mine report for 1912 showed a lead output of 1,144,731 lb., while the estimated returns for 1913 show a yield of 5,060,841 lb. This is an increase of 3,916,110 lb., and is due mainly to the renewal of mining and shipping operations of the Tecopa Mining Co., of Inyo county.

In zinc mining an advance in output is also shown, though it is small. In 1912 the mine report showed a yield for California of 4,345,591 lb.; the estimate for 1913 is 4,500,000 lb., an increase of 154,509 pounds.

Idaho Metal Output

In 1913 the metal mine output of Idaho was so much increased that the total value exceeded that of the record year, 1906, according to preliminary estimates of C. N. Gerry, of the United States Geological Survey. The value of the gold, silver, copper, lead, and zinc mine production was over \$23,500,000, an increase of over \$2,000,000, or nearly 10%. Record productions were made in silver, lead, and zinc; and substantial increases were made in output of all metals but gold, which remained close to the yield of 1912, the figure for 1913 being \$1,373,000. To compensate for this loss, the gold output from dredging continued to increase and that from copper ore was greater since the Lost Paeker smelter was operated.

The mine yield of silver output increased 20%, from 8,294,745 oz. in 1912 to about 9,970,000 oz. in 1913, a large increase even over the previous record of 1906. In silver output the state, which in 1913 had a value of nearly \$6,000,000, was only exceeded by Nevada, Utah, and Montana. Nearly all this silver was derived from lead ore and concentrate, shipments of which were unusually large.

The copper output from Idaho mines increased from 7,492,152 lb. in 1912 to about 9,312,000 lb. in 1913, an increase of over 24 per cent.

The lead mine production increased from 284,000,000 lb. in 1912 to nearly 311,000,000 lb. in 1913, or over 9%. At the average price for 1913, this total was valued at more than \$13,500,000. Probably 93% of the lead came from the Coeur d'Alene region of Shoshone county, and the remainder from Lemhi, Fremont, Blaine, and Custer counties.

The record mine production of zinc ore and concen-

trates in Idaho in 1913 increased the spelter output from 13,905,502 lb. in 1912 to 23,594,000 lb. in 1913, an increase of nearly 70 per cent.

Two smelting plants within the state were active in 1913, one a lead plant at Clayton, now owned by the Red Bird Smelting Co., and the other a copper matting plant at Ivers. Both are in Custer county. Four dredges were operated, two at Idaho City and two in Lemhi county. The construction of a fifth one on Bohannon bar, Lemhi county, was completed.

Nevada Metal Output

Nevada's mines yielded in 1913 from ores sold or treated, \$36,374,000 in value in gold, silver, copper, lead, and zinc, according to preliminary estimates of V. C. Heikes, of the United States Geological Survey. Of this total, which is about 5% less than in 1912, the value of copper forms the largest part, or 37%; that of gold, 33%; that of silver, 25%; and the values of lead and zinc each about 2 per cent.

The mine production of gold decreased about 10%, from \$13,456,180 in 1912 to \$12,072,000 in 1913. The silicious ores cyanided were the main source of gold, which, in the form of bullion, was shipped chiefly from Goldfield, Tonopah, Fairview, Wonder, Virginia City, Manhattan, Round Mountain, National, and Seven Troughs. An increase estimated at 15% in the Nye county production of gold, from \$3,123,935 in 1912 to \$3,602,753 in 1913, is due to the large tonnage of silver ore treated at Tonopah and of gold ores at Manhattan.

Nevada in 1913 was the leading state in silver production, which came mainly from the silver ores at Tonopah. The mine production increased to about 15,300,000 oz., or about 7%. Eleven of the Tonopah mines produced 11,923,651 oz. of silver, which was extracted from the ore largely by the cyanide process. In 1912 the district yielded 10,144,987 oz. of silver. The Belmont mine, followed by the Tonopah Mining and West End Consolidated, were the largest producers. On the Comstock lode in Storey county the silver ores yielded about \$1,248,000 in gold and silver. This is slightly less than the output valued at \$1,352,089 in 1912.

An increase estimated at 2% in the mine production of copper, from 86,477,494 lb. in 1912 to about 88,368,890 lb. in 1913, is due to a slight increase in the output of the Nevada Consolidated and Giroux mines from copper 'porphyries' at Ely and in a larger output of copper matte at the Thompson smelter from Mason Valley, Nevada Douglas, and custom ores.

The lead mine output decreased from 19,500,100 lb. in 1912 to 15,300,000 lb. in 1913, or about 21%. This decrease is largely due to the decline in shipments from the Bullionville tailing dump near Pioche. The Yellow Pine district in Clark county had its usual output of about 6,500,000 lb. The lead mines in Eureka county did not all resume work, but the production of lead was greater than for several years. The output of recoverable spelter from zinc ores sold or treated

increased from 13,322,988 lb. in 1912 to 15,137,000 lb. in 1913, or about 13%. Practically all of this output is from the Yellow Pine district from carbonate ores.

Utah Metal Output

Utah mines in 1913 produced over 10,250,000 tons of ore with recoverable gold, silver, copper, lead, and zinc valued at \$43,000,000, according to the preliminary estimates of the United States Geological Survey. The tonnage shows an increase of about 32%, but the total estimated value is only slightly larger than in 1912. No new mines of consequence were put in operation, but those having large development and improvements in handling greater tonnages increased the ore output. Notable tonnages of ore were mined and shipped daily from the Utah Copper mine to its mills at Garfield where the treatment of the ore concentrated increased from 18,000 tons during the first part of the year to more than 21,000 tons per day during the latter half of 1913. The output of Bingham was the largest in the history of the camp, increasing from 6,567,948 tons in 1912 to over 9,300,000 tons of ore mined in 1913. The Tintic district mines yielded approximately 390,000 tons of ore, all of which was of shipping grade excepting a small tonnage of dump ore treated locally by the cyanide process. Ore mined at Park City aggregated about 225,000 tons.

In gold yield a decrease was noted, due largely to the closing of the Mercur gold mines. This loss was partly made up, however, by the increase in gold from copper ores, bringing the total value of the gold produced to about \$3,581,900, which is about 16% less than that of 1912. Mining of true gold ores on a large scale is on the decline in Utah.

The silver yield of Utah is principally from the lead ores, but although there was a material increase in the lead output in 1913, the silver yield from this source decreased. The mine output aggregated about 12,500,000 oz., which is about 9% less than in 1912. Park City, Bingham, and the Tintic district mines yielded nearly all the silver. Larger tonnages of lead ore with low silver content were shipped from Bingham and a notable silver decrease was indicated in the Park City district for 1913. Most of the silver is recovered at the smelters, but recently the use of the cyanide process on Bingham and Tintic ores has been encouraging.

The copper mine output, which has broken previous yearly records, reached 137,307,485 lb. in 1912 and slightly over 158,200,000 lb. in 1913, an increase of about 15%. Much of this increase was made from the 'porphyry coppers' in Utah, all of which had larger production of copper, aggregating 131,000,000 lb., increasing 22%, against 102,662,335 lb. in 1912.

The lead mine output shows an increase of nearly 12% in 1913, reaching the total of 156,679,000 lb., against 140,311,135 lb. reported in 1912. The production of zinc ore and concentrate shipments remained about the same as in 1912, yielding over 17,000,000 lb. of recoverable spelter.

The California Mother Lode and the Plymouth Mine

At the annual meeting of the London, Australian & General Exploration Co., Ltd., held in London early in December, W. J. Loring made the following remarks with reference to the Mother Lode and the Plymouth mine:

The Mother Lode of California, in which the Plymouth mine is situated, was prospected in the early days, with the result that highly profitable ore was found at or near the surface in rather widely-separated areas. In the late eighties, one mine after another closed down on account of having reached, as was thought, the end of profitable zones in the bottom of the mines, they having been highly productive down to 1200 and 1500 ft. After the mines had been lying idle for a number of years, syndicates or private companies were formed to reopen some of these mines. After sinking from 90 to 300 ft. below the old workings, profitable ore was discovered, and, as a result, other mines were reopened and good results were obtained. The mines were equipped for a second time, and another series of highly productive results were obtained. When at a depth of from 2000 to 2500 ft., another poor zone was encountered, similar to the one found at about 1000 to 1500 ft., and, without considering what had occurred at the shallower depth, the mines were shut down, exactly in the same manner as previously. After these plants had been sold, or demolished, a third series of investors took an interest in the properties, and for a third time the mines were reopened and profitable ore was again opened quite similar to that previously opened. The result is that the mines now at work on the Mother Lode are down to a depth of between 2500 and 4000 ft. on the incline.

Development at the Plymouth Mine

Highly profitable results are at present being obtained at a depth of 4300 ft. on the underlie in a mine which is situated about nine miles south of the Plymouth Consolidated. On a visit to California, 2½ years ago, I was approached by some of the principals in the Plymouth Consolidated, by whom I had been employed for 18 years, who made a proposal that I should endeavor to handle the Plymouth Consolidated group. Before recommending this property, Messrs. Bewick, Moreing & Co. considered it necessary to investigate thoroughly what had happened in other mines along this line of lode. With that object in view, the services of Malcolm Maclaren were secured, and, together with that gentleman, I investigated the points referred to. Having an intimate knowledge of other mines on the Mother Lode, and what they had done, and supported by the strong recommendations of Mr. Maclaren that we could expect to prove the downward continuation of profitable ore in the Plymouth Consolidated by deeper sinking, the California

Exploration Co. was formed. The unwatering of the mine commenced with two bailing tanks, operated by an electric hoist, and 64,000,000 gal. of water was removed. When unwatering had reached the 950-ft. level, the station was found to be in good condition. By the time the water had been lowered to 1140 ft., an inspection had been made of the southern workings off the 950-ft. level, and sampling proved the value to be \$9.16 per ton, and upon reaching the 1140-ft. level it was found that the south drift had collapsed. No attempt was made to reopen it, but a winze which extended from the 950 to the 1140-ft. level was cleaned out and on the latter level there had been stoped nearly 200 ft. The ore remaining in the back averaged \$19.34 per ton over a width of 41 in. By this time the water had been reduced to the bottom of the mine, the 1600-ft. level was cleaned up, and driving north was commenced. The orebody on this level is 160 ft. east of the shaft. The vein exposed in the drift was sampled, showing unprofitable ore, although the width was about 16 ft. Driving south was continued for a considerable distance, when profitable ore was opened, and for 115 ft. the average value was \$6.02 per ton over a width of 5 ft. It should be mentioned that this was north of the downward continuation of the original shoot worked by the former owners. An old winze was found below the 1600-ft. level, at a point 63 ft. north of the shaft, and, after cleaning it out to a depth of 75 ft., the first sample across the bottom assayed a value of \$17.18 per ton over a width of 30 in. Sinking was continued in more or less profitable ore to the 1850-ft. level, or 250 ft. below the 1600-ft. level. At the same time driving south had been commenced on both the 1500 and 1600-ft. levels. In the 1500-ft. level, 195 ft. of ore was opened, of an average value of \$4.36 per ton, over a width of 3¼ ft., and the east and west cross-cuts at 116 ft. south showed 10 ft. of ore worth \$8.56 per ton. On the 1600-ft. level the ore was 5 ft. wide for a length of 255 ft., and had an average value of \$6.96 per ton, while the cross-cuts at 87 and 153 ft. south proved a width of 19½ ft. with an average value of \$5.12 per ton, which must be considered satisfactory. At the 1850-ft. level, opened up by the winze, good ore was opened from the beginning, and 334 ft. of driving proved an average width of 4½ ft., and assay value to be \$6.32 per ton over the total length. When the end of the shoot had been reached, driving was discontinued and deeper sinking commenced, with a view to proving the downward extension of the ore. When the 2000-ft. level was reached, the vein where cut showed 21 ft. of ore which averaged \$5.78 per ton, or, taking a section, the average value for 10 ft. was \$8.80 per ton. Driving south was continued for 90 ft. The average value of the ore for a distance of 120 ft. was \$15.86 per ton over a width of 7¼ ft. There are parts standing in the south face at present worth \$288 per ton. This is, of course, from special samples, but taking it as a whole it is a magnificent body of ore.

The resources of development in this mine have not by any means been exhausted.

Apparently the second series of profitable ore-shoots has been entered, the same as has been found in other mines on the Mother Lode, whereas other mines have entered their third series, and if there is a third series in the Plymouth, of which there can be very little doubt, there is at least 2000 ft. still to go before reaching the greatest depth worked by other companies.

This mine was worked to 2450 ft. in depth, and over a million tons of ore was taken out of it, yielding \$7,200,000, about one-half of which was distributed in dividends. Working costs in this part of California are low, and, together with loss in residue, the total will be covered by \$3.12 per ton. This is mainly due to cheap power, which is generated by water within easy reach of the mines on the Mother Lode. There has been developed 110,000 tons of ore, having a gross value of \$720,000, or a net value of \$350,000, which is equal to \$3.04 per ton; but for the purpose of all calculations, the net profit is based on \$2.46 per ton. The plant is expected to treat 8000 to 9000 tons per month, and will start about September 1, 1914. The profit obtained will range between \$240,000 and \$288,000 per year over all expenses. The property should certainly prove to be a substantial producer for many years to come.

Production of Arsenic in 1913

The output of arsenic in the United States during 1913 was all in the form of white arsenic or arsenious oxide, commonly known as arsenic, and amounted to about 2375 short tons, valued at \$142,340, against 3141 tons, valued at \$190,757, in 1912, a decrease of 766 tons in quantity and \$48,417 in value, according to the preliminary figures collected by Frank L. Hess of the United States Geological Survey.

There is so little direct profit in the manufacture of white arsenic, owing largely to the long distances it must be shipped to market, that the smelting companies make it only because they must prevent its escape into the atmosphere. If the demand and prices justified a larger output the production could be greatly increased. Arsenic is used principally as an insecticide for spraying fruit trees; in the manufacture of glass, especially plate glass; and for destroying weeds.

Metal Production of Texas in 1913

The output of Texas mines for eleven months of 1913 and an estimate for December, according to preliminary figures compiled by Charles W. Henderson, of the U. S. Geological Survey, was \$100 for gold, 401.415 oz. of silver, 260,000 lb. of lead, and a nominal quantity of copper. The greater part of the output of these metals came from the Shafter district, Presidio county. Lead-silver ore was shipped from the Sierra Blanca district, El Paso county.

Discussion

Readers of the MINING AND SCIENTIFIC PRESS are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment. Insertion of any contribution is determined by its probable interest to the readers of this journal.

The Government and the Individual

The Editor:

Sir—In the issue of December 6, 1913, in your editorial comment on the reversal of the Yard Decision by the Department of the Interior, you say, "As between the Government and the individual, no questions arise until application for patent is made. Prior to that date locators must rely upon state courts for protection, though there is a shadowy right of the Government involved in protection of the public domain from trespass."

Under the rulings of the Supreme Court of the United States, unless recently reversed or overruled, a mining claim is private property. It is a contingent freehold estate, held under the following conditions: (1) Before the location can be made, there must be a discovery of mineral-bearing rock, or deposit containing valuable minerals; (2) when the location is made it must be recorded as required by the regulations of the mining district in which it is situated; (3) each year thereafter until a patent is issued for it, the locator must perform labor upon the claim or make improvements thereon to the value of at least one hundred dollars. Under the provisions of section 2324 of the Revised Statutes of the United States, every organized mining district is a quasi land district, the records of which are notice to the Government and its officers as they are to all others.

There should be no question of the right of the Government, at all times to bring suit to have a mineral location set aside and canceled on the ground of fraud in its inception, or for failure on the part of the locator to comply with the terms of the grant.

I am one of those who believe that the courts are the proper tribunal for the settlement of all disputes, whether arising between the Government and a citizen, or between private individuals. The courts are the bulwark of the liberty of the citizen, and any assumption of judicial power by an administrative bureau is a menace to the freedom guaranteed under our constitutional form of government.

HENRY S. HAZLITT.

Dixie, Idaho, December 12, 1913.

Specialism and Efficiency

The Editor:

Sir—Mr. Sydney Additon's articles on the design and erection of milling plants, which have appeared in your journal of late, are of more than usual interest, and he is to be congratulated on the definite stand

taken in a subsequent letter with regard to the value of a specialist in connection with special work. As he says, a remedy for the many gross blunders connected so often with mill design and erection may be found in the employment of a metallurgical engineer, assisted by a chemist if necessary, to devise treatment; the same metallurgical engineer, assisted by a mechanical engineer if necessary, to design the plant and estimate the cost; and the same metallurgical engineer, assisted by a constructing engineer, to supervise the installation. A metallurgist has to run the plant, not a mining engineer, and it is only right that all phases of design and erection should be under the control of a metallurgical specialist.

The same views were propounded by a correspondent in a London contemporary, *The Mining Magazine*, some time back. Local opinion was, however, on the side of the general practitioner. A reply was published from one of the latter, who deplored the confined field which would be left for the mining engineer if a specialist were engaged for special work. An imaginary example was quoted of a cyanide 'specialist' having been called in to advise treatment on a copper ore, and who advocated cyanidation. The moral pointed out was that the mining engineer, "of broad training," would have seen that smelting was the correct method. Such an argument would only escape severe criticism in a centre where metallurgical decision was made by the mining engineer, and where the metallurgical specialist was only required to fill positions as working operator. In the first place, the phrase 'cyanide specialist' or 'cyanide expert' is a term which generally denotes a limited experience, coupled with a swelled head. A metallurgical specialist must be conversant with the metallurgy of a metal or group of metals. Knowledge in one detail of treatment does not permit him to assume the consulting position of a specialist.

The correspondent referred to is inclined to decry the work of specialists on account of their limited outlook which might result in taking a too narrow view. In other words, if the mining engineer who makes this statement was suffering from concussion of the brain he would prefer the services of an ordinary *medico* in preference to those of a specialist for fear that the latter might turn out to be a chiropodist who would insist on massage of the toe joints as the correct treatment.

A glance through the professional directory of *The Mining Magazine* indicates that, as far as London is concerned, there is practically no metallurgical influence to moderate or control the connection between the mining engineer and the metallurgical machinery houses. This is a situation which, for obvious reasons, neither the one nor the other desires altered. On the other hand metallurgical specialists were somewhat elated by a recognition of their status by the late President of the Institution of Mining & Metallurgy who, in his inaugural address (March 21, 1912, stated that "***** the fact was overlooked that the metallur-

gist was a specialist, whom they, as mining engineers, gladly recognized as being no less important to the success of mining enterprise than themselves." Hopes ran high, but subsequent official utterances, aided by an influential press, have since clearly defined the profession as consisting of mining engineers—and the rest.

The final paragraph in the last letter published in *The Mining Magazine* on the subject leaves no doubt as to the position the mining engineer insists on assuming with regard to metallurgical matters. "The subsequent work of the specialist in designing and laying out the mill work that is to embody the scheme of treatment selected is of extreme importance, but it must be controlled and directed by the all-round engineer, who alone should be held responsible." The need for the specialist is admitted but he is to take a subordinate position; and his work is to be controlled and directed by a man with no special knowledge. Of what use is any specialist who is not allowed a free hand; and what more damning influence on initiative and perseverance could be conceived than by the adoption of such a method. How easy and safe and unselfish for the 'all-round' engineer to assume responsibility when he has a specialist of proved ability and professional reputation to advise him, and when he knows that the glory goes to the person assuming such responsibility.

'SPECIALIST.'

Bulawayo, Rhodesia, December 10, 1913.

Lead Salts in Cyanidation

The Editor:

Sir—In M. W. von Bernewitz' article on 'Lead Salts in Cyanidation' in the issue of November 15, he states that, "Litharge has been used by C. M. Eye to good advantage, instead of lead acetate in treating reground tailing, etc. Only 1.5 lb. of the former salt was used, against 2.5 lb. of the latter; the litharge cost half as much and showed a saving of 30 per cent."

An inspection of these figures show that the saving would be 70% instead of 30% as stated. In Mr. Eye's notes he said "reduced to 30% of original cost," which would correspond with the data given.

JOHN B. LIVINGSTON.

Chicago, December 12, 1913.

Wyoming Metal Production

The output of Wyoming mines for eleven months of 1913 and an estimate for December, according to preliminary figures compiled by Charles W. Henderson, of the United States Geological Survey, was \$26,100 for gold, 1040 oz. of silver, and 437,000 lb. of copper, compared with \$22,235 for gold, 265 oz. of silver, and 25,080 lb. of copper in 1912. The principal producing mining districts in Wyoming in 1913 were the Atlantic City (or South Pass) district, Fremont county, with output in gold bullion and cyanide precipitates; and the Hartville district, Platte county, with output in silver-bearing copper ore.

Concentrates

Most of these are in reply to questions received by mail. Our readers are invited to ask questions and give information dealing with the practice of mining, milling and smelting.

In New Caledonia there are 800 nickel concessions, but only 40 are being developed.

Total working force at Panama canal at the end of October numbered 36,426 people.

Minimum wage of miners at Rio Tinto, Spain, is 3 pesetas, or 58 cents, per day of 8½ hours.

Mineral production in South Australia in 1912 was \$2,880,000, an advance of \$216,000 over that of 1911.

Practically all of the carnotite ore mined during the year 1912 was shipped abroad. At this time the Colorado deposits are furnishing three times as much radium from its deposits as all the rest of the world put together.

Copper ingots for the Royal Mint, London, must not contain less than 99.8% copper, and not more than 0.005% lead, 0.005% tellurium and selenium taken together, 0.001% bismuth, 0.001% tin, 0.001% antimony, 0.01% iron, and 0.02% arsenic.

Coins valued at \$1,108,325 were made at the mints of the United States in November. These consisted of 30 double eagles, 235 half dollars, 248,235 quarter dollars, 5,450,000 dimes, 9,657,285 nickels, and 1,768,518 pennies (one cent), a total of 17,124,303 pieces. For the Philippine Islands, 360,000 ten-centavo pieces were made.

Steel plates in sluice-boxes get highly polished from the flow of water, sand, and coarse gravel through them. It is found that this is important for the life of the plates. A 0.75% carbon steel is practically as good as 1.25%, and much easier to make plates from in the rolling mills. With such plates it is possible to use a 2% grade in the boxes, as compared with 6% for rails. The life of plates is from 10,000,000 to 12,000,000 tons, against 200,000 for rails. Plates are being tried at Lagrange hydraulic mine, Trinity county, California.

Recent determinations made by G. K. Burgess and R. G. Waltenberg show the following melting points:

	°C.	°F.		°C.	°F.
Titanium	1795	3263	Iron	1530	2786
Vanadium	1720	3128	Cobalt	1478	2692
Chromium	1520	2768	Nickel	1452	2545
Manganese	1260	2300			

The determinations were made with a micro-pyrometer and the metals were melted in hydrogen gas to prevent oxidation. In some cases the metals were melted in an Arsem electric-vacuum furnace.

Sand for filtration plants should be clean, with either sharp or rounded grains, entirely free from clay, dust, or organic impurities, and if necessary should be washed to remove such materials from it. The grains should all of them be of hard material which will not disintegrate. The effective size should not be less than 0.25 nor more than 0.35 mm. The uniformity coefficient should not be more than 3. The sand should be free from dust and contain not more than 1% finer than 0.13 mm., and should be entirely free from particles over 5 mm. diameter. The sand should not contain more than 2% by weight of lime and magnesia taken together as carbonates. Gravel for the floor of filters may be broken trap rock or granite screened to the proper sizes, or gravel screened from sand and gravel banks of a sandy nature. Gravel screened from hardpan or clayey material cannot be sufficiently cleaned. The gravel should not contain more than a very small amount of shale or limestone, and should be washed entirely free from fine material.

In steam-shovel operations the method of moving the Keystone drills, used for drilling blast holes, has been greatly expedited by the use of steam cranes.



METHOD OF HANDLING CHURN-DRILLS.

Formerly the drills were moved by their own power, and roads or track were necessary in moving from one position to another. The crane method has resulted in a saving of time and money. The halftone shows the crane in use at the Nevada Consolidated property.

Special Correspondence

MEXICO

MINING CONDITIONS. — SMELTERS. — HYDRO-ELECTRIC POWER PLANTS. — FINANCIAL SITUATION. — PETROLEUM. — COPPER COMPANIES. — CONDITIONS IN NORTHERN MEXICO. — EL ORO AND PACHUCA.

The mining industry of Mexico was affected to a greater extent in 1913 than in either of the preceding two years of political trouble. Government statistics covering the first

Rebel depredations during the year did not extend to the big power plants supplying current to mining districts, although trouble seemed imminent on several occasions. The El Oro and Pachuca districts received continuous supplies of power from the Necaxa plant of the Mexican Light & Power Co., and the Guanajuato Power & Electric Co. and the Chihuahua Hydro-Electric Co. suffered no interruptions. The Mexican Northern Power Co., the Canadian concern building the Conchos river dam and power-house, and which will eventually supply power to important Chihuahua mining districts, was compelled to suspend work, due to the impossibility of securing supplies. The dam has been built to an elevation of 144 ft., and the power-house is practically completed, with much of the machinery in place. The Company reports that its properties have not been damaged.



MAP OF MEXICO.

two months of the present fiscal year (July and August), which are the latest at hand, show a decrease in exports of mineral products of \$9,871,938 compared with the corresponding months of the last fiscal year. General conditions were bad at the opening of 1913, and after the overthrow of the Madero government and the launching of the revolutionary movement against Gen. Huerta, they steadily grew worse. Rail communication between the interior of Mexico and the American border was stopped early in the year, and repeated attempts to reestablish it have been unsuccessful. Scores of bridges and station buildings have been destroyed, long stretches of track have been wrecked, and many trains have been dynamited.

The Torreón, Velardeña, and Matehuala smelters were forced to close during the first half of the year. The Aguascalientes smelter has been able to operate almost continuously, but at reduced capacity. The smelter at Chihuahua has been shut down at intervals, but has operated during the greater part of the year, and the same has been true of the smelters at Monterrey. The Towne smelter at San Luis Potosí was able to operate until August, when inability to get coke caused a shut-down of two months. The plant was again forced to suspend operations in December.

Financial disturbances have resulted from the inability of the Huerta government to secure a foreign loan, due to the attitude of the United States, and high exchange rates have prevailed since early in the year. In April a 10% export tax on all gold not sold to the Exchange Commission, at the established rate of \$1.33½ per gram, was decreed, and has been in force since that time. An executive decree issued in November doubled the stamp taxes, including those pertaining to the mining industry, and increased the tax on crude petroleum produced to 75 centavos per ton. These increases became effective December 1. Discovery that Mexican pesos were being extensively melted for exportation in the form of bars, their silver value under prevailing exchange rates being greater than their value as Mexican money, resulted in an executive decree in October providing severe punishment for those guilty of such practice. During the latter part of the year the government recoined many silver pesos into 50-centavo pieces. The increased revenues for domestic expenses resulting to producers by reason of the high rates of exchange are offset to some extent by increased costs of operation and marketing, due to disturbed conditions, and now by increased taxation.

Petroleum production continued to increase during 1913,

and in a memorial protesting against a heavy increase in taxation, prepared by producers and submitted to the government in November, the production for the year was estimated at 3,955,228 tons. At the opening of 1913 there were 64 producing wells in the Tampico territory, with a possible production of nearly 200,000 bbl. per day. The year's exports through the ports of Tampico and Tuxpam have been heavy, increased transportation facilities having been provided. In November, rebels attacked the port of Tuxpam, and in December the port of Tampico, and the petroleum industry was temporarily affected as a result. When the rebels entered the Tampico territory, the American government warned them that foreign properties must not be molested, and this warning proved effective.

Shipments from the Coahuila coalfields were stopped with the cutting of railroad communication in Coahuila, early in the year, but a number of the concerns continued operations for a time and accumulated big reserve supplies of coal, which were burned when the mines were dynamited by the rebels.

The Mazapil Copper Co., one of the important copper producers of Mexico, was forced to suspend operations in April. The Company has a copper smelter at Concepcion del Oro, Zacatecas, and a lead smelter at Saltillo. Later in the year the Saltillo smelter was blown in again, but did not operate long. In 1912 Mazapil averaged 495 tons of fine copper, 63,000 oz. silver, and 1200 oz. gold per month. In the first 10 months of 1913, Greene Cananea had a production of 36,685,000 lb. of copper, and complete returns for the year will show about 43,000,000 lb. The 1912 production of Greene-Cananea was 48,346,000 lb. At the start of the anti-Huerta movement in Sonora, the Company had difficulties, due to lack of transportation and labor troubles. Its dividends were passed as the result of curtailed operations. The Moctezuma Copper Co. had the best year in its history in 1913. In the first 10 months the production was 30,031,600 lb. of copper, as against 32,080,099 lb. in the 12 months of 1912. Complete returns for the year will show a production considerably in excess of that of last year. The Teziutlan Copper Co., another important copper producer, was able to operate until late in the year, when rebels made an attack on Teziutlan, in the state of Puebla, and it was necessary to suspend temporarily. The Company is resuming. During the year a 500-ton concentrator was built.

The impossibility of securing supplies and of shipping products forced many Chihuahua mines to shut down in 1913. The same was true of Durango properties. Operations in the Santa Eulalia district of Chihuahua were well maintained, considering conditions, the ores supplying the Chihuahua smelter. The Mines Company of America closed its El Rayo and Dolores plants. Suspension of traffic on the Mexico Northwestern railway stopped shipments from Cusihiuriachic district mines. The Alvarado Mining & Milling Co. continued operations in the face of great difficulties, and made shipments of bullion by wagon-train to the border. Many of the Sonora concerns have continued operations during the year, due to the fact that after the Sonora revolutionists secured control of the state there was little brigandage, and the operation of the railroad lines enabled them to secure supplies. For months mining has been practically at a standstill in the state of Sinaloa. The important El Tajo, Panuco, and Guadalupe de los Reyes properties are shut down.

Quiet has prevailed during the year in the El Oro district of the state of Mexico, and the important concerns there have operated steadily. Labor troubles threatened at the Dos Estrellas, but the difficulties were satisfactorily adjusted, and no break occurred. Dos Estrellas production has fallen off during the year, and the dividend payment has been reduced to ₡3 per share per month. There has been no interference with operations in the Pachuca district of Hidalgo, except that near the end of the year a scarcity of dynamite tempo-

rarily affected some of the companies. The Real del Monte has been milling about 40,000 tons per month and has earned big profits. Good records have been made by the Santa Gertrudis, San Rafael, and La Blanca companies.

The Amparo Mining Co., of the state of Jalisco, has paid 16% on its capital of \$2,000,000 in 1913. Production has been increased during the year. The El Favor Mining Co. became a dividend payer, disbursing \$35,000 quarterly. A 250-ton reduction plant was built by the Cinco Minas Co. and will be in operation early in 1914. The Consolidated Mining Co. built a small experimental plant at its Casados mine, and has been at work on a plant to handle 100 tons per day. Work on a 50-ton cyanide plant was started by the Amajac Mines Co., but bandit activity forced a temporary suspension of work in November. The Magistral-Ameca Copper Co. resumed work at its concentrating plant, and has been shipping concentrate during a great part of the year.

Rebel activity in the state of Guanajuato did not interfere with mining and milling in the Guanajuato district, and shipments of mill products have been made regularly during the year. Rebel activity has made it impossible for the Towne interests to continue operations at Sombrerete and Fesnillo, in Zacatecas, and the Santa Rosa Mining & Milling Co., of that state, was forced to shut down in May. Operations have been at a standstill in the important Sierra Mojada lead district of Coahuila since April. The antimony smelter at Wadley, San Luis Potosi, was forced to shut down several months ago. Operations in Oaxaca districts have been greatly curtailed during the year.

LONDON

LEVANT MINE AND 'LORDS.'—FURTHER NOTES ON GEEVOR.

A few months ago I mentioned that the directors of the Levant mine, near Land's End, were in a quandary as to the future of their operations, owing to the approaching termination of their lease, and also that there was every prospect of the owners of the mineral rights, called 'the lords' in Cornwall, demanding onerous terms for a renewal. This mine is still run by a 'cost-book' company, being the sole remaining mine of any size to stand out against the principle of limited liability. It is also the only mine in Cornwall producing both tin and copper. Another fact in connection with it that is of interest is that Francis Oats, of De Beers fame, is a large shareholder, and gives the last word of advice in connection with the policy to be pursued. It was due to him that a reserve fund was accumulated, and money spent freely on development. At the present time the mine is only just paying its way, and it is doubtful whether the board will care to renew the lease. Now comes the publication of the terms under which the lords offer the new lease. They demand the expenditure of £60,000 cash capital in improving the mine, and an advance of 33% on the dues, that is, royalties. As the dues are based on the gross output and not on profits, an increase during bad times is a serious matter. The directors urge that to spend such a sum on a mine that is fairly well equipped and drained would be contrary to the best mining policy. It will be remembered that when the lease at Dolcoath was renewed 10 years ago, the demand made by A. F. Basset, the lord, for the expenditure of £25,000 on lines laid down by his own advisors was regarded as a prodigious imposition, so that £60,000 for Levant is a 'fair knock-out,' as Bombardier Wells would say. But this does not exhaust the subject by any means, for it is necessary to add that the chief lord at Levant is the Duchy of Cornwall Office. This Office manages the estate of the Duke of Cornwall, otherwise the King. In feudal days it was the King in his personal capacity; nowadays the Office is only a government department. The administration of the Crown Lands is already known to be strict and grasp-

ing to the uttermost farthing as heartless and soulless as a limited liability company. What will happen when all land and minerals are under the control of the government is apparently foreshadowed by the action in connection with the Levant lease. The only people likely to take the property on such terms are the promoters of the rascally type. It is impossible to imagine mining men, detached from the Stock Exchange, acceding to them.

In these notes of December 20, I recorded the results of concentration with step-classification and step-grinding tried at the Geovor tin mine, which is quite close to the Levant, and that Horace G. Nichols had read a paper at the November meeting of the Institution of Mining and Metallurgy describing the results obtained, also that Oliver Wethered, the chairman of the Company, had contributed to the discussion by announcing that this modern plant had been remodeled and Dolcoath practice substituted. This week the report of the Geovor Tin Mines, Limited, for the 15 months ended September 30, 1913, has been published. The directors here give their own version. They state that, during the earlier months of the period under review, they were "caused grave anxiety owing to the great delay in restarting the mill, and the unsatisfactory results obtained from the method of treating the ore, which necessitated very material alterations. This delay had the inevitable result of disturbing the Company's finances, and as the whole of the debentures had not been subscribed, it was necessary to obtain assistance from the principal shareholders; advances were also made by the directors." It is stated in the report that after the alterations profits were made, but the information given as to the alterations is so meagre that I will not quote it.

JOPLIN, MISSOURI

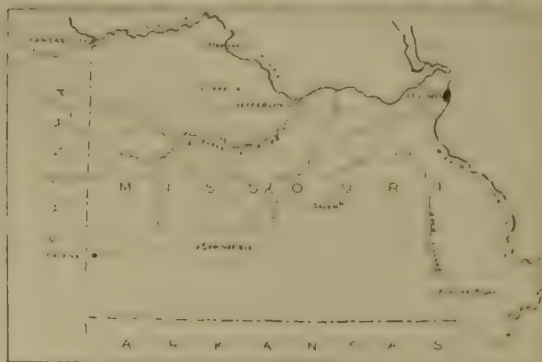
METAL PRICES.—INCREASED OUTPUT FROM OKLAHOMA.—PROSPECTING.—DEVELOPMENT AT THOMS STATION.—PRODUCTION STATISTICS.

Although prices for both zinc and lead ores throughout the year of 1913 were much lower than prevailed in 1912, when new price records were attained, production of both ores was remarkably heavy in the Missouri-Kansas-Oklahoma district. In lead ore production a new record was established, the output reaching 94,962,640 lb. and exceeding the previous record attained in 1911. The state of Kansas has always been second in the rank of the three states prior to 1913 when Oklahoma forged into second position, due to the heavy output of the Miami, Okla., mines. The Miami camp jumped from sixth to third place in the list of 21 camps, so far as aggregate valuation of the ores was concerned, while in lead ore production it went to second place, forging ahead of the Joplin camp in this item.

The year was one of importance to mining men although no high-price records were established. Probably more prospecting was done in 1913 than in any previous year in the district's history, yet there was not a great deal of development as a result of the prospecting thus undertaken. While the reports of new strikes were comparatively few, those that were made are considered of unusual worth. The greatest amount of work in virgin territory was undertaken to the north of Miami, Okla., and this field bids fair to be a heavy producer of both zinc and lead ores. As the ore deposits, as a rule, occur at great depth in that locality the cost of development is heavy. Some of the richest of soft ground development was carried on in the Thoms Station district, adjoining Joplin on the north. Not only were several large new concentrating plants constructed in that field during the year but a number of new properties are under course of development which bid fair to do their share in helping Thoms Station retain the important position it has reached because of its continuous heavy ore production of the past few years.

The blende production of the entire district amounted to

41,107,593 lb., which was valued at \$11,304,794. The calamine production for the year amounted to 40,446,251 lb., valued at \$491,244. The lead production amounted to 94,962,640 lb., valued at \$2,559,421. The total production of the district, which includes parts of Missouri, Oklahoma and Kansas, amounted to \$14,355,461. The metal production of that part of the district which is in the state of Missouri was 4,104,423 lb. of blende valued at \$9,559,972; 40,446,251 lb. of calamine, valued at \$486,500, and 72,192,329 lb. of lead, valued at \$1,976,438, making a total of \$12,922,910. In Oklahoma the production of blende amounted to 47,943,870 lb., valued at \$877,



MAP OF MISSOURI.

997; calamine 105,620 lb., valued at \$1320; and 16,150,763 lb. of lead valued at \$418,456. The total production of that part of the district lying in Oklahoma is valued at \$1,297,775. In Kansas, the production of blende amounted to 43,014,390 lb., valued at \$867,828; calamine, 272,190 lb., valued at \$3323; and lead 6,409,557 lb., valued at \$164,527; making a total of \$1,035,678 from Kansas.

CALGARY, ALBERTA

COAL MINING IN THE PROVINCE.

The extensive railway construction in Alberta during 1913 has been accompanied by a rapid development of the coal deposits thus rendered accessible, which will form an important source of supply for railway requirements. The Brazeau Collieries, Ltd., in which the Canadian Northern railway is largely interested, is developing a large coal area near the new townsite of Nordegg, 120 miles west of Blackfalds, on the new Canadian Northern branch line from Stettler, which is now nearing completion. The first shipments are expected to be made before the end of January. Development has been in progress for 18 months by driving 1400 ft. of adits on two seams which are, respectively, 14 and 7 ft. in thickness, with a dip of only 12 degrees. The development work alone has produced 35,000 tons of coal, which is now ready for shipment. An up-to-date plant with a capacity of 2000 tons per day has been ordered, to be installed in running order by September 1, 1914, and in the meantime a temporary chute has been installed, sufficient to handle from 400 to 500 tons per day. When in full operation, the two mines now opened will employ about 450 men.

The Mountain Park Coal Co.'s mines have been reached by a branch of the Grand Trunk Pacific railway, recently completed, and now that transportation facilities are assured, will considerably extend its operations. The present output is about 500 tons per day, and by April 1914 it is expected to be increased to 2500 tons. A colony of English and Scotch miners was brought out by the Company, for whose accommodation a village of 50 houses was built at the mines. The force will before long be increased to about 800 men. The coal is high-grade bituminous, and suitable for steam purposes.

BUTTE, MONTANA

COPPER OUTPUT IN 1913.—LABOR SITUATION.—PILOT BUTTE AND BULLWHACKER.

The estimated production of copper during the past year was 290,000,000 lb. To the man about Butte it would seem that there has been no intentional curtailment of output. In fact, operating conditions have been improved at many of the mines and smelters, with a view to increasing tonnage. The figures will probably show a considerable increase in tonnage. This means, of course, that the average grade of the ore is lower. This fact is reflected at the smelters, where 5% ore is now considered first class and is charged direct to the blast-furnaces. Reviewing the statistics of production for the past 10 years, it is apparent that the copper production from Butte has remained about stationary—this in spite of the opening of several new properties. It is reasonable to conclude from these facts that Butte is at the zenith of its copper production, with a lowering grade of ore. With increasing depth, and increasing labor costs, it is not improbable that a gradual decreasing production will characterize the coming years.

At present there are more than 15,000 men employed about the mines at Butte, and the payroll is estimated to exceed \$2,000,000 per month. This local prosperity has been widely made known among the miners of the country, and in consequence the town is overrun with idle men. Men should be warned not to come to Butte this winter, as the "rustling line" at the mines is already very long and living expenses are high here. The year's payroll of the Butte mines makes large figures, estimated as follows by *The Butte Miner*:

Company.	Amount.
Anaconda	\$14,400,000
East Butte	695,000
North Butte	1,250,000
Butte & Superior	1,180,000
Tuolumne	168,000
Butte-Duluth	100,000
Pilot-Butte	60,000
Davis-Daly	292,000
Butte-Alex Scott	182,500
W. A. Clark	600,000
Miscellaneous (estimated)	500,000
Total	\$19,427,500

These estimates cover the Butte mines alone, and do not take in the smelters, coal mines, logging camps, etc. Including all its branches, the Anaconda company's payroll alone amounts to over \$20,000,000.

It is generally conceded that labor unions run things just about to suit themselves at Butte. But once in a while they overstep the mark, and the general public rises in its wrath against some rank injustice. A case in point is now attracting local public attention. The Workingmen's Union, composed of the unskilled labor of the community, has issued an ultimatum to the effect that on and after January 1, 1914, the minimum wage for the craft shall be \$4 per day. As the skilled underground miner, under the present price of copper, receives \$3.50 per day, the humor of the situation becomes apparent to all but the employers. They have failed to see the joke, and are now banding themselves together with the intent to resist the demand. The present minimum price for unskilled surface labor is \$3.50 per day.

The Anaconda Copper Mining Co. has so far pursued the policy of letting its employees look after themselves outside of working hours, and Company boarding-houses, stores, etc., have not been introduced. Of late, however, a tendency is manifesting itself for the Company to take more interest in the welfare of its employees. This interest can in no way be construed as encroaching on the rights of the individual.

For instance, a young men's club has been started in Meaderville, and has been given material financial assistance by the Anaconda company. That, however, is to be the extent of the Company's interest in the matter. The club is to be managed by the members themselves. In similar manner it is now proposed to assist the employees of the Anaconda smelter to secure comfortable houses and a competence for themselves. This is to be done by selling them on easy terms and at low interest farm tracts of ten acres each in the Deer Lodge valley, near the works. The Company will spend large sums in improving the land, laying out the tracts, putting water and electric light systems in, and other necessities. The returns which the Company expects from the investment will be in a better, thriftier, and more contented class of employees at the smelter.

The Pilot-Butte Mining Co. is arranging to sink its shaft from the 2000 to the 2400-ft. level. A fund of \$50,000 will be necessary to do this work and to make some needed surface improvements.

The Bullwhacker Copper Co. has completed a building to house 24 precipitation-vats and the electric generator connected therewith. With this equipment it expects to be able to precipitate 4400 lb. of copper per day. Some recent developments in the mines nearby suggest that the oxidized leachable ores extend to depths of several hundred feet, which condition is encouraging to the operators of the leaching plants.

NEW YORK

UTAH CONSOLIDATED PROPERTY.—GREAT FALLS MILL AND SMELTER PROPOSALS.—BUSINESS IN COPPER IN 1913.—PRESENT COPPER SITUATION.

The Utah Consolidated is showing a surprising ability to 'come back.' Its lead output for 1913 is estimated at 17,000,000 lb., compared with 8,700,000 in 1912 and 3,000,000 in 1911. The net earnings are not expected to greatly exceed \$600,000, those of last year. The Company owns the old Highland Boy mine, which was a good producer of silver-lead ore forty years ago and gradually developed into a copper mine, with the result that the earnings of the Company in 1906 were nearly \$3,000,000. About this time, the Company, like all others in the Salt Lake district, was subjected to the attacks of 'smoke farmers' and had to curtail operations of its smelting plant. In 1910 the blow fell, for a special examination by R. H. Channing showed that instead of the million tons of 2.4% copper ore believed to be in reserve, there was actually less than 400,000 tons. There followed a period when directors, managers, and consulting engineers were busily engaged in explanations, and then the mining of lead ore was resumed. The ore reserves are now small, being given as 24,100 tons of 15% lead ore, 12,000 tons of 6.8% lead ore, and 251,500 tons of 1.9% copper ore. The Utah receives about \$40,000 per year as dividends on its shareholdings in the International Smelting & Refining Co., but, curiously enough, it was the failure of the Highland Boy mine which gave the International its greatest setback. The excellent copper-smelting plant of the International was built chiefly to handle the copper ore from the Highland Boy, and as a result has never been operated at over one-half its rated capacity.

The news that the Anaconda company will hereafter divert its concentrating ore to the mills at Anaconda, shutting down the concentrator at Great Falls, is merely a natural step in the evolution of institutions. Except to keep up capacity, there have been few good reasons for maintaining the plant at Great Falls since it was taken over by the Anaconda. There is unusually cheap water-power available in abundance at Great Falls, the plant is there and has an unusually well organized technical and laboring staff, and there is always

an advantage in having eggs in two baskets, in other words, in the event of an attempt to hold up the Company either at Anaconda or Great Falls, it would be easy to divert operations to the other place. Over against these advantages is the 280-mile haul of the ore and the fact that the coal available at Great Falls for reverberatory smelting is of every poor quality as compared with the coal available at Anaconda. The Company will unquestionably continue smelting operations at Great Falls, for the reasons mentioned, but there seems no good reason for hauling the crude ore 280 miles, only to put it through the mill and send a large portion of it to the waste heap. As a matter of fact, milling operations at Great Falls have been gradually reduced for a long time back, the mill having been used for the purpose of carrying out careful and elaborate experimental work to determine the most efficient and economical milling method. This is now being introduced in the reconstruction at Anaconda, and the Great Falls mill has therefore served a very useful purpose.

Market journals and brokers' circulars have had much to say during the year concerning the tremendous effect on the output of copper expected from the Lake Superior strike and the Mexican troubles, and it is interesting to notice that the U. S. Geological Survey estimates that the output for the year is only 1.75% less than that in 1912. Most observers would have expected that the shrinkage in the volume of business resulting from the desire of everyone to wait and see what the effect of the new tariff and banking regulations are to be, was much greater than 2% and it is doubtless the unusually heavy exports of copper that sellers have to thank for staying over a greater decline in the price of copper than the market has shown during the year. The general sentiment is that an early increase of business activity is now to be expected, and probably the price of the metal will remain fairly steady at 14 to 15 cents. This is certainly to be hoped for, as rapid ups and downs help no one but the speculator, and what the miner wants is to know where he stands and then to be able to go ahead.

BRITISH COLUMBIA

THE MINING INDUSTRY IN THE PROVINCE IN 1913.

Metalliferous mining in British Columbia during 1913 progressed satisfactorily. From the standpoint of dividends paid, the year has been the best on record, as is shown by the following table:

Standard Silver-Lead Mining Co.....	\$ 650,000
Hedley Mining Co.....	360,000
Consolidated Mining & Smelting Co.....	464,416
Granby Consolidated Mining, Smelting & Power Co.....	899,911
British Columbia Copper Co.....	88,756
Le Roi No. 2, Limited.....	43,200
Total	\$2,506,283

The above table does not represent the total profits derived from mining operations during 1913, because profits have been earned in addition to the dividends paid by the companies mentioned, as well as by the Britannia Copper Co., the Crow's Nest Coal Co., and some of the smaller mining companies. The total production from the province during 1913, including gold, silver, lead, copper, coal, and coke is estimated at about \$2,000,000 below that of the total production for 1912, when the output was \$32,440,800; but the fact of the long period during which the strike lasted among the coal miners on Vancouver island, and which caused almost a suspension of coal-mining operations for several months, must be considered.

One of the most satisfactory features relative to the metalliferous mining industry is the fact that many of the leading companies have acquired considerable areas of mineral properties in addition to the holdings they were operating in

1912. For example, the Britannia company, operating on Howe sound, about 40 miles from Vancouver, has acquired all of the mineral-bearing zone situated between the beach and the original Britannia group of claims. These additional properties include the Goldsmith and Empress groups as well as some other claims. The Granby company has purchased some of the claims formerly included in the Van Anda company's property on Texada island, also a mine on Prince of Wales island, Alaska, formerly owned by the Hadley Copper Co., and the Midas group of claims on Solomon basin near Valdez, Alaska. The British Columbia Copper Co. has acquired a large number of claims on Copper mountain in the Similkameen district.

In the Sandon district, of the Slocan mining division, active work has been resumed on the Slocan Star, the Payne and Noble Five silver-lead mines. On Vancouver island, the Ptarmigan Mines, Ltd., an English corporation, has started opening the old Big Interior property. A syndicate of Butte mining men is preparing to work a group of copper claims near Quatsino sound. At Sooke, about 30 miles from Victoria, B. H. Johns and associates have been working on some claims containing copper-bearing ore. In the Kamloops district, the Kamloops Copper Co. has resumed operations at the Iron Mask. On Queen Charlotte islands, at Tassoo Inlet, a group of claims carrying copper-bearing ore in a magnetite gangue, has been acquired by R. H. Hedley and associates of Vancouver. They have been extending the development and purpose to ship ore in the near future. In the Lillooet district, development has been resumed on the Pioneer, Why Not, and Blackbird claims on Cadwallader creek, and milling operations started on the Coronation property, after the mill had been closed down since 1910.

The most work done by prospectors has been confined principally to four fields as follows: The North Thompson river, along the line of the Canadian North Pacific railway; the Cotton-Belt, on the north fork of the Seymour river; on Eldorado and Taylor creeks, to the north from Bridge river, and situated between that river and the Chilcoten country; and on McGillivray mountain in the Lillooet district. The number of prospectors in these districts has been few as compared with the number which was formerly searching the mountain ranges for ores; but the amount of work done has been considerable. In other words, the prospectors out during the past year have been working to show up their discoveries rather than confining their energies to staking and traveling. On the North Thompson, some gold-bearing quartz has been opened during 1913, which may develop into successful mines, and as these locations are near the Canadian Pacific railway, they are of easy access. On the Cotton-Belt, some of the ores carry copper in a quartz gangue, and others carry galena and zinc in a magnetite gangue. These locations at present are handicapped by lack of transportation facilities. On Eldorado and Taylor creeks the ores are free milling mainly and contain gold. On McGillivray mountain, in the Lillooet district, about 10 miles from the line of the Pacific Great Eastern railway, where the grade crosses the mouth of McGillivray creek, considerable prospecting work has been in progress on a vein carrying silver in gray copper ore.

The only camps in British Columbia to produce any great quantity of placer gold have been at Atlin and Cariboo, where the operations have been successful and satisfactory to the owners of hydraulic claims. So far, dredging has not yet been carried on with success. Some prospecting was done on Louis creek, a tributary of the North Thompson, during the past summer, and it is claimed that about \$8000 in placer gold was recovered by individual miners. The bedrock is deep and only exposed at one point. This creek was worked as early as 1862 for placer gold. The placer gold production in the province in 1913 is estimated at \$550,000, about the same as in 1912.

General Mining News

ALASKA

JUNEAU

November returns from the group of mines on Douglas Island are as follows:

	Alaska Mexican.	Alaska Treadwell.	Alaska United.
Development, feet	261	113	1,033
Ore in stopes, decrease or increase, tons	+4,281	-38,743	-6,158
Stamps working	120	540	240
Ore crushed, tons	18,438	74,508	37,793
Concentrate produced, tons.	401	1,456	816
Gold by amalgamation.....	\$16,300	\$109,209	\$36,906
Gold by cyanidation.....	18,019	85,420	31,612
Realizable value	33,976	192,683	67,832
Net profit	5,533	102,510	12,900

SHUSHAN

There are 400 men at Johnson City, which is at the actual seat of placer operations, with others coming and going every day. On December 5 about 100 lb. of mail left Dawson for the district. Thirteen of the James claims have been sold to F. Manley, E. J. Ives, and J. J. Price for \$500,000. Cash amounting to \$40,000 was paid, and the balance when the option is up. There are six suits pending against James and his associates over the claims located in the district. These will be tried at Cordova. Many claims are still being staked.

ARIZONA

GILA COUNTY

Seven engineers and draftsmen are at Globe with Repath & McGregor in connection with the new smelter being erected by the International Smelting & Refining Co. This plant will treat concentrate from the Inspiration and Miami mills, also custom ores. A. G. McGregor has stated that the smelter will consist of three large reverberatory furnaces, a drying and roasting plant, a sampling plant, drying and roasting furnaces, three reverberatory furnaces with waste-heat boilers in the flues, five converter stands, modern flues, and two stacks, 22 by 300 ft., and 15 and 250 ft. in diameter and height respectively. The daily capacity of the plant will be 500 tons of concentrate and 300 tons of first-class ore and fluxes.

GREENLEE COUNTY

(Special Correspondence.)—A 50-ton concentrator and cyanide plant is being erected at the property of the Twin Peaks Mining & Milling Co. at York. Treatment will consist of leaching the sand and agitating the slime in Parral tanks. The El Paso Foundry & Machine Co. is supplying the equipment, and the plant should be in operation by March 1. The ore opened in the mine justifies the installation, and this will be increased as development warrants.

York, December 23.

Beam Bros., of Wilkesbarre, Pennsylvania, have leased the old Carlyle mines, 18 miles from Duncan and 8 miles from the Twin Peaks property. Machinery is being received at the mine, and 60 men will be employed by the middle of January.

PINAL COUNTY

At the Ray mine, an area of ground 400 ft. in diameter above the stopes did not settle, and arrangements were made to blast it. A drift was driven through the ore, and four winzes and four raises were driven from the drift. These were charged with dynamite, and on Christmas Day the ground was blasted.

SANTA CRUZ COUNTY

At the Chief mine, at Patagonia, the shaft is down 175 ft. A good grade of ore containing gold, silver, lead, and copper has been opened in other parts of the mine. It is probable that shipments will be made from the property at an early date.

CALIFORNIA

AMADOR COUNTY

It is reported that at a depth of 2700 ft. the Central Eureka company has cut an extension of the South Eureka orebody. Sinking will be continued to get under the ore. The Rail-



road Commission has made practically no changes in freight rates over the Amador Central railway. A suit under the compensation law was recently heard at Sutter Creek, where a miner sued the South Eureka Mining Co. for damages on account of a fall of rock in the mine. The case is not finished.

The suit between the Kennedy Extension and Argonaut mining companies is being further argued at Jackson. On January 5, Judge Woods inspected the underground workings of both mines, with a view to getting acquainted with the ground in dispute.

CALAVERAS COUNTY

An examination of the copper mine at Copperopolis has been made by Thomas Leggett, J. G. Hardy, Samuel Levy, and G. McM. Ross for the American Smelting & Refining Co. The mine is said to have a large tonnage of good ore opened and is equipped with a mill and smelter, the latter requiring overhauling.

ELDORADO COUNTY

At the Slate mountain mine, 10 miles east of Georgetown, O. W. Jackson has several men employed. Good ore has been opened and a stamp-mill will be erected in the spring. The principal mines at Georgia Slide are the Blue Rock, Pacific, and Beattie. The Live Oak, near Georgetown, is yielding profitable ore.

LASSEN COUNTY

An option has been secured by J. G. Benninghoff on a prop-

erty about 20 miles from Susanville. C. E. Emerson has taken over the Wild Horse mine.

NEVADA COUNTY

Rich ore is being extracted from the lower levels of the Pennsylvania mine at Grass Valley. Forty stamps are working. During 1913 the North Star company paid \$200,000 in dividends. The Union Hill mine, at Nevada City, under bond to L. B. Doe, has been acquired by a new company, Henry Malloch being manager. The Rose Hill, near the Golden Center company's property, is to be reopened.

PLUMAS COUNTY

The Walker copper mine, 18 miles north of Portola, partly owned by J. K. Walker of Salt Lake City, has had new equipment installed. High-grade ore has been opened. Either auto-trucks or traction engines will be used to haul ore to Portola.

SIERRA COUNTY

Work has been resumed at the Columbia drift mine, 10 miles east of Forest City. Shortage of water last summer caused the shut-down. It is probable that the Omega gravel mine, on Oregon creek below Forest City, will be opened in the spring. F. O. Dale, of Oakland, represents the controlling interests. At the Sixteen-to-One mine, at Alleghany, drifts are being opened in quartz at 100, 150, and 200 ft. The mine is dry, being drained by the lower workings of the Tightner. Sinking is under way at the Plumbago mine.

On January 6 the Tightner company, operating at Alleghany, paid a dividend of \$500 per share to its 100 stockholders.

SISKIYOU COUNTY

The Highland mine, near Sawyers Bar, will be reopened on a larger scale than formerly next spring. The Forks of Salmon gravel property, operated by the Lagrange company, is to be equipped with hydraulic giants and elevators. M. A. Singer is in charge. The Forks of Salmon placer property is being sold to Los Angeles people. An elevator has been installed at the Michigan Salmon mine. Hydraulic mining is being done on about a dozen properties, there being plenty of water.

SUTTER COUNTY

The county of Sutter has commenced suit against W. J. Chaney and others to enjoin them from further dumping of debris from gold dredges into the Feather river near Oroville. The complaint is on secret file.

TRINITY COUNTY

Steel plates are being tried in sluice-boxes at Lagrange gravel mine. The Company's siphon on Stuart's fork blew up on December 20. This is a 36-in. diameter steel pipe and carries water across a cañon. A new pipe was to have been inserted. A wagon with 22 horses and 11 men have been trying to transport a new steel plate to the break, but without success. It is now to be taken there over the Buckeye ditch. The Company's officials figure that it will cost \$2000 to deliver the plate, but it must get there for the season's work.

YUBA COUNTY

Reports received at Marysville from Smartsville state that the Guggenheim drilling plant on the Yuba river was destroyed by a flood, and two valuable drills were lost.

COLORADO

CHAFFEE COUNTY

This county produced \$290,000 in gold, 154,000 oz. of silver, 2,763,000 lb. of lead, and 300,000 lb. of copper, and a considerable quantity of zinc in 1913, a heavy increase for all the metals.

CONJOS COUNTY

(Special Correspondence.)—There have not been any very

favorable developments in the Platoro district, and no shipments have been made. There are said to be about 50 men wintering in the district. There are unconfirmed rumors regarding a discovery of copper ore near the Worrell ranch, Platoro, January 1.

CLEAR CREEK COUNTY

(Special Correspondence.) A rich mineral discovery has been made at the Georgetown adit, on Columbian mountain. At a distance of 800 ft. from the portal, a vein has been opened, and two streaks give assays of 700 oz. of silver per ton. J. J. Keating is manager. The motor for the Capital adit has arrived, and the trolley system has been brought into use. The Onondago Mining Co. will at once enlarge the working force, and the Capital company will also enlarge operations. Good results are coming from work at the Esmeralda, Montgomery-Ward, Santiago, Little Giant, and lessees at the Jo Reynolds and Free America properties. The New Era mine at Freeland has been sold to Eastern people for \$250,000. Mineral output from the Idaho Springs district in 1913 was about \$960,000. Snowstorms have interfered with work lately.

Idaho Springs, January 1.

Clear Creek county's output of metals in 1913 was \$495,000 in gold, 424,700 oz. of silver, 4,230,000 lb. of lead, 524,000 lb. of copper, and approximately 1,500,000 lb. of zinc, an increase for all the metals except zinc. On December 24 the Edison rolls were started at the Burleigh mill.

EAGLE COUNTY

The output of this county, from Red Cliff and from Eagle (a new producing silver district in 1913), was \$42,000 in gold, 300,000 oz. silver, 1,000,000 lb. lead, and 5,500,000 lb. zinc.

GILPIN COUNTY

This county's output in 1913 decreased about \$200,000 in gold and 50,000 oz. of silver, allowing for bullion produced in Clear Creek county mined through the Newhouse tunnel.

Ore shipments from Black Hawk during 1913 totaled 76,075 tons, a decrease of 8275 tons compared with the previous year. This was principally due to the stoppage of work at the Frontenac-Aduddell and Topeka properties.

GUNNISON COUNTY

Owing to the closing of the Gold Links mine at Ohio, the county's output of bullion, ore, and concentrate showed a heavy decrease for gold. Lead and zinc production also decreased, but there was an appreciable increase in silver output, owing to the opening of mines at Whitepine and on Italian mountain.

HINSDALE COUNTY

The output from this county in 1913 showed a decrease of 400,000 lb. of lead.

LAKE COUNTY (LEADVILLE)

Including the Lackawanna Gulch district, this county in 1913 produced \$981,416 in gold, 3,200,000 oz. of silver, 2,000,000 lb. of copper, 28,000,000 lb. of lead, and 98,000,000 lb. of zinc, with a total value of \$10,000,000, as against \$11,780,131 in 1912, according to the U. S. Geological Survey. The output of zinc carbonate was 137,000 tons of approximately 27% zinc, against 142,782 tons of 29.2% zinc in 1912. The production of zinc sulphide shipped varied little from the 104,148 tons of 24% zinc in 1912. The zinc carbonate ore was treated at smelters in Kansas, Oklahoma, and Wisconsin, and the zinc sulphide was treated at the Empire Zinc Co.'s magnetic separation plant at Cañon City, at the Western Chemical Co.'s wet-concentration and magnetic separation plant at Denver, at the United States Zinc Co.'s magnetic plant and smelter at Pueblo, and at the zinc oxide plant at Coffeyville, Kansas. A total of 453,560 tons of ore was mined in the Leadville district.

MINERAL COUNTY

(Special Correspondence.)—The Del Monte mine is producing over 1000 tons per month now, in spite of the fact that it was supposed to have been worked out six years ago. The Amethyst is also producing about 1000 to 1200 tons per month, and the Bachelor and Commodore are shipping regularly. The Creede Mines Co. has been doing almost nothing but development work during the past year. Its properties are on the north end of the Amethyst, the Antlers-Park Regent, and the Happy Thought. Considerable milling ore has been developed. In the near future the Company will start the Humphreys mill, which has been shut down for eight or ten months. Shrive Collins, of Creede, is working the fluorspar deposit at Wagon Wheel Gap, and is shipping about three cars per week to the steel works at Pueblo. It is said that this is excellent fluorspar, containing over 90% pure in carload lots. On the whole, Creede is in a promising condition at present; better than for some time past.

Creede produced \$52,000 in gold, 790,000 oz. silver, 3,560,000 lb. lead, 35,000 lb. copper, and 510,000 lb. zinc in 1913, which is an appreciable decrease for gold and lead, but an increase for silver, copper, and zinc.

Creede, January 1.

PARK COUNTY

In 1913 the output of silver, lead, and copper increased, more than balancing an appreciable decrease in gold.

PITKIN COUNTY

The mineral output of Aspen in 1913 was 591,000 oz. silver and 16,780,000 lb. lead, an increase of 62,000 oz. and 8,370,000 lb., respectively.

ROUTT COUNTY

The Routt County Taxpayers' League, on January 3, deported seven union men and gave notice to every coal miner that he must get work or leave the county.

SUMMIT COUNTY

The output of gold from dredges and small mines at Breckenridge, in 1913, according to the U. S. Geological Survey, increased \$50,000, and gold in smelting ore from Kokomo, Breckenridge, and Montezuma showed an increase for the county of \$14,000. Silver, lead, and copper yields showed increases. The yield of zinc decreased, owing to the closing of the wet mill of the Wellington company during the latter part of the year, although the magnetic plant continued to be operated.

TELLER COUNTY (CRIPPLE CREEK)

During December the Cripple Creek district was visited by storms, and the output decreased. The following shows the estimated yield for the month:

Plants.	Tons.	Av. val.	Gross val.
Smelters, Denver and Pueblo...	3,500	\$65.00	\$ 227,500
Golden Cycle, Colorado Springs.....	25,000	20.00	500,000
Portland, Colorado Springs.....	8,500	22.00	170,000
Portland, Cripple Creek	15,000	3.00	45,000
Stratton's Independence	10,000	3.00	30,000
Colburn-Ajax	4,000	4.00	16,000
Wild Horse	1,100	4.00	4,400
Kavanagh-Jo Dandy	1,600	2.15	3,440
Gaylord-Dante	1,000	3.00	3,000
Rex	500	3.00	1,500
Isabella	450	3.00	1,350
Total	70,650		\$1,002,190

Dividends amounting to \$180,000 were paid in December. On January 1 the Golden Cycle company paid dividend No. 82, equal to \$45,000.

The Progressive Leasing & Development Co., operating the Chicken Hawk mine on Guyot hill, owned by the Katiakia Gold Mining Co., has finished sinking, and timbermen are

now at work in the station cut out at a depth of 1250 ft. from the surface. The collar of the Chicken Hawk shaft is at an elevation of 9800 ft. above sea-level. At a depth of 500 ft., on the 350-ft. level of the Eclipse shaft, the El Oro company has opened rich ore containing tellurides. Warner and party, lessees at the Ajax company's block 13, have finished their lease. It is figured that they have netted \$125,000. According to the U. S. Geological Survey, the district's gold output showed an increase of \$176,000 during 1913.

MONTANA

FERGUS COUNTY

The Barnes-King Development Co. has acquired full title to the North Moccasin property, the final payment of \$4178.40 having been made on December 24. The full price was \$150,000, and \$5000 was paid in cash when the contract for purchase was made in August 1912. The balance, \$145,000, has come out of the mine, and in the meantime important additions to the equipment and development have been made. In November the gold output was \$27,942, and for December it is estimated at \$30,000. On account of the Heinze injunction in New York, there is \$90,000 in funds tied up temporarily.

MADISON COUNTY

It is stated that representatives of a dredging company are examining ground in the vicinity of Twin Bridges.

POWELL COUNTY

There is said to be a fair amount of active work going on in the Snowshoe district, northeast of Powell.

SILVERBOW COUNTY

The new development on the Edith May vein, at 2600 ft. in the North Butte mine, is regarded as important. Ten feet of ore containing 5.5% copper has been opened on the foot-wall. Generally the mine is looking well. An official announcement has been made by the Anaconda Copper Mining Co. that after February 1 no more ores will be sent to the Boston & Montana mill; milling will be done at the Washoe concentrating plant. Only high-grade ore and concentrate will be sent to the Great Falls smelter. The mill at Great Falls has a daily capacity of 2700 tons in its six units, and the smelter about 5000 tons per day. It is 172 miles from Butte to Great Falls, and freight on ore costs 75c. per ton. These changes will result in great economy for the Company.

NEVADA

ESMERALDA COUNTY

The Goldfield Consolidated Mines Co. reports as follows for november, 1913:

Ore treated, tons	28,947
Net profit	\$170,779
Costs	
per ton.	
Stopping and development	\$3.26
Shipping expense	0.19
Dump moving	0.04
Transportation	0.09
Milling	1.78
Marketing	0.05
General expense	0.36
Bullion tax	0.15
Construction	0.01
Flood damage	0.01

Total costs

Miscellaneous earnings

Net costs

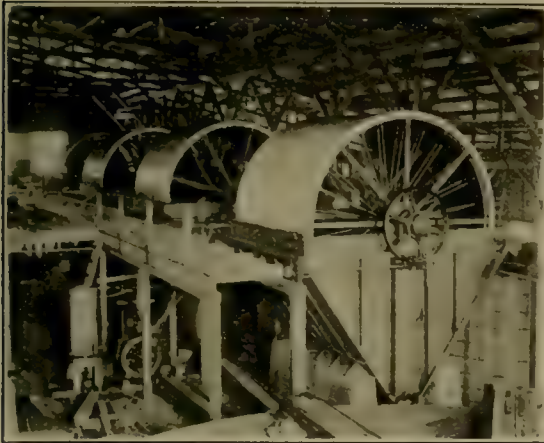
At a cost of \$4.48 per foot 2675 ft. of development was done.

CHURCHILL COUNTY

During November the Nevada Hills Company treated 421 tons of ore yielding \$38,271 or \$9.09 per ton. The net profit was \$8069. Cash on hand and in banks is \$38,556, which, with supplies, concentrate, bullion, etc., makes total resources of \$181,416. A number of inquiries have been received regarding the monthly charge of \$5000, for depreciation, shown in the full reports to newspapers. This is merely a matter of bookkeeping, being depreciation allowed in computing returns subject to tax and does not effect the actual monthly earnings, hence is not included in these monthly condensed reports. The cash on hand and in banks has not increased proportionately with the monthly earnings the last two months because of some large purchases of store supplies.

EUREKA COUNTY

The new Buckhorn mill started work on December 30, and



OLIVER FILTERS AT THE BUCKHORN MILL.

is running well. It is hoped to keep mining and milling costs down to \$2.50 per ton.

HUMBOLDT COUNTY

The Mexican Gold & Silver Mining Co., operating on the Comstock lode, has decided to invest \$145,000 at Rochester. The Rochester Mining and Rochester Weaver companies' mines will be acquired, and a large mill is to be erected, these companies supplying 100 tons per day at an agreed charge for treatment. Work has been started at the property of the Highland National Mining Co., in the Tobin district, 37 miles from Battle Mountain. In one claim a shaft has opened ore assaying 29 oz. silver and 17% lead.

LINCOLN COUNTY

Instead of timbering stoped ground in the Prince Consolidated, a caving system has been introduced, costing a total of \$1.20 per ton, including ore transport. A new schedule of railroad rates has just gone into effect.

MINERAL COUNTY

The first clean-up from the Black Eagle Gold Mining Co.'s new 20-stamp mill at Rawhide has been made. The plant has a daily capacity of 100 tons. The mine has been opened to 300 ft., and reserves total 30,000 tons of \$15 ore. Twenty-five men are employed. Work at the Aurora mill continues in spite of bad weather. The 6000-ft. adit has opened better ore than expected. The marble deposits west of Mina are being reworked. According to a report from Reno, the Iron-dyke property, near Mina, is opening well. A mill of ten 1250-lb. stamps and cyanide plant has been erected at the Iron-dyke-Bley mine by the Trent Engineering Works of Reno. A large tonnage of \$20 ore has been mined. The Oneota dis-

trict is showing a fair amount of activity of late. It is 5½ miles from Sunland on the railroad.

NVI COUNTY

(Special Correspondence.) Ten stamps are being added to the War Eagle mill. The gold and silver production of the Manhattan district in 1913 is figured at \$560,000 according to the Chamber of Mines. Of this amount the mines produced \$442,262, from 54,260 tons, an average of \$8.15 per ton. The placer workings yielded \$117,738 from 29,435 yards of gravel sluiced, an average value of \$4 per yard. The tonnage treated, and gross value of the ore milled during the year by the various mills of the camp, as nearly as can be obtained is as follows:

Mill.	Tons.	Gross value.
Associated	3,082	\$ 52,209
Manhattan	13,647	130,386
Big Four	18,294	79,668
East Side	103	1,770
War Eagle (estimated)	18,442	140,000
Shipped by White Caps company	692	38,229
Total	54,260	\$442,262

Manhattan, January 3.

STOREY COUNTY

The water in the Con. Virginia winze is 120 ft. below the 2500-ft. level.

WHITE PINE COUNTY

At the Steptoe Valley Smelting & Mining Co.'s plant, Ely, Nevada, 22 Dorr thickeners are in operation, dewatering the slime, several of these machines being 50 ft. in diameter.

NEW MEXICO

GRANT COUNTY

During 1913 the copper output of the state was about 53,671,000 lb., against 29,377,966 lb. in 1912. The most of this came from the Chino Copper Co.'s mine and mill at Santa Rita and Hurley, respectively. It is stated in New York that the Chino mill will be increased in capacity from 5000 to 10,000 tons of ore per day. Water supply has hitherto been an obstacle, but that from the Lampbright creek is expected to serve all requirements. The Lordsburg and Burro Mountain districts shipped a good deal of ore.

SOCORRO COUNTY

This county showed an increase of \$100,000 in gold and 270,000 oz. of silver during the past year over 1912. Zinc production from the Magdalena district, which is the most important in the state, increased. The total yield from all districts was 32,189 tons of 39.9% zinc ore and concentrate.

SOUTH DAKOTA

LAWRENCE COUNTY

Operations at the Wasp mine were resumed on December 28 after several weeks of idleness, the result of a temporary shortage of the water supply. The water problem was solved by sinking a well deeper. The Homestake Mining Co. will install a new hoist at Lead during the current year, and also an electric distributing plant for the Company's buildings in the town.

UTAH

BOXELDER COUNTY

Near Brigham City the British-American Petroleum Co. is drilling for oil and gas. Two rigs are in use, a Standard and a Keystone. One well is now down 1300 ft., and will be drilled to 3000 feet. Sufficient gas has been tapped to supply the town. M. C. Hagan is in charge.

JAB COUNTY

About 200 tons of 8% copper ore is being shipped from the 600 and 700-ft. levels of the Iron Blossom at Tintic. Iron ore

is not being mined at the Dragon as the United States company's smelter has plenty on hand. Lead-silver ore will be shipped as usual.

SALT LAKE COUNTY

After examining the Utah Apex mine, the sheriffs found no trace of the Mexican outlaw Lopez, who was supposed to have been killed by fume sent into the workings. In November the Ohio Copper Co.'s mill at Lark treated 66,424 tons of ore averaging 1.105% copper. Recoveries have improved lately. Costs were, mining, 28.78c.; transport, 16.04c.; and milling, 51.52c., a total of 96.32c. per ton. The month's profit was \$20,000.

SUMMIT COUNTY

On December 28 the mill, hoisting plant, assay office, and other equipment at the Daly-West mine, Park City, was destroyed by fire. This started in the boiler room, but could not be checked. The loss is \$200,000, insurance covering \$120,000. A new plant will be erected in the spring. The Thompson-Quincy mine, which is worked through the Daly-West, will be shut down for the present. Over 200 men will be out of employment.

WASHINGTON

FERRY COUNTY

(Special Correspondence).—Involuntary bankruptcy petitions have been filed by the Washington Northern Telephone & Telegraph Co. against the Republic Mines Corporation, which owes the former \$3502. The mining company owes a total of \$80,000, of which \$50,000 is unsecured. A receiver has charge of the property. The 200-ft. level of the Ben Hur mine is opening well, and 5 ft. of \$17 gold ore was recently developed. Other levels are showing good ore.

Republic, January 2.

PIERCE COUNTY

Working hours at the Tacoma smelter were increased from 9 to 10 hours on December 30, at the old rate of \$2.25. About 250 men went out on strike, but the officials state that their places are being filled.

STEVENS COUNTY

Results of small trials in smelting ore at the Copper King, at Chewelah, have been satisfactory, and the Company is considering the erection of a smelter costing between \$35,000 and \$50,000. Further tests will be made, when coke will be used instead of charcoal. A concentrating plant may also be erected. Development has been started at the Security and Amazon claims in this district.

CANADA

BRITISH COLUMBIA

Camp Hedley had an active year, according to the *Hedley Gazette*. This was mainly due to the Nickel Plate mine. The Dickson incline shaft, which is to serve as the main outlet for ores from the property, was sunk 700 ft. It is 8 by 16 ft. in the clear, and is provided with double tracks and a manway. Diamond-drilling covered 1300 ft. during 1913. The mill treated about 70,700 tons of ore, averaging \$12 per ton in gold, with 94% recovery. The total gold output to date is \$5,413,700. A considerable amount of construction was accomplished. Development was continued at the Clifton and Oregon mines.

ONTARIO

The last quarterly report of the Beaver Consolidated states that development covered 1526 ft. and stoping 1164 sq. yd. There is 30,000 tons of broken ore in the stopes. Work has been temporarily stopped on the 700 and 800-ft. levels, and one drill is operating at 600 ft. This is on account of the limited capacity of the hoist. A new engine, capable of lifting 8000 lb. from a depth of 2000 ft. at a speed of 1200 to 1800 ft. per minute, will be running by February 1. The 600-ft. level has opened well. At 460 ft. depth, the

shoot is 600 ft. long. The 6-ft. Hardinge mill installed in the plant has increased the tonnage treated. The available balance is \$134,335. During the year ended October 31, 1913, the Coniagas company produced 3,572,399 oz. of silver from 611 tons of high grade and 54,890 tons of low-grade ore. Permission has been granted to the Cobalt Lake Mining Co. to drain Cobalt lake. Work will be started at an early date. In November the Buffalo mill yielded 100,454 oz. silver from 6174 tons of ore. The sum of \$30,000 has been appropriated for developing the Buffalo property, outside of that already opened. The mill tailing is being resampled. T. R. Jones is superintendent.

At Porcupine, the McIntyre mill, in November, treated 3965 tons of ore yielding \$30,278 in gold, with 94.3% extraction. Costs were: development, \$1.72; mining, \$2.17; milling, \$1.69; and general, \$0.66; a total of \$6.24 per ton. A new tube and Hardinge mill are being installed. On the 200-ft. level of the Tough-Oakes mine, at Kirkland lake, a shoot 18 in. wide containing 65.68 oz. of gold per ton has been cut.

YUKON

The Canadian Klondyke Co.'s three dredges produced 1538 oz. gold during the last week in November. After many years of prospecting, the conglomerates opposite Quartz creek, along the Indian river, are to be opened. About 95 claims have been optioned to an American company, which will start core-drills as soon as navigation is open this spring. T. A. Fifth, of Dawson, has been acting for the owners of the claims. Telephone connection is now obtainable with Dawson from the Quartz creek district. Temperatures at Dawson on December 5 were: maximum, 5°F. below; minimum, 15°F. below zero.

KOREA

The Seoul Mining Co., operating the Suan Concession, in Whang Hai province, Korea, reports the following results for November 1913:

Stamps working	40
Time, days	26½
Ore crushed, tons	6,337
Total recovery	\$60,758
Operating expenses	25,000
Net earnings	35,758

The Oriental Consolidated Mining Co.'s mills treated 25,602 tons of ore in November, yielding \$140,059. The weather was dry and cold, and the Tabowie mill was short of water for a while. Retimbering the Tabowie mine shaft was completed.

MEXICO

JALISCO

Two hundred and fifty tons of concentrate was recently shipped by the Amparo Mining Co., in the Etzatlan district, to the Selby smelter, San Francisco. The product formerly went to the Torreon smelter. The annual report of El Favor Mining Co., the Makeever property in the Hostotipaquillo district, gives the following:

Ore shipped to smelters, tons	3,896
Value	*\$485,465
Ore milled, tons	9,213
Yield	*\$140,818
Sales by Company's store	112,500
Profit from store	17,827
Profit from all operations	359,100
Dividends in 1913	\$140,000

Ore containing 700 gm. of silver and some gold amounts to 6½ years' supply at 100 tons per day, with a large tonnage of low-grade ore. Concentrates are being sent to the Aguascalientes smelters. During the year the Southern Pacific railroad built 9 kilometres of line for the transport of ore and supplies to and from the mines.

Schools and Societies

The Geological Society of America held its twenty-sixth annual meeting at Princeton, New Jersey, on December 30. The president gave an address entitled 'Some Pioneers in Gulf Coastal Plain Geology and their Contributions to Geological Literature.' This was delivered in the house of the Nassau Club. A smoker, offered by Princeton University and resident fellows of the society, was held after the lecture.

The Mining and Metallurgical Society of America is holding its annual meeting in New York on January 13. In order to transact business there must be 50 members present in person or by proxy. An informal dinner is to be held at the Engineers' Club. At this meeting the gold medal of the Society will be awarded to Mr. and Mrs. H. C. Hoover. Arrangements for the formal presentation at some subsequent date will be duly announced. The El Paso, Texas, School of Mines project is assured of success and will be opened during next fall.

The last meeting of the New York section of the American Electrochemical Society was a joint one with the American Institute of Electrical Engineers and the New York section of the American Society of Mechanical Engineers, on January 10, in the auditorium of the Engineering Societies building, New York City. C. O. Mailloux presided. After the meeting members were the guests of the A. I. E. E. at a smoker held in the rooms of the Institute. The subject for the evening was 'The Power Problem in the Electrolytic Deposition of Metals,' and the program was as follows: 'The Limitations of the Problem,' by Lawrence Addicks, of the United States Metals Refining Co. This was a brief statement of the conditions imposed by practice in the electrolytic refining of copper as a typical process. 'The Mechanical Side of the Problem,' by H. E. Longwell, of the Westinghouse Machine Co. This was on the application of gas and steam for driving generators of the type required. 'The Electrical Side of the Problem,' by F. D. Newbury, of the Westinghouse Electric & Manufacturing Co.; a discussion of the application of various direct current and alternating current-direct current apparatus to furnish current of the required dimensions.

The UNIVERSITY of CALIFORNIA register for 1912-13, contains the following announcements for 1913-14: In the chemistry courses there are 12 professors and 14 assistants. The laboratory is well equipped for research work, and is open to properly qualified graduate students, not only throughout the college year, but also during the summer vacation. For every laboratory course in chemistry, the charge will be \$5 each half-year per credit unit of laboratory work. A student, taking only upper division courses, will not be charged for more than four units, that is, the maximum fee in such cases, exclusive of deposits covering breakages, will be \$20. There are 13 on the staff of civil engineering courses. Engineering students who wish to study irrigation, can do so in connection with the College of Civil Engineering. For mechanical and electrical engineering classes there are 11 teachers. In this department, laboratory fees are at the rate of \$5 per half-year for each laboratory or mechanical practice exercise a week. The courses cover everything connected with these subjects. Mining and metallurgy classes cover mine surveying, mining, excavation, the mining laboratory, summer class in practical work, structural metal and fuels, ore crushing, sampling, assaying, metallurgy of gold, silver, quicksilver, lead, copper, and mill work. Graduate courses cover 17 units of work per week during the first half-year, and 15 units in the second half-year; including lecture and laboratory work on ore dressing, treatment, iron and steel metallurgy, mine machinery, mill design, and mining law. In all the colleges there are 7695 students of all grades.

Personal

C. E. BUNKER is in San Francisco.

EDMUND JUESSEN has gone to Colorado.

A. C. BOYD was in New York last week.

H. FOSTER BAIN is at Jackson, California.

E. B. BRADEN has left for New York and the East.

A. E. DRUCKER is on his way from Korea to London.

W. TOYOTE has completed his work at Globe and returned to Bisbee.

JOHN H. EGGERS was down from East Rochester, Nevada, for the holidays.

E. A. LORING has been appointed manager of the Phoenix mine, Cornwall.

THOMAS F. COLE, of Duluth, president of North Butte Mining Co., has been on a visit to Butte.

THOMAS T. READ attended the meeting of the Geological Society of America at Princeton last week.

JAMES WOOD has resigned as superintendent of the Calumet & Arizona smelter to retire from active work.

F. B. FORBES left last Saturday for Nicaragua, to accept a position at the Escandalo mine, with F. A. Pellas & Company.

A. P. BUSSY, Jr., general manager for the Penn Mining Co., of Campo Seco, has been making a visit to the Arizona copper districts.

D. W. OHERN has resigned as director of the Geological Survey of Oklahoma, and C. W. SHANNON has been appointed to the position.

FREDERICK G. LASIER will be at Crescent City, Florida, during January and February, returning to Detroit, Michigan, early in March.

S. F. SHAW, superintendent for the American Smelting & Refining Co., at Charcas, San Luis Potosi, is spending the holidays at San Antonio.

H. A. GUESS has been made consulting engineer for the American Smelting & Refining Co., and will hereafter be at 165 Broadway, New York City.

WILLIAM F. JAHN is superintendent of the new mill and cyanide plant of the New York & Honduras Rosario Mining Co., at San Juancinto, Honduras, Central America.

WILLIAM MALONEY has been appointed Territorial Mine Inspector for Alaska. He will work in cooperation with SUMNER S. SMITH, of the U. S. Bureau of Mines.

D'ARCY WEATHERIE has been appointed consulting engineer for the Casey Cobalt, Cobalt Townsite, and other Canadian mines controlled by a financial group in London.

L. MAURICE COCKEREL, from Guanajuato, W. S. HARRISON, of the San Francisco del Oro, and J. LESLIE MENNELL, from Mexico City, are among the arrivals in London from Mexico.

U. A. GARRED, superintendent of construction at the Washoe Reduction Works, Anaconda, has resigned and will go to the Mount Morgan Gold Mining Co., Queensland. W. N. TANNER will succeed Mr. Garred at Anaconda.

H. M. WOLFFIN, one of the engineers of the United States Bureau of Mines, has been detailed for work in California in connection with the Industrial Accidents Commission. His work will be directed to increasing safety in the mines.

Obituary

JOHN J. CRAWFORD, former State Mineralogist of California, died suddenly of heart failure at the Key Route station, at South Berkeley, January 7.

M. A. M'CALL, for a number of years managing director of the St. John del Rey Mining Co., Ltd., died in London on December 6.

The Metal Markets

LOCAL METAL PRICES

San Francisco, January 8.

Antimony	9 — 9½c
Electrolytic copper	15½—15¾c
Pig lead	4.40—5.35
Quicksilver (flask)	\$39.50
Tin	41 — 42½c
Spelter	6½—6¾c
Zinc dust, 100 kg. zinc-lined cases, 7½ to 8c. per pound.	

EASTERN METAL MARKET

(By wire from New York.)

NEW YORK, January 7.—The copper market is weak and there is but little demand being evidenced; lead remains dull, and spelter is weak. The stock transactions on the New York Stock Exchange for the year 1913 amounted to only 83,362,639 shares, which is the smallest reported since the year 1897, when the sales totaled 77,177,132 shares. January copper is offered at 14.37½; February, March, and April, at 14.30; and electrolytic at 14.62½c. The tin market is easy with spot and January at 36.50 to 36.70. Antimony is dull, with Cookson's quoted at 7.45 to 7.60.

SILVER

Below are given the average New York quotations in cents per ounce, of fine silver.

Date	Average week ending
Jan. 1 Holiday	Nov. 25.....58.20
" 2.....57.12	Dec. 3.....67.22
" 3.....57.50	" 10.....58.25
" 4 Sunday	" 17.....57.79
" 5.....57.50	" 24.....57.77
" 6.....57.37	" 31.....57.52
" 7.....58.00	Jan. 7.....57.50

Monthly averages.

1912.	1913.	1912.	1913.
Jan. ....56.25	63.01	July ....60.67	58.70
Feb. ....59.06	61.25	Aug. ....61.32	59.32
Mch. ....58.37	57.87	Sept. ....62.95	60.53
Apr. ....59.20	59.26	Oct. ....63.16	60.83
May ....60.88	60.21	Nov. ....62.73	58.76
June ....61.29	59.03	Dec. ....63.38	57.73

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date	Average week ending
Jan. 1 Holiday	Nov. 25.....4.13
" 2.....4.15	Dec. 3.....4.15
" 3.....4.15	" 10.....4.00
" 4 Sunday	" 17.....3.90
" 5.....4.15	" 24.....4.02
" 6.....4.15	" 31.....4.15
" 7.....4.15	Jan. 7.....4.15

Monthly averages.

1912.	1913.	1912.	1913.
Jan. ....4.43	4.28	July ....4.71	4.35
Feb. ....4.03	4.23	Aug. ....4.54	4.69
Mch. ....4.07	4.32	Sept. ....5.00	4.70
Apr. ....4.20	4.36	Oct. ....5.08	4.37
May ....4.20	4.34	Nov. ....4.91	4.16
June ....4.40	4.33	Dec. ....4.20	4.02

COPPER

Quotations on copper as published in this column represent average wholesale transactions on the New York market and refer to electrolytic copper. Lake copper commands normally 1-5 to 1-4c. per lb. more. Prices are in cents per pound.

Date	Average week ending
Jan. 1 Holiday	Nov. 25.....14.62
" 2.....14.50	Dec. 3.....14.41
" 3.....14.15	" 10.....14.13
" 4 Sunday	" 17.....14.17
" 5.....14.35	" 24.....14.28
" 6.....14.32	" 31.....14.56
" 7.....14.33	Jan. 7.....14.39

Monthly averages.

1912.	1913.	1912.	1913.
Jan. ....14.09	16.54	July ....17.19	14.21
Feb. ....14.08	14.93	Aug. ....17.49	15.42
Mch. ....14.68	14.72	Sept. ....17.56	16.23
Apr. ....15.74	15.22	Oct. ....17.32	16.31
May ....16.03	15.42	Nov. ....17.31	15.08
June ....17.23	14.71	Dec. ....17.37	14.25

Owing to the "hang-over" of the advance during Christmas week, the copper market was firm at the beginning of last week and good sales were made. It was reported that several of the large sellers had no more January copper on hand.

There is a large amount of February copper still to sell, however. The rest of the week the market was inactive, waiting for the fortnightly statistics from abroad and the Producers' figures. Exports for December were 30,503 tons, as compared with 29,274 in 1912. The foreign statistics to December 30 showed an increase in stocks and the visible supply. As the Producers' figures are expected to show an increase in the stocks here, there is not likely to be much buying until after they appear.

QUICKSILVER

The primary market for quicksilver is San Francisco, California, being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending				
Dec. 11.	40.00	Dec. 21.	40.00	
" 18.	40.00	31.	40.00	
	10.00	Jan. 8.	39.50	
Monthly averages.				
1912.		1913.		
Jan.	43.75	39.37	July	43.00
Feb.	46.00	41.00	Aug.	42.50
Mch.	46.00	40.20	Sept.	42.12
Apr.	42.25	41.00	Oct.	41.50
May	41.75	40.25	Nov.	41.50
June	41.30	41.00	Dec.	39.75

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date	Average week ending
Jan. 1 Holiday	Nov. 25.....5.08
" 2.....5.25	Dec. 3.....5.00
" 3.....5.25	" 10.....5.00
" 4 Sunday	" 17.....5.15
" 5.....5.20	" 24.....5.13
" 6.....5.20	Jan. 7.....5.02
" 7.....5.20	

Monthly averages.

1912.	1913.	1912.	1913.
Jan. ....6.42	6.88	July ....7.12	6.11
Feb. ....6.50	6.13	Aug. ....6.96	5.51
Mch. ....6.57	5.94	Sept. ....7.45	5.65
Apr. ....6.63	5.52	Oct. ....7.36	5.22
May ....6.68	5.23	Nov. ....7.32	5.00
June ....6.88	5.00	Dec. ....7.09	5.07

TIN

New York prices control in the American market for tin, since the metal is almost entirely imported. San Francisco quotations average about 5c. per lb. higher. Below are given average monthly New York quotations, in cents per pound:

Monthly averages.

1912.	1913.	1912.	1913.
Jan. ....42.53	50.45	July ....44.25	40.70
Feb. ....42.96	49.07	Aug. ....45.80	41.75
Mch. ....42.58	46.95	Sept. ....48.64	42.45
Apr. ....43.92	49.00	Oct. ....50.01	40.61
May ....46.05	49.10	Nov. ....49.92	39.77
June ....45.76	45.10	Dec. ....49.80	37.57

COPPER PRODUCERS' ASSOCIATION REPORT

The Copper Producers' Association statement, January 8, shows an increase in production and stocks on hand. The details are as follows:

Stocks of marketable copper of all kinds on hand at all points in the United States, December 1, 1913..	47,929,429	
Production of marketable copper in the United States from all domestic and foreign sources during December	138,990,421	
Deliveries for consumption, December	21,938,570	
Deliveries for export, December	13,542,413	
Stock of marketable copper of all kinds on hand and at all points in the U. S., January 1.....	91,438,867	
Recent changes in surplus have been as follows, in pounds:		
	Increase.	Decrease.
December 1912.....	19,148,523	
January 1913.....	17,885,770	
February		896,134
March.....		18,032,928
April.....		28,720,162
May.....		9,074,883
June.....		14,569,619
July.....	690,330	
August.....		15,280,908
September.....		8,531,043
October.....	2,773,288	
November.....	15,363,047	
December.....	43,509,438	

The Stock Markets

SAN FRANCISCO STOCKS AND BONDS

(San Francisco Stock and Bond Exchange)

BONDS					
January 7.					
Listed.	Bid	Ask	Unlisted.	Bid	Ask
Associated Oil Co.	\$ —	99½	General Petroleum Co.	47½	—
E. I. du Pont pfd.	84	—	Natomas Dev. Co.	—	100
Unlisted.	—	—	Pac. Port. Cement Co.	99½	—
Am. Oil Co.	—	85	Santa Cruz Cement Co.	84	—
STOCKS					
Listed.	Bid	Ask	Unlisted.	Bid	Ask
Amalgamated Oil	75	76	Noble Electric Steel	—	8
Associated Oil	41½	—	Natomas Consol.	1½	—
Giant	—	87½	Riverside Cement	60	—
Pac. Cat. Borax, pfd.	85	—	Santa Cruz Cement	43	46
Pacific Crude Oil	—	35c	Stand. Port. Cement	20½	—
Sterling O. & D.	—	1½	—	—	—
Union Oil	66	—	—	—	—

NEVADA STOCKS

(By courtesy of San Francisco Stock Exchange.)

San Francisco, January 8.			
Atlanta	\$.19	Mispah Extension	\$.31
Belcher	.63	Montana-Tonopah	1.12
Belmont	7.60	Nevada Hills	.31
Big Four	.07	North Star	.38
Cash Boy	.07	Ophir	.10
Florence	.28	Pittsburg Silver Peak	.32
Goldfield Con.	1.40	Round Mountain	.45
Goldfield Oro	.08	Sierra Nevada	.09
Halifax	1.25	Tonopah Extension	1.75
Jim Butler	.79	Tonopah Merger	.62
Jumbo Extension	.15	Tonopah of Nevada	6.50
MacNamara	.09	Victor	.30
Mexican	1.15	West End	1.32
Midway	.38	Yellow Jacket	.30

COPPER SHARES—BOSTON

(By courtesy of J. C. Wilson, Mills Building.)

January 8.			
Bid	Ask	Bid	Ask
Allouez	\$.34	Nevada Con.	\$.14½
Ariz. Commercial	4½	North Butte	27½
Butte & Superior	31½	Old Dominion	50
Calumet & Arizona	63½	Osceola	75½
Calumet & Hecla	420	Quincy	60
Copper Range	36½	Shannon	6½
Daly West	2½	Superior & Boston	2½
East Butte	11½	Tamarack	28
Franklin	3	U. S. Smelting, com.	39½
Granby	73½	Utah Con.	9
Greene Cananea	30½	Winona	2½
Isla-Royale	19	Wolverine	42
Mass Copper	2		

NEW YORK CURB QUOTATIONS

(By courtesy of E. F. Hutton & Co., Kohl Building.)

January 8.			
Bid.	Ask.	Bid.	Ask.
Braden Copper	6½ 7½	Mason Valley	3½ 3½
Braden 6s	142 148	McKinley-Dar.	1 1½
B. C. Copper	2 2½	Mines Co. Am.	2 2½
Con. Cop. Mines	2½ 2½	Nipissing	7½ 8
Davis-Daly	2 2½	Ohio Copper	¾ ¾
Dolores	2 4	San Toy	15 20
El Rayo	3 5	Slouss Con.	1 2
Ely Con.	4 6	Stand. Oil of Cal.	288 292
First Nat.	3 3½	Tri Bullion	¼ ¼
Giroux	½ 1	Tuolumne	¾ ¾
Iron Blossom	1½ 1½	United Copper	¼ ¼
Kerr Lake	4½ 4½	Wetlaufer	7 8
La Rose	1½ 1½	Yukon Gold	2 2½

NEW YORK STOCK EXCHANGE

(By courtesy of J. C. Wilson, Mills Building.)

January 8.			
Bid	Ask	Bid	Ask
Amalgamated	71½ 71½	Miami	22½ 22½
Anaconda	33½ 34	Nevada Con.	14½ 14½
A. S. & R.	63½ 64	Quicksilver, com.	\$ 1½ 2
Calif. Pet.	23½ 24½	Ray Con.	18 18½
Chino	38½ 38½	Tenn. Copper	32½ 37
Guggenheim Ex.	44 44½	U. S. Steel, pfd.	107½ 107½
Inspiration	15½ 15½	U. S. Steel, com.	68½ 68½
Mexican Pet.	50½ 50½	Utah Copper	49½ 50½

LONDON QUOTATIONS

(By cable, through the courtesy of Carter & Powell.)

New York							
January 8.							
	£	s.	d.		£	s.	d.
Alaska Mexican	1	7	6	Kern River Oilfields	0	4	4
Alaska Treadwell	8	0	0	Mexico Mines	5	2	6
Alaska United	1	7	6	Messina	1	10	0
Arizona	1	17	8	Oroville	0	15	0
California Amalg.	0	1	3	Pacific Oilfields	0	1	3
California Oilfields	0	0	0	Rio Tinto	68	5	0
Camp Bird	0	12	6	Santa Gertrudis	0	16	4
El Oro	0	15	0	Stratton's	0	1	3
Esperanza	0	18	8	Tanganyika	1	17	6
Granville	0	10	0	Tomboy	1	7	6

AUSTRALASIAN

January 8.							
	£	s.	d.		£	s.	d.
British Broken Hill	1	15	0	Mount Boppy	1	15	0
Broken Hill Prop	1	15	0	Mount Elliott	1	3	9
Golden Horse-Shoe	2	13	9	Mount Lyell	0	15	0
Great Boulder Prop	0	15	0	Mount Morgan	3	2	8
Ivanhoe	2	16	9	Walhi	2	12	8
Kalgurli	1	15	0	Walhi Grand June	1	5	0

IRON ORE FROM MINNESOTA MINES

During the past year, shipments amounted to 36,195,183 tons, and with the output of other ranges the total was 50,056,247 tons, according to *The Iron Trade Review*. The following table shows the production of some of the principal mines on the Mesabi and Vermillion ranges of Minnesota:

Mine.	Tons.	Mine.	Tons.
Hull-Rust	3,457,608	Leonard	905,606
Mahoning	2,000,000	Hill	846,662
Alpena	1,409,124	Chisholm	641,854
Fayal	1,257,430	Burt-Pool	622,951
South Uno	1,202,454	Dale	621,540
Susquehanna	1,100,000	Stevenson	600,000
Genoa-Sparta	1,141,796	Hawkins	562,746
Canisteo	1,099,748	Leonidas	558,826
Adams	1,021,290	Spruce	544,887
Shenango	1,000,000	Pioneer	520,000
Commodore	1,000,000	Kinney	500,000

MINERAL OUTPUT OF JAPAN

According to statistics compiled by the Department of Agriculture and Commerce, the output during the last fiscal year was valued at \$65,120,667, an increase of \$12,155,909 compared with the previous year. The principal minerals were as follows:

Mineral.	Quantity.	Value.
Coal, tons	19,659,755	\$30,705,918
Copper, pounds	138,711,322	20,126,045
Gold, ounces	165,952	3,399,524
Iron, short tons	76,301	1,535,151
Petroleum, barrels	1,388,853	4,188,536
Silver, ounces	4,832,850	2,948,042
Sulphur, tons	60,615	686,421
Zinc ore, tons	39,364	549,063

GOLD OUTPUT OF WESTERN AUSTRALIA

During October 1913, the mines of the state produced 111,508 fine ounces, the following being some of the principal yields:

Mine.	Tons.	Yield.	Profit.
Associated	11,368	\$ 68,000	\$ 7,500
Associated Northern	1,216	21,000	4,800
Bullfinch	6,175	72,000	41,000
Great Boulder	18,006	233,000	117,000
Great Fingall	5,595	43,000	—
Kalgurli	10,875	102,000	43,000
Ivanhoe	20,712	185,000	68,000
Lake View and Star	18,982	103,000	16,000
Mountain Queen	3,775	21,000	8,800
Perseverance	21,012	102,000	7,700
South Kalgurli	9,780	49,000	24
Victorious	7,866	37,000	5,300

Current Prices for Ores and Minerals

(Corrected monthly by Atkins, Kroll & Co.)

The prices are approximate, subject to fluctuation, and to variation according to quantity, quality, and delivery required. They are quoted, except as noted, f.o.b. San Francisco. Buying prices marked *.

	Min.	Max.
Antimony ore, 50%, $\frac{1}{2}$ ton	\$18.00	\$20.00
Arsenic, white, refined, $\frac{1}{2}$ lb	0.02	0.03
Arsenic, red, refined, $\frac{1}{2}$ lb	0.08	0.08
Asbestos, chrysotile	100.00	350.00
Asbestos, amphibole	5.00	15.00
Asphaltum, refined, $\frac{1}{2}$ ton	11.50	20.00
Barium carbonate, precipitated, $\frac{1}{2}$ ton	40.00	45.00
Barium chloride, commercial, $\frac{1}{2}$ ton	40.00	42.50
Barium sulphate (barytes), prepared, $\frac{1}{2}$ ton	20.00	30.00
Bismuth ore, 15% $\frac{1}{2}$ ton	\$250.00	upward
Chrome ore, according to quality, $\frac{1}{2}$ ton	10.00	12.50
China clay, English, levigated, $\frac{1}{2}$ ton	15.00	20.00
Cobalt metal, refined, f. o. b. London, $\frac{1}{2}$ lb	2.50	
Coke, foundry, $\frac{1}{2}$ 2240 lb	15.00	20.00
Diamonds:		
Borts, according to size and quality, $\frac{1}{2}$ carat	2.00	15.00
Carbons, according to size and quality, $\frac{1}{2}$ carat	55.00	80.00
Feisepar, $\frac{1}{2}$ ton	5.00	25.00
Firebrick:		
Bauxite, $\frac{1}{2}$ M	175.00	
Magnesite, $\frac{1}{2}$ M	190.00	275.00
Silica, $\frac{1}{2}$ M	50.00	55.00
Flint pebbles for tube-mills, $\frac{1}{2}$ 2240 lb	21.00	22.50
Fluorspar, $\frac{1}{2}$ ton	10.00	15.00
Fullers earth, according to quality, $\frac{1}{2}$ ton	20.00	30.00
Gilsonite, $\frac{1}{2}$ ton	35.00	40.00
Graphite:		
Amorphous, $\frac{1}{2}$ lb	0.01	0.02
Crystalline, $\frac{1}{2}$ lb	0.04	0.13
Gypsum, $\frac{1}{2}$ ton	7.50	10.00
Infusorial earth, $\frac{1}{2}$ ton	10.00	15.00
Iridium	55.00	
Magnesite, crude, $\frac{1}{2}$ ton	5.00	7.50
Magnesite, dead calcined, $\frac{1}{2}$ ton	20.00	25.00
Magnesite, brick (see firebrick).		
Manganese ore, oxide, crude, $\frac{1}{2}$ ton	10.00	25.00
Manganese, prepared, according to quality, $\frac{1}{2}$ ton	30.00	70.00
Mica, according to size and quality, $\frac{1}{2}$ lb	0.05	0.30
Molybdenite, 95% MoS ₂ , $\frac{1}{2}$ ton	400.00	450.00
Monazite sand (5% thorium), $\frac{1}{2}$ ton	150.00	200.00
Nickel metal, refined, $\frac{1}{2}$ lb	0.45	0.60
Ochre, extra strength, levigated, $\frac{1}{2}$ 100 lb	2.00	2.50
Osmiridium, $\frac{1}{2}$ oz	25.00	
Platinum, native, crude, $\frac{1}{2}$ oz	30.00	45.00
Silex lining for tube-mills $\frac{1}{2}$ 2240 lb	35.50	37.50
Sulphur, crude, $\frac{1}{2}$ ton	20.00	25.00
Sulphur, powdered, $\frac{1}{2}$ ton	30.00	35.00
Sulphur, 80%, $\frac{1}{2}$ ton	16.50	18.00
Talc, prepared, according to quality, $\frac{1}{2}$ ton	20.00	50.00
Tin ore, 60%, $\frac{1}{2}$ ton	50.00	550.00
Tungsten ore, 65%	425.00	450.00
Uranium ore, 10% min.	25.00	per unit
Vanadium ore, 15% V ₂ O ₅ , $\frac{1}{2}$ ton	150.00	180.00
Wolframite (see tungsten ore).		
Zinc ore, 50% $\frac{1}{2}$ ton	*15.00	20.00

Current Prices for Chemicals

(Corrected monthly by Braun-Knecht-Heilmann Co.)

Prices quoted are for ordinary quantities in packages as specified. For round lots lower prices may be expected, while in smaller quantities advanced prices are ordinarily charged. Prices named are f.o.b. San Francisco and subject to fluctuation. Other conditions govern Mexican and foreign business.

	Min.	Max.
Acid, sulphuric, com'l, 66°, drums, $\frac{1}{2}$ 100 lb	\$0.85	\$1.10
Acid, sulphuric, com'l, 66°, carboy, $\frac{1}{2}$ 100 lb	1.25	1.75
Acid, sulphuric, C. P., 9-lb. bottle, bbl., $\frac{1}{2}$ lb	0.13	0.18
Acid, sulphuric, C. P., bulk, carboy, $\frac{1}{2}$ lb	0.09	0.12
Acid, muriatic, com'l, carboy, $\frac{1}{2}$ 100 lb	1.85	3.00
Acid, muriatic, C. P., 8-lb. bottle, bbl., $\frac{1}{2}$ lb	0.15	0.20
Acid, muriatic, C. P., bulk, carboy, $\frac{1}{2}$ lb	0.10	0.15
Acid, nitric, com'l, carboy, $\frac{1}{2}$ 100 lb	6.00	6.50
Acid, nitric, C. P., 7-lb. bottle, bbl., $\frac{1}{2}$ lb	0.16	0.22
Acid, nitric, C. P., bulk, carboy, $\frac{1}{2}$ lb	0.12	0.15
Argols, ground, bbl., $\frac{1}{2}$ lb	0.10	0.20
Borax, cryst. and conc., bags, $\frac{1}{2}$ 100 lb	3.00	4.35
Borax, powdered, bbl., $\frac{1}{2}$ 100 lb	3.38	4.50

*Extra charge for packing nitric acid for shipment to conform to regulations.

Borax glass, gd. 30 mesh, cases, tin lined, $\frac{1}{2}$ 100 lb	10.50	13.50
Bone ash, 80 to 80 mesh, bbl., $\frac{1}{2}$ 100 lb	6.50	6.50
Bromine, 1-lb. bottle, $\frac{1}{2}$ lb	0.55	1.00
Candles, adamantine, 14 oz., 40 sets, $\frac{1}{2}$ case	4.60	1.00
Candles, adamantine, 14 oz., 60 sets, $\frac{1}{2}$ case	5.25	5.45
Candles, Stearic, 14 oz., 40 sets, $\frac{1}{2}$ case	5.00	5.20
Candles, Stearic, 14 oz., 60 sets, $\frac{1}{2}$ case	5.70	5.90
Clay, domestic fire, sack, $\frac{1}{2}$ 100 lb	1.50	2.00
Cyanide, 98 to 100%, 100-lb. case, $\frac{1}{2}$ lb	0.18	0.22
Cyanide, 98 to 100%, 200-lb. case, $\frac{1}{2}$ lb	0.18	0.22
Cyanide, 129%, 100-lb. case, $\frac{1}{2}$ lb	0.22	0.25
Cyanide, 129%, 200-lb. case, $\frac{1}{2}$ lb	0.22	0.25
Lead acetate, brown, broken casks, $\frac{1}{2}$ 100 lb	9.00	10.50
Lead acetate, white, broken casks, $\frac{1}{2}$ 100 lb	10.50	10.75
Lead acetate, white, crystals, $\frac{1}{2}$ 100 lb	12.50	13.25
Lead, C. P., test, gran., $\frac{1}{2}$ 100 lb	13.00	15.00
Lead, C. P., sheet, $\frac{1}{2}$ 100 lb	15.00	18.00
Litharge, C. P., silver free, $\frac{1}{2}$ 100 lb	11.50	13.50
Litharge, com'l, $\frac{1}{2}$ 100 lb	8.00	9.50
Manganese ox., blk., dom. in bags, $\frac{1}{2}$ ton	20.00	25.00
Manganese ox., blk., Caucasian, in casks, $\frac{1}{2}$ ton	33.00	35.00
(85% MnO ₂ - 15% Fe)		
Nitre, double ref'd, small cryst., bbl., $\frac{1}{2}$ 100 lb	7.00	8.00
Nitre, double ref'd, granular, bbl., $\frac{1}{2}$ 100 lb	6.50	7.50
Nitre, double ref'd, powdered, bbl., $\frac{1}{2}$ 100 lb	7.25	8.00
Potassium bicarbonate, cryst., $\frac{1}{2}$ 100 lb	12.00	15.00
Potassium carbonate, calcined, $\frac{1}{2}$ 100 lb	7.50	9.00
Potassium permanganate, drum, $\frac{1}{2}$ lb	0.10	0.13
Silica, powdered, bags, $\frac{1}{2}$ lb	0.03	0.05
Soda, carbonate (ash), bbl., $\frac{1}{2}$ 100 lb	1.50	1.75
Soda, bicarbonate, bbl., $\frac{1}{2}$ 100 lb	2.00	2.50
Soda, caustic, ground, 98%, bbl., $\frac{1}{2}$ 100 lb	3.00	3.25
Soda, caustic, solid, 98%, drums, $\frac{1}{2}$ 100 lb	2.50	2.75
Zinc shavings, 850 fine, bbl., $\frac{1}{2}$ 100 lb	12.00	13.00
Zinc sheet, No. 9-18 by 84, drum, $\frac{1}{2}$ 100 lb	10.20	11.00

Company Reports

LENA GOLDFIELDS, LIMITED

This Company controls large placer deposits in Siberia, and the report covers the year ended September 30, 1913. During the year revenue amounted to £672,499, made up of £81,270 cash balance from the previous term, £378,664 from Lenskoie Gold Mines Co.'s shares sold, £178,629 from Lenskoie dividend, and £33,936 from interest and royalties. The Lena Goldfields paid £266,648 in dividends, etc., and has a cash balance at September 30 of £405,851. The Company holds 61.20% of the Lenskoie company's stock. The Lenskoie, the operating company, mined 820,189 cu. yd. of gravel, yielding 335,348 oz. gold, against 549,244 cu. yd. and 260,505 oz. gold in the previous year. The total production of the different groups of claims since the commencement of operations is 4,746,511 oz. gold, as given in the report of Charles M. Rolker. Out of 950 drill-holes, 69 average over 7 dwt. per yard. Probable reserves are as follows: stream length, 30,275 ft.; gravel content, 2,438,424 cu. yd.; total gold content, 946,230 oz.; net profit, 187,003 oz. Doubtful reserves have a stream length of 15,687 ft., containing 682,722 cu. yd. of gravel and 180,714 oz. gold, on which there would be a loss of 24,266 ounces.

YUANMI GOLD MINES, LIMITED

This Company operates the Yuanmi and Oroya Black Range mines, in the East Murchison goldfield, Western Australia. Operations during the year ended June 30, 1913 were as follows:

Yuanmi mine:	
Ore reserves, tons	71,391
Ore milled, tons	64,530
Gold recovered	\$528,000
Profit	307,000
Oroya Black Range mine:	
Ore reserves, tons	45,377
Ore milled, tons	59,680
Gold recovered	\$525,000
Profit	307,000
Dividends	212,000

Recent Publications

CARNOTITE. By THOS. F. V. CUTLER. CUTLER & HUDSON, New York, 1913. P. 26. Ill.

THE PRODUCTION OF IRON AND STEEL IN CANADA DURING 1912. By JOHN McLEISH. Department of Mines. OTTAWA, 1913. P. 39.

REPORT OF TOPOGRAPHIC AND GEOLOGIC SURVEY COMMISSION OF PENNSYLVANIA. P. 182. Ill., index. HARRISBURG, PENNSYLVANIA, 1912.

CONSIDERATIONS SUR LA COMPOSITION CHIMIQUE ET MINÉRALOGIQUE DES ROCHES ÉRUPTIVES. By E. C. ABENDANON. P. 34. The Hague, 1913.

PSYCHOLOGICAL ASPECTS OF THE PROBLEM OF ATMOSPHERIC SMOKE POLLUTION. By J. E. WALLACE WALLIN. P. 46. University of Pittsburgh, 1913.

HUDSON BAY EXPLORING EXPEDITION, 1912. By J. B. TYRRELL. Reprinted from the 22nd Report of the Ontario Bureau of Mines. P. 51. Ill., maps.

THE RED IRON ORES OF EAST TENNESSEE. By ERNEST F. BURCHARD. State Geological Survey of Tennessee, Bulletin No. 16. P. 173. Ill., maps, index.

THE GENERAL PRINCIPLES UNDERLYING METAMORPHIC PROCESSES. By JOHN JOHNSTON and PAUL NIGGLI. Reprinted from the *Journal of Geology*, 1913. P. 71.

NORMAL FAULTING IN THE CAMBRIAN OF NORTHERN PIEDMONT, VIRGINIA. By T. L. WATSON and J. H. CLINE. Bulletin of the Philosophical Society, University of Virginia, May 1913. P. 7. Ill.

THE PHENOMENA OF EQUILIBRIA BETWEEN SILICA AND THE ALKALI CARBONATES. By PAUL NIGGLI. Reprinted from the *Journal of the American Chemical Society*, November 1913. P. 34.

DRAINAGE CHANGES IN THE SHENANDOAH VALLEY REGION OF VIRGINIA. By T. L. WATSON and J. H. CLINE. Bulletin of the Philosophical Society, University of Virginia. July 1913. P. 14. Ill.

THE HYDROTHERMAL FORMATION OF SILICATES, A REVIEW. By GEORGE W. MOREY and PAUL NIGGLI. Reprinted from the *Journal of the American Chemical Society*, September 1913. P. 44. Bibliography.

PETROLOGY OF A SERIES OF IGNEOUS DIKES IN CENTRAL WESTERN VIRGINIA. By T. L. WATSON and J. H. CLINE. Reprinted from the *Bulletin of the Geological Society of America*, June 1913. P. 33. Ill.

ON THE BEHAVIOR OF COLD ACID SULPHATE SOLUTIONS OF COPPER, SILVER, AND GOLD WITH ALKALINE EXTRACTS OF METALLIC SULPHIDES. By FRANK F. GROUT. Reprinted from *Economic Geology*, August 1913. P. 26. An investigation by laboratory experiments, simulating natural conditions, of the conditions by which secondary sulphides may be deposited. The author finds that metallic gold, silver, and copper may be precipitated from acid sulphate solutions, but rarely the sulphides of the metals. From his experiments he concludes that the secondary sulphides of these metals may be precipitated from descending acid solutions in a zone where alkaline solutions predominate and the two mingle.

United States Bureau of Mines publications:

PRELIMINARY REPORT ON URANIUM, RADIUM, AND VANADIUM. By RICHARD B. MOORE and KARL L. KITHIL. Bulletin No. 70. P. 101. Ill., index.

U. S. Geological Survey publications:

ADVANCE CHAPTERS FROM 'MINERAL RESOURCES OF THE UNITED STATES, 1912.' Washington, 1913:

PRODUCTION OF ZINC AND CADMIUM IN 1912. By C. E. SIEBENTHAL. P. 53.

PRODUCTION OF LEAD IN 1912. By C. E. SIEBENTHAL. P. 42.

THE STONE INDUSTRY OF 1912. By ERNEST F. BURCHARD. P. 112. Maps.

OFFICIAL YEAR-BOOK OF THE COMMONWEALTH OF AUSTRALIA.

Compiled by G. H. KNIBBS. No. 6, 1913. P. 1236. Ill. maps, charts, index. Commonwealth Bureau of Census and Statistics, Melbourne, Victoria. This is a valuable publication containing authoritative statistics for the period 1901 to 1912, inclusive, and corrected figures for the period 1788 to 1900. It is not merely a record of statistics in tabulated form but contains a considerable amount of interesting details of everything connected with the work of 1,800,000 people on an area of 2,974,581 square miles, mining being well covered. The price of this book, including postage and duty, is about \$1.75.

Decisions Relating to Mining

OIL LEASE—NO FORFEITURE CLAUSE

An oil and gas lease binding the lessee to drill a well on the leased premises within a certain period, or in lieu thereof make periodical payments of rental or delay money, and containing no clause of forfeiture, is not forfeitable merely by non-payment of the rental. It can be terminated only by surrender, abandonment, or expiration of the lease.

Reserve Gas Co. v. Carbon Black Mfg. Co. (West Virginia), 79 Southeastern, 1002. September 30, 1913.

OIL LANDS—INJUNCTION DENIED

Where in an action to enjoin defendants from operating for oil on land, it appeared that they had been in undisputed possession for a number of years, had drilled a number of wells, built tanks, established pipe-lines, and produced large quantities of oil, a preliminary injunction was properly dissolved.

Ingram v. Bream (Pennsylvania), 88 Atlantic, 880. June 27, 1913.

COAL LANDS—SUIT FOR RESCISSION OF SALE

The grantee of coal in place under a deed conveying all the coal in a tract of land cannot rescind the sale merely because the coal area in the land is not as large as he had expected to obtain or because a particular vein which he had expected to find there was missing, but he may retain a repayment of so much of the purchase price as equals the value of any shortage in the acreage contracted for.

Light v. Grant & Co. (West Virginia), 79 Southeastern, 1011.

SOAPSTONE LEDGE—NO ADVERSE POSSESSION

A grant to 'G and his assigns' of the right to mine minerals created only a life estate in the grantee. One accepting possession of land under a deed reserving the mineral rights above granted could not establish adverse possession to the soapstone ledge involved by merely building a fence around the entire tract, as such act was not in itself adverse to the mineral grantee.

White v. Shippee (Massachusetts), 102 Northwestern, 948. October 22, 1913.

DAMAGES FOR UNLAWFUL REMOVAL OF COAL

The measure of damages for a surface tenant's unauthorized mining of coal is the value of the coal in place, where there is evidence to show such value, and not its value at the pit's mouth. Where the mine is immediately available for operation and there is a present market, such value is the royalty value, otherwise value in its natural state. Treble damages should not be awarded where the coal was removed by mistake, honestly or unintentionally made.

Trustees v. Lehigh Valley Coal Co. (Pennsylvania), 88 Atlantic, 768. June 27, 1913.

To the same effect see:

Stark v. Pennsylvania Coal Co. (Pennsylvania), 88 Atlantic, 770. June 27, 1913.

Belt Conveyors

The use of these is extending in every branch of mining and metallurgy. These include the handling of ore underground, from crushers to ore-bins, from bins to various types of grinding machines, disposing of mill residue on high dumps, stacking dredge tailing, and handling coal and any material necessary, where other conveying machinery is not suitable. The wear and tear on belts in some works is extremely heavy, and only the best rubber construction will stand it.

The accompanying photograph shows a 'Longlife' conveyor-belt built by the B. F. Goodrich Co., at Akron, Ohio. This belt, which is to be used in handling coal, is 1322½ ft. long and 36 in. wide. It is of 7-ply construction, with a 3/16-in. top rubber cover, and weighs over 14,000 lb. net. In order to handle it during shipment, it was necessary to divide it into two parts, but it will be used on one conveyor. The Goodrich factory is the largest of its kind in the world, and its belt room is likewise the greatest in size and capacity. Transmission, elevator, and conveyor-belts, ranging from the



A 14,000-LB. BELT.

smallest transmission to 72-in. conveyors, can be turned out at the rate of approximately four miles per day. This great production has enabled the Goodrich factory to effect many manufacturing economies, and to offer service which has been the subject of much favorable comment. Shipments are being made constantly to all parts of the world, and Goodrich belts, especially 'Longlife' conveyor, are to be found in mines and plants everywhere.

Mine-Rescue Telephones

One of the important additions to the work which is being conducted to bring about safety for mine workers has been the perfection of a mine rescue telephone equipment. Rescue crews, although equipped with oxygen helmets and various safety appliances, have heretofore been considerably hampered in their work by the lack of means of communication with the outside of the mine. The mine rescue telephone equipment manufactured by the Western Electric Co. consists of a transmitter which is arranged to fit the throat of the helmet man, thus permitting of the transmission of the sound waves through the walls of the throat, as the mouth is needed for breathing the oxygen. A head receiver is also furnished, the combination of receiver and transmitter being held in place by a light but serviceable leather harness. The helmet man also carries one or more coils of wire, which connect to the telephone at the mouth of the mine. This wire pays out as the rescue gang advances. The advent of mine-rescue telephones in safety work is an important step forward and a much larger use is anticipated in the future.

Commercial Paragraphs

The Westinghouse Electric & Manufacturing Co. has undertaken a number of contracts during the past year for hydro-electric development in Alaska. The most important of these is the new generating unit for the Alaska Treadwell Gold Mining Co. to be installed in the Nugget Creek Development. This unit will consist of a 2350-kva. water-wheel generator driven by a Pelton water-wheel running at 300 revolutions per minute, and will give the mining company about 3000 additional horse-power. A 50-kw. motor generator exciter set with special shaft so that the unit may be driven by water-wheel when desired, is also included. A contract has also been recently closed for a 300-kva. water-wheel generator to be installed by the Chichagoff Mining Co. near Sitka. This generator will be used to supplement the Company's present installation, which is 127½ kw. With the generator in question there were also ordered the necessary step-up and step-down transformers for transmitting the energy at high voltage from the power plant to the mines. During the summer the Kennecott Mines Co., operating one of the highest grade copper mines in the world, in the Copper River district, purchased a 200-kva. water-wheel generator, together with all the necessary switch-board and accessories. This water power-plant will supplement a steam driven power-plant now being operated by the Company. A considerable number of electric motors for mining and milling operations were purchased with the above generators. In addition to the above, the Alaska Juneau Gold Mining Co. of Juneau, Alaska, recently purchased from the Westinghouse Electric & Manufacturing Co. a 1012-kva. water-wheel generator to be driven by a Pelton wheel, the energy from which will be used to supplement that of a 937-kva. steam turbine.

Catalogues Received

CHICAGO PNEUMATIC TOOL CO., Chicago, Illinois. Bulletin No. 149. 'Chicago Portable Mine Hoist.' 8 pages. 6 by 9 inches. Illustrated.

ALBERGER PUMP AND CONDENSER CO., Newburgh, New York. Bulletin No. 18. 'Alberger Spiroflo Surface Condensers.' 32 pages. 6 by 9 inches. Illustrated. This deals with the 'Spiroflo' condenser, rotative dry air pumps, 'hydroflo' pumps circulating pumps, and cooling towers.

INGERSOLL-RAND CO., New York. Form 672. 'Story of the Imperial.' 9 by 12 inches. Illustrated. This attractive publication describes the main points in design and construction in the 'Imperial' air-compressors. Those using, or about to use compressors should study this valuable book.

DODGE MANUFACTURING CO., Mishawaka, Indiana. Catalogue 106-A 14. 'Power Transmission Machinery.' 98 pages. 6 by 9 inches. Illustrated. This is an interesting publication, covering such information as horse-power of shafting, key seating, inconsiderable detail, flange couplings, hangers and bearings, ring-oiling pillow blocks, tighteners, friction clutches, Dodge wood-split pulleys, iron-split pulleys, gears, ropes, and belts. Prices are also given for each article mentioned.

NEW YORK ENGINEERING CO., New York. Catalogue 'G.' 'Empire Prospecting Drill.' 46 pages. 7 by 10 inches. Illustrated. Increased attention is being paid to gravel deposits containing gold and tin in remote parts of the world, and a handy prospecting drill is a prime necessity. This handsome publication, besides giving details of the machine, illustrates their use in Canada, Korea, Colombia, Cornwall, Brazil, Siberia, Manchuria, Russia, and the Philippines. There are also descriptions of the pulling level, casing pulling jack, drilling winch, casing, cleaning bedrock, and a clean-up and assay outfit. A few pages are devoted to dredges and mechanical elevators.

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EDITORIAL

IN spite of the statement made by the President some time ago to the effect that no movement would be made by the army or navy which would convey the impression that preparation was being made for hostilities in Mexico, and regardless of the fact that the permission granted by the Mexican government for American warships to remain in Mexican waters expired some time ago, there are fifteen warships off the Mexican coast and a fair sized army encamped along the Rio Grande.

SAFETY first has found a new expression in Nevada through the passage of a law, which went into effect the first of the year, prohibiting the employment of men in and about mines who cannot speak or understand the English language. An industrial safety conference has also been organized for promoting the safety first movement, which will convene at Reno on January 26 and 27. The Governor, Mr. Tasker L. Oddie, will preside at the conference and a number of papers have been prepared which will treat the various phases of the movement.

ANNOUNCEMENT is made of the appointment of Mr. R. W. Brock to the position of Deputy Minister of Mines for Canada, a position in which he succeeds Mr. A. P. Low, for whom he has been acting some years. This is an eminently fitting recognition of good work not only in geology but administration, and Canadian mining men are to be congratulated on having so able and sympathetic a representative in this high position. Under the form of government obtaining in Canada the Deputy Minister is a non-political permanent officer. As such he becomes the technical adviser of each succeeding Minister. Mr. Brock will have charge of both the Geological Survey, of which he is director, and the Mines Branch of the Department of Mines.

ARRIVAL of the steamship, or more properly the motor ship, *Siam* in San Francisco recently marks the advent of a new type of marine boat in these waters. Equipped with modern Diesel type engines, this 13,000-ton freighter, using 20 tons of oil per day in its internal-combustion engines, and with a sailing radius of two months, has demonstrated the wide adaptability of crude oil fuel to marine purposes. The sixteen cylinders of the *Siam* power-plant develop 3200 horse-power at a fuel cost of about two cents per horse-

power day, which is in marked contrast with the eight and ten-cent costs of the boiler and steam engine type of ships. The cargo capacity is also increased by 15 to 20 per cent because of the space saved in boiler rooms and coal bunkers, and this is reflected in lower operating charges.

DETAILS of the world's production of gold and silver for the calendar year 1912, as compiled by Mr. George E. Roberts, director of the Mint at Washington, are presented on another page of the current issue. In the production of gold the Transvaal, as usual, takes first place with a production valued at \$188,293,100; the United States ranks second with a production of \$93,451,500; and Australasia third with a production of \$54,509,400. In the production of silver, Mexico stands first, regardless of the handicap under which mining has been conducted, the output being 74,640,300 ounces. The United States is second with a production of 63,766,800 ounces, and Canada third with a production of 31,625,451 ounces. The world's production of gold was valued at \$466,136,100, while the silver output amounted to 224,310,654 ounces.

ARGUMENT in the Kennedy Extension-Argonaut case was heard at Jackson, California, last week, and upon completion of the record by the stenographer, will be formally submitted to the court for judgment. Interesting as the case is, we forbear comment at this time, the matter being still before the court. We may say, however, that the differences of opinion, as reflected in the arguments of Messrs. G. O. Perry and Frank Zelinsky for the plaintiff and C. H. Lindley for the defendant, relate mainly to the facts. There was practically no controversy as to the law, and only one point of general interest, that is the presumptions allowable from patent issued under the law of 1871 in cases where the location itself was long anterior and allegations in the patent brief. As to the facts, the differences related to the integrity of the apices of the Pioneer and the Jackson veins and their continuity and identity in depth. The question of most general interest to geologists is whether the Mother Lode represents, as previously held by Mr. F. L. Ransome, and as maintained by Messrs. A. C. Lawson, Walter Wiley, and Fred Searls, a thrust fault, or whether Messrs. J. W. Finch and R. D. George are correct in inferring a large normal fault. Of this we shall speak later.

GAS and oil engines as economic sources of power are becoming more universally recognized and their various applications, from turning the farmer's grindstone to the propeller shaft of 10,000-ton freighters, evidence their wide range of adaptability. In Montana the economy of hydro-electric power and the futility of steam-power competition when hydro-electric is available has been proved by experience, and the electrification of a number of the railroads and most of the mines is now under way. Our Butte correspondent points out the tendency toward the development of

electric power from gas engine power-plants at the coal mines. Under some conditions electricity is cheaper to transport than coal, and the thermal efficiency of the internal-combustion engine is far greater than that of the coal-fired boiler and steam engine. There can be little doubt that a large field exists for central power stations in the coalfields, though the proper limits for such practice are not yet determined. It is even possible that the prediction that the Miocene lignites of western Montana will supply power throughout the state may some day be fulfilled, though this is not probable at present. The use of producer gas in Western Australia is recorded in the current edition, and in other parts of the world its success has been amply attested.

California Miners and Workmen's Compensation

Workingmen's compensation acts have been recently passed in a number of states and, along with the financial adjustment now under way throughout the world, employers are being called upon to reorganize their business upon a new basis with difficulties as great as a general increase in wages. However much we may approve the general principle that each industry should amply provide for its own killed and injured, and the *Mining and Scientific Press* does heartily approve that principle, no one can blink the fact that an increased expenditure equivalent to 27½ cents per day per worker and amounting yearly to 12¾ per cent of the capital of the employing company, these being figures from an actual case, calls for serious question. It is possible that this heavy tax on industry is necessary, and that corresponding benefits will be realized, but we are frank to say that we doubt it, and in any event it will require a complete recasting of wage scales and other elements of cost, with such readjustment of prices as may be possible. The particular illustration taken is that of a gold mine in California. In another case a company which is not yet 'out of the woods' in the payment for its property, must face an immediate increase of payroll of about \$400 per month. Such figures warrant one in pausing to inquire whether our sympathies have by chance outrun our business sense, or whether our employers are being unfairly treated by the insurance companies.

The English compensation act has long been held up as a general model. Figures carefully compiled by a competent commission in Illinois showed that for a term of years all workmen injured in that state might have received compensation under the terms of the law, and yet the total paid would have been no greater than the cost of the old indemnity insurance. Under this condition it was manifestly good sense and good business to pay the money to the workmen rather than expend it on agents' fees and litigation. In the various Australian states there are stringent compensation laws. They must be satisfactory to the laboring men, as they were enacted by labor governments; yet at one large mine in New South Wales, where figures are avail-

able, the cost of insurance is only $1\frac{1}{2}$ per cent of the payroll. In Nevada, where a new law is in operation, the basal rate in mining is $2\frac{1}{2}$ and the maximum is 3 per cent. In California the basal rate is 7.86 and in certain kinds of mines 9.80. The lowest mining rate scheduled in California, that for prospecting, is 6.75. It is true that private insurance companies have, in some cases, allowed separate classification of surface men in such manner as to bring the average down to 5 per cent, but even this is out of all proportion to rates paid elsewhere. In other schedules than mining there are similar rates which on their face seem absurdly high, and which will require much argument to justify. The schedules are inconsistent: for example, why should iron mining take a rate of 9.80 and copper mining 7.86? Both are too high, but why are they different?

When the California law was enacted it was part of the plan to insure reasonable rates by having the state itself undertake to carry insurance at cost. In practice something seems to have gone wrong. The total amount of the insurance fund placed at the disposal of the Industrial Accident Commission, which must administer this law, was \$100,000. Premiums to the amount of \$200,000 were reported to have been collected in the first ten days, but clearly an insurance company working on so small a capital is not a serious factor in the situation and its effect on rates is not yet apparent. At first the state refused to accept any individual mining risk of more than \$15,000. Later it was cut to \$10,000. Insurance to that amount is not much comfort to a manager who must face unlimited liability. Few companies would be forced into bankruptcy by a loss of \$10,000 or \$15,000, but many California companies might well be put out of business by a single accident, even after having paid the state premiums upon the total amount of the insurance that the latter will accept. In other words, the mining companies are forced at present to deal with private insurance companies regardless of cost. Only a concern with a large surplus can afford to carry its own risk. We do not believe that this condition can or will last. The harvest of agents' commissions in the past few weeks has attracted attention throughout the insurance world and there will undoubtedly be increased competition for the California business. We know already of one large London company which is investigating the field.

The reason urged for the high rates in California is that the liability is unlimited. A man totally injured is to receive a pension for life, and in similar details there is a large and unmeasured risk not met under the laws of other states. There should be some way to meet this situation. It is always possible to commute an annuity, and a way will doubtless be found to convert into lump sum settlements these contingent risks. In Nevada the maximum individual payment is \$5000, and we see no reason why more should be paid in California. If the workman wants more insurance he

can buy it at current rates for himself. California industries do not stand alone. In gold mining the selling price cannot be raised, and in cement making and other competitive industries it is equally impossible for the operators in one state to raise their prices generally. All that can be done by the manager facing such a situation is to raise the price to the limit in his non-competitive territory, which is that nearest his own works. If the rates now quoted are really the best warranted under the law, the latter should be promptly modified, since protection ample elsewhere is certainly sufficient in California.

In New York there has recently been enacted a law which is hailed by Mr. Samuel Gompers as the best yet put on the statute book. It also meets the approval of so sturdy a champion of capital as the *New York Sun*, and those who are responsible for it seem to have accomplished the difficult task of pleasing both sides. It is possible that the pleasure may be more one-sided after the law has been subjected to a test in the courts. The measure provides for the usual commission, but gives it the unusual power of bringing suit, at state expense, against any employer who does not pay the compensation due. The employee is debarred from bringing suit. The employer may insure himself with the state, or some company, may join in forming a mutual association, or may, where his resources are ample, carry his own risk. An injured employee, after a waiting period of two weeks, receives two-thirds wages. In the case of permanent partial disability he receives two-thirds the amount in wages lost as a result of the injury. The widow of a man killed receives 30 per cent of his wages during her widowhood, with 10 per cent additional for each child under 18 years of age, the total not to exceed $66\frac{2}{3}$ per cent. This law is cited to indicate that the California plan is not necessarily the only satisfactory one.

In commenting on the situation faced by California mine managers, we would not be understood as criticizing the commission charged with the administration of the law. As business men its members cannot assume risks beyond those warranted by the capital advanced by the state, and we have no doubt that they will use every proper effort to secure as low rates as may be possible. We commend unreservedly their action in organizing the safety department. A determined effort has been made to get the best men available, and for the mining work, the United States Bureau of Mines has, by request, detailed Mr. H. M. Wolfen, a capable and experienced mining engineer. This is the more commendable since in certain other branches of the state's activities politics has been permitted to dictate appointments as our readers know. Also the exemption of farmers from the provisions of so general and so sweeping a compensation act as that of California, is a transparent appeal to political favor. We are entirely unable to see why a man is less dead when killed by falling off a haystack than down a winze, or how his widow is less of a problem.

What is the Matter With Prospecting?—II

A SYMPOSIUM

In the annual review number we published a number of letters received in response to the inquiry sent to many of our friends prominent in mining circles, regarding the evident lack of interest in prospects and the apparent dearth of funds available for prospecting purposes. We find the mining fraternity is greatly interested in this subject and take pleasure in presenting this series of extracts from the numerous letters which have been received.

R. Gilman Brown:—I cannot speak for conditions in the United States, but so far as London goes there are several venture companies here who devote a good deal of expense to developing prospects. As to finding prospects, that is a difficult matter for a company to embark in; at the same time I know of more than one London syndicate that has sent out men into promising regions. Looking at this from another angle, there are several companies in England owning large tracts of country abroad, supposed to be mineralized, that have been successful in carrying on organized and scientific prospecting within their areas, maintaining specifically a geological and prospecting staff for this purpose. I can cite the Ashanti Goldfields as one of these companies, whose prospecting work, under the scientific management of Mr. Justice, has already resulted in the discovery of Justice's Find. The Kyshtim Corporation, under American geologists has been doing the same work successfully in the Middle Urals, Russia; and the Tanalyk Corporation has been working on similar lines in the Southern Urals. All of the above companies, and I think most companies of this class, have had as a basis, discovered mines which they were either developing or operating. I rather tend to the belief that in order to justify the risking of capital in prospecting work, the general control of it should be under a trained geologist. This does not eliminate the prospector, but merely puts a man over him. I do not believe in direct government aid for anything: indirect aid could perhaps be supplied by opportunities to take up prospecting licenses in certain areas on liberal terms as to the ground that can be acquired under them, and with suitable provisions to prevent large areas of ground being held and not prospected. I am strongly of opinion that prospecting methods can be vastly improved, waste work eliminated, and fewer good opportunities lost, by expert geological control. If by "undeveloped mineral lands" you mean lands on which promising surface indications have been found, but little more than trenching doffe, I would say that here again the practical geologist comes in, and so far as my own companies go we have not hesitated to spend money in investigations when our geologist in charge has given favorable reports. In general, it seems to me evident, that as the more easily recogniza-

ble and more accessible deposits are found, prospecting work is bound to become more expensive, involving shaft-sinking, drilling, etc., and that consequently the scope for the 'grubstake prospector' is being limited.

L. S. Cates:—During recent years two conditions have arisen which I think will answer practically all of your questions: The first is, the change in the class of men who are following the mining business. The old time prospector, such as was in existence twenty years ago, is almost a thing of the past. There are very few men who have the disposition which will allow them to isolate themselves from civilization and endure the hardships which are necessary to those who enter unexplored portions of our mining territory. This may be caused by the change in the early education of the present generation, or from the fact that employment is so easily obtained by those who desire to follow the mining profession. At the present time there are so many large camps developed that a man can usually obtain employment very easily, whereas, in the past when there were only a few camps it became profitable and necessary during certain portions of the year for a man to devote a portion of his time in prospecting. Personally, I do not think there is any ground for the statement that there is no money available for grub-stake. The real trouble lies, as has been mentioned before, in the fact that it is hard to find men who will conscientiously and intelligently spend time and money in looking for new mines. The second condition, which has arisen during recent times, is the appearance of the unscrupulous mine-promoter. There is hardly a city or town in the United States which has not been visited by this character. In a great many instances, he knows nothing regarding mining and spends a major portion of his time traveling from one town to another selling cheap mining stocks and putting ridiculous advertisements in the papers, in an attempt to further their unworthy endeavors. This has been going on for such a long time, and so many people have been fraudulently deceived into placing their earnings in these wild-cat adventures, that the public at large is being gradually educated and looks askance when one mentions the subject of mining investments. I must admit that a great many excellent properties have been developed from prospects to productive mines in this manner, but the majority of the money raised has been ruthlessly squandered. Another reason why undeveloped claims are not attractive is because the larger interests prefer to pay a large sum for a developed property than to take a prospect and endeavor to make a mine from it. However, I think eventually this policy will have to be changed. Owing to the old prospector being a thing of the past and the small investor refusing to assist in

the development of the minor properties, it will become necessary for the larger interests to organize and maintain exploration departments, but just how long it will be before this condition will materialize is problematical.

John Wellington Finch:—I do not find it true that money is no longer available for developing prospects. I am at the present time engaged in the supervision of the development of a number of prospects which are being opened up under lease and bond arrangements by experienced mining people. It is true, however, that none of the operators with whom I am associated consider it wise to expend money for finding prospects. Perhaps they are guided to some extent by my advice in this matter. Additional money for such purposes is becoming available automatically, because there is an increasing number of owners of prospects who are willing to share the chances of exploitation with the purchaser by offering their properties under reasonable terms as to time and payments. I do believe in Government aid to prospecting and prospectors. I think this aid can best be given by allowing them the freedom of the public domain for their explorations and by eliminating all unreasonable obstructions. Prospecting methods are, in my opinion, all right as they are. The natural person to discover new mineral deposits is the man who can subsist simply and who has the physical endurance and patience to wander for long periods of time in remote places. Such a man is usually a miner and not an engineer. He is bound to locate valueless deposits along with the occasional deposits of prospective merit, but he does sufficient work upon the latter so that the man of higher training and more fastidious physical requirements may find a sufficient basis eventually to interest the capital which he represents. At the present time very little actual prospecting is being done because the prospecting miner has been so mystified by the restrictions placed upon him by some of the governmental bureaus that he is reluctant to expend his efforts in searching for that which he afterward may find he is not allowed to possess as he did in former times, when he was permitted to explore upon all lands owned by the Government. The chief trouble with the restrictions and supervision now imposed by the Government is, it seems to me, not so much that the supervision is improper but that it is not uniform, nor is it clearly defined. Prospecting would, I believe, be gradually resumed if the prospector could clearly comprehend the regulations under which he must act and could feel sure that mineral locations would not be taken from him by the whim of individual Government agents not technically qualified to pass upon the merits of the location. I consider the market for undeveloped mineral lands to be good, on the whole. The development of new coal areas is, of course, not likely to be undertaken until capital can be satisfied that it will be allowed to work tracts of sufficient size to give the enterprise long enough life to make it attractive. Nor

will new coal lands be worked under the leasing system until the commercial possibilities in it, from the point of view of the lessee, can be clearly calculated. In metal mining, I feel quite optimistic concerning the proper future development of promising prospects. The great mining corporations and syndicates are concentrating their attention upon thoroughly developed properties. The promoter, who was once the intermediary between the prospector and capital, is not now able successfully to present prospects to these concerns. Moreover, the prosecutions by the Department of Justice have curtailed the activities of the unscrupulous promoter in the use of the mails. This form of promotion has been the chief cause of exorbitant prices for prospects. In several instances with which I have been familiar in the past year, enterprising small mining companies have been able to acquire prospects on businesslike terms whereby the original owner and the purchaser became joint owners in such a way that a successful outcome of development would inure to the benefit of both.

G. W. Metcalfe:—In my opinion, the money available for finding and developing prospects is strictly proportionate to the probability of making a profit from such investment. This particular district, Shasta county, California, is largely a copper district. Even when a promising copper prospect is found, it takes a large amount of money to develop it to the point at which it is possible to determine its value. In addition to the ordinary risk in prospecting, the prospector also has to consider that if he finds a copper mine of sufficient magnitude to justify the construction of a smelter, the present attitude of the Legislature and of many agriculturists is decidedly inimical toward allowing him to operate such a smelter if the slightest indication can be found of any effect from his smelter fumes on vegetation, even although such effect does not amount to material damage. This consideration has been extremely discouraging to copper prospecting in this district. Another difficulty in this district is the fact that a large quantity of land in the copper belt is the property of the Southern Pacific Railroad. The prospector is likely to find, in case he discovers a mine, that it is on railroad land and that there is no way in which he can obtain any advantage from his discovery. In general, I think the only way that more money can be made available for prospecting is for conditions to change so that the probable returns from such investment would be larger than at present. I do not believe in government aid to prospecting and prospectors in any very radically different way from that in which such aid is now being supplied; that is to say, the government has made and is making a geological survey of the country, which survey, when completed, will give much information as to where it is reasonable to look for mineral deposits. The state government of this and other states maintains mining schools in which embryo mining engineers are given the training which should enable them most readily to

take advantage of the further lessons they will receive from experience. These and similar activities on the part of the government are perfectly proper and very valuable. The available funds for prospecting appear to be adequate; that is to say, the inducement at present for prospecting appears to be great enough, so that sufficient supplies of the valuable metals are discovered to supply the world's needs. If the possible metal famine actually comes to pass, the price of metals will naturally rise to the point at which greater returns can reasonably be expected from an investment in prospecting or mining. When this occurs, there will be a greater inducement than at present for the investing of time or money in prospecting work, with the natural effect that more mines will be found and developed and the metal famine will be a thing of the past.

E. H. Nutter:—The nomadic prospector, with his shovel, pick, pan, and a sack of grub, on a burro, is largely of the past. Can he be revived, and is it worth doing? I think not. This old-time prospector, who found most, if not all, of the productive districts, was, I think, always animated by the hope of 'striking it rich'; that is, he was on the lookout for rich surface ores of gold, silver, lead, or copper that would pay for burro-back transportation, or reduction by the sluice, arrastre, or other primitive device, hoping, as well, to find something that he might sell at a good price. Spurred by this hope, he did a great deal of burrowing or gophering in likely looking places. A large part of his effort was wasted; the rest opened up or drew attention to the mines or districts that have become productive, and which attracted capital or produced their own capital. The Klondike excitement drew off a large part of this type of prospector from the older districts and started the condition in them to which your letter draws attention. Except perhaps in British Columbia and other parts of Canada, the continent has been pretty well prospected, and the chances for a prospector of the old type to find rich surface ore or alluvial gold are slimmer than they ever were. In consequence, he is disappearing for lack of subsistence; he cannot make even his modest living, rent-free and tax-free though it is, and a 'grubstake' is not so easy to get now, and fails to satisfy as it once did. So far as my experience with the capitalist goes, he is willing to put up money when there is a good chance of seeing it come back again leading some more with it. He relies more and more on his engineer's advice, if he is not himself an engineer. In general, probably more is lost than gained from putting money into the exploration and development of mere prospects; also, the owner thereof usually asks more than they are worth. There are certain classes of investors, however, who look to mining or collateral branches for investment possibilities rather than to other industries, and any dearth of conservative opportunities along this line will undoubtedly make available more funds for exploration and develop-

ment. It seems probable, however, that these funds in the future will be spent more and more by men working on salary for others. Their prospecting, too, will be guided more and more by geological considerations. It will be more sanely done, and probably will yield a higher average of profitable returns than did the aggregate work of the old-timer. As to government aid, I do not believe in it for prospecting any more than for manufacturing. While some mineral deposits might be developed earlier thereby than in the natural course of events, I think that on balance there would be greater economic loss than gain. Let the government give us just and adequate laws, continue its geological and police work, and leave the mining industry to work out its own problems.

E. G. Spilsbury:—Unquestionably, the spirit of venture which formerly exhibited itself in the outfitting and staking of the old time prospector and sent him into unknown and unexplored territory has practically died with the incentive. Such terra-incognita no longer exists. On the other hand, money is still to be obtained for the development of claims, when sufficient inducement is offered by the owner of these undeveloped claims. The only way increased capital is likely to be attracted to undeveloped properties, would be by means of a well organized propaganda, publishing reliable and accurate information regarding successful ventures along this line. I do not believe in government direct aid to prospecting for minerals any more than I would advocate that the settler on public lands be subsidized by the government to clear and prepare his land and determine what crops it was good for. On the other hand, increased efforts by the U. S. Geological Survey to give accurate information regarding the geology and mineralization of territory not already thoroughly prospected would, when published, furnish an incentive to careful prospecting by trained men sent out by capital for the purpose. The Survey ought to be the pioneer and not the trailer on behind. For unprospected mineral lands there is no market; and there cannot well be one, as there is nothing tangible to offer to capital—not even a title. On the other hand, after mineral has been discovered, the given claims located, and the locator has something to offer, there is always capital available to carry on the development to a point where commercial success can be predicated provided the original discoverer or prospector is willing to share with capital not only the eventual profits, but also the risks which may attend the attaining of these profits. For instance, supposing a prospector has spent a year in a given field and has discovered mineral which he thinks is worth developing. His expenses during the year have been say \$1000; his outfit may have cost him \$500; his time calculated liberally at \$4 a day would amount to say \$1500 more; his investment therefore would be in all \$3000. Now if the investor comes in and furnishes the same amount, he ought to do so only on becoming a partner to the extent of a half interest. When that amount has been spent on

development a reappraisal of values should be made, and if further capital is required it should be offered the same proportionate advantages. If some such general plan of co-operation were made public and thoroughly understood I think it would prove a great incentive to the development of simple prospects. The reason why capital is apparently so difficult to obtain by prospectors lies in the fact that the owner of the prospect generally wants to realize an unearned profit before he is willing to accept capital on the same basis as his own investment.

Vice President of a large exploration company writes as follows:—A large amount of money is being used continually for finding and developing prospects. As to the adequacy of the amount it is extremely difficult to judge. The facts seem to warrant the belief that the surface deposits and the more easily found rich mines have been discovered; and that, therefore, prospecting for and finding new mines costs materially greater sums than in the past and also necessitates a somewhat wider vision, as the big new mines that have recently been found are mines in which, what is now (through the advance of mining and metallurgical skill) highly profitable ore, was not so very long ago uncommercial mineral. I do not believe in direct government aid to prospecting or prospectors. The aid that the government can give to this class of work is: (1) Passing understandable and adequate mining laws, so insuring the title of claims legally acquired; simplifying the rulings of the Land Office and prohibiting the passage of retroactive legislation and Land Office rulings. (2) In furthering education in the art of recognizing valuable minerals and mineral products. Prospecting, economically conducted, is bound to be a matter for individuals. No corporation can require from its employees the endurance of the hardships which are cheerfully undertaken by the prospector when the gain to be made is his own or to be shared with a few individuals, all of whom are known to him. It depends on how much the individual prospector can be improved in knowledge of commercial mineral products, their occurrence, and the wise expenditure of money, as to whether the available funds will prove adequate to the finding of new mineral deposits or not. My experience tends to show that 95% of the owners of undeveloped mineral properties put an entirely prohibitive price upon their possessions. The value of undeveloped mineral lands is one of the most difficult values to determine, and consequently the imagination and cupidity of their owners have free rein, and the price that they fix for an entirely indefinite value bears no sort of relation to the risk that has to be run. The direction in which I see a chance for an improved market is the realization by the owners of undeveloped mineral land that if they are not willing to take part of the risk, they should ask the people who are willing to put up the capital to develop their property at a price commensurate with the money that has been spent on locating the property.

Montana Metal Production

The total value of gold, silver, copper, lead, and zinc produced by deep and placer mines in Montana in 1913 was somewhat over \$59,000,000, a decrease from \$64,754,615 in 1912, over 8%, according to preliminary estimates of V. C. Heikes, of the United States Geological Survey. Metal prices were slightly less than those of 1912. There was also a large decrease in copper yield and consequently in gold. These were in part offset by a record increase in zinc production and silver output from zinc ores.

The gold yield decreased nearly 12%, the mine figures being \$3,625,235 in 1912 and \$3,194,000 in 1913. There was no great change in the placer output, but a decrease is noted in gold from copper ores and from silicious ores.

An increase of nearly 4% was made in the silver output of the state, the mine figures being 12,731,638 oz. in 1912 and 13,203,000 oz. in 1913. A decrease of about 10% in silver output from Butte copper ores was largely balanced by an unusual increase in silver from lead concentrate and zinc residues from the Butte & Superior mine, which made a notable record the last half of the year. Over 13% of the total value of the state output was that of silver.

The copper output declined about 9%, from 309,738,873 lb., according to mine reports, in 1912, to 280,658,000 lb. in 1913. This last was about 30% less than the output of Arizona, the leading copper producer in 1913.

The lead output increased from 7,446,749 lb. in 1912, according to mine figures, to 8,547,000 lb. in 1913, or nearly 15%. This increase was largely due to shipments of lead concentrates and residues from zinc concentrates from the Butte & Superior mine at Butte.

A record production of recoverable spelter was made from zinc concentrates shipped from Montana mines in 1913. From 26,918,881 lb. of spelter in 1912, the output increased to 85,449,297 lb. in 1913, or 217%. This was largely due to results at the Butte & Superior mine.

Extensive deposits of platinum have been discovered at Wenden, in Westphalia, Germany. Drilling has been done over 500 acres, and 9 holes gave from 0.9 to 1.9 oz. per cubic yard. Over 100 analyses have been made. Plans are being made to begin extracting the metal from the ores. Unlike the platinum found in Russia and other countries, the German deposits are said to contain the metal in the form of an alloy.

Madagascar, an island off the coast of Africa, and owned by France, produced 2,119,571 gm. of gold in 1912, a decrease of 730,473 gm. compared with 1911. The output of graphite is increasing. There are 942 workings, and in 1912 the yield was 5000 tons. This country will soon be a serious competitor of Ceylon in this mineral.

Deep Mine Pumping and Air Lifts

By A. E. CHODZKO

The end of the last century was marked by a decided advance in the art of treatment of metallic ores, and profitable returns have nowadays become available from immense accumulations of low-grade materials, both in natural and artificial shape, hitherto left unproductive owing to the limited paying percentage obtainable through time honored metallurgical processes. The measure of their commercial returns is the product of two factors, quality and quantity, and the immediate consequence of the new discoveries was the necessity of operating on vast amounts of materials. Leaving aside the mountains of discarded tailing that form a familiar foreground at large mining plants, an unprecedented activity became in order in opening up new underground levels at constantly increasing depths: the methods of exploitation had to keep pace with that increment of production, and among them, the problem of pumping is unquestionably one of the most momentous. It again involves two factors, volume and head, the graphical product of which shows a rapid upward trend.

Percolation of water through the freshly opened ground is generally, for natural reasons, enhanced by the depth, and its growing volume must be disposed of against a likewise increasing height of lift, so much so, indeed, that the machinery built for that purpose has gradually become subjected to requirements of unusual severity as to strength, capacity, and endurance. The chances of breakdowns are more numerous, their results are more serious, the repairs are more difficult and expensive, and when one stops to consider that the lives of the underground force, as well as the commercial success of the entire undertaking are essentially dependent upon the continuous and efficient action of pumps, it is soon realized that the importance of this question could not be overestimated.

Any pretense at a description of the modern types of deep mining pumps is beyond the object and the permissible extent of these pages; it could not, moreover, but be a compilation of a number of valuable contributions on the subject, beginning with the highly instructive review prepared by H. C. Behr for the State Mining Bureau in 1896. All of these machines fall, moreover, within the scope of a few remarks of a general nature. No mining reader is likely to contest the statement that a reliable high lift pumping outfit should meet, at least, two requirements: it must be as free as possible, by its design and by its construction, from causes of accidental stoppage; but should this happen, the pump must be able and ready to start up again under all conceivable conditions, namely, when immersed into any depth of water, and however long it has remained inoperative. The flooding of an underground pumping station at the lower

levels must not be considered a problematic accident, but an ever possible and impending occurrence, unless each plant is built in duplicate, and even if it is.

Broadly speaking, the former desideratum applies to all classes of mining, and even other machinery. The latter is more decisive; it forthwith eliminates all pumps driven by steam or by electricity, under the customary methods of installation, that is, the pump and its motor being in free communication with the shaft. As a rule, any station pump adjacent to its motor and placed below the highest water-level liable to be reached in a flooded mine, should be encased in a water-tight reduct or casemate of reinforced concrete, capable of resisting collapse under the maximum head of water. Very exceptionally will it be practicable to maintain a permanent access from the surface to that submarine engine room; this would be an essential requisite to the use of steam, which is, otherwise, unacceptable. But even for want of it, the machinery would at least remain in working condition during the period of inactivity, while protracted immersion spells ruin of an electric motor. Cornish sets and multi-stage centrifugals driven from above would not require that protective fortification. A piston pump, operated by compressed air, may work under water, provided that the exhaust pipe is carried beyond its upper level.

Duplex Direct Acting Pump

As an instance of personal experience, I may quote a duplex direct-acting pump, installed at the 200-ft. level of an inclined shaft, with its exhaust pipe reaching the 100-ft. level for ventilation purposes. The air-compressor at the collar of the shaft was driven by a Pelton wheel, the supply for which was interrupted during a winter night, by the wholesale freezing of the feeding flume. The pump naturally stopped, the water began to rise in the shaft, and before long had reached the 100-ft. level, and so things remained till the following spring, when the compressor was started again; a few moments later, water issuing from the delivery pipe showed that the pump had instantly responded. This, however, was due, first to the unusual extension of the air-exhaust pipe, which is very exceptional in a pump of that kind, and also to the fact that the rapid inrush of water at the time of stopping had caused the attendant to take a bee line toward upper quarters, leaving the throttle at the pump wide open.

It is safe to contend that machinery in motion under water charged with foreign substances, beyond possible control, oiling, etc., is apt to get out of order at any time, and cannot be depended on for steady work. Another drawback common to all high-lift pumps is

that due to the violent vibration of a long column of water in motion under heavy pressure, with consequent leakage and breakdowns. So that, leaving aside the inconvenience of immense moving weights and of a cumbersome and expensive outfit, it is true to say that the old types of pumps driven from the surface were offering better guarantees of permanent action in a deep mine than the more improved underground installations of today.

There is, however, one class of modern pumps enjoying a marked immunity from all the previous objections, and in which compressed air is in immediate contact with the water to be raised. Their principle of action is elementary.

If we have an inverted siphon with two equal branches, one (A) open at its upper end, and the other (B) connected to a supply of water and likewise open, the latter will fill the two branches and occupy the same level in both, placing them in perfect balance. Now, if in any manner we alter the weight of water

in one of the branches, leaving the other intact, a flow will take place from the heavier branch toward the lighter, and therefore if we place a weight at the surface of the water in branch (B) (or which amounts to the same, if we close that branch and admit air under pressure on top of the water) the latter will be forced down in (B) and escape at the top

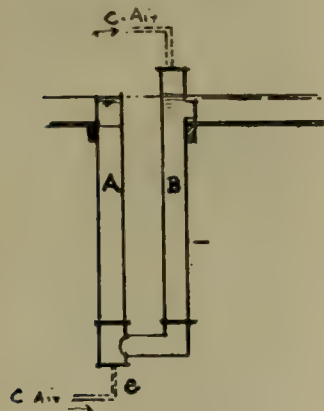


FIG. 1.

of (A), compressed air replacing in (B) the expelled water. This type of pump is known as a 'displacer.' When branch (B) is full of compressed air, the latter is shut off, and allowed to escape; then a fresh charge of water takes its place, and is again driven out, and so on. The action of the displacer is therefore essentially intermittent, branch (B) being alternately emptied and refilled, and the successive admissions and exhausts of compressed air being regulated by an automatic timing device.

Let us now revert to the original siphon, in its balanced condition, and without touching branch (B), which is open to the water supply, let us admit compressed air by a pipe (c) at the foot of branch (A). This air will rise up that branch by reason of its lesser density, eject part of the water from the pipe by its expansion, and form, with the remaining contents of (A) a mixture lighter than the water alone. The contents of (B) are therefore lighter than those of (A) and a flow will set in, and persist as long as air arrives at (c), the water in (A) being constantly replaced by the supply. This class of pump is the 'Air Lift' proper,

and it is evident that its action is continuous, without the necessity of any timing device.

In practice, the displacer (B) is a closed vessel, communicating with the water supply through an inlet valve which opens automatically when the air has escaped, and with the delivery pipe (A) by a discharge valve, which closes at the same time. In the air lift the branch (B) is represented by the well supplying the water, which enters the delivery pipe (A) at its lower end, where it meets the air pipe.

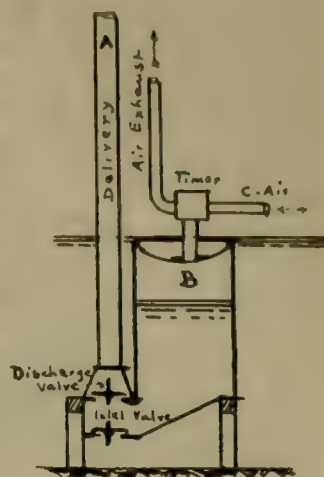


FIG. 2. DISPLACER.

Both kinds of pumps have been widely used. The displacer is better adapted to mining work because it is more compact and not subject to the condition of acceptable efficiency, of having a submergence practically equal to the actual lift which in a deep shaft would require an abnormally deep sump. On the other hand, the use of a volume of compressed air equal to that of the water raised, and allowed to escape without doing expansive work, reduces considerably the efficiency of the displacer. However, its simplicity and positiveness of action may recommend its adoption in a number of cases for temporary work.

This low efficiency has been improved upon by a combination of the two classes of air-pumps, the submergence head of the air lift being replaced by an equivalent air pres-

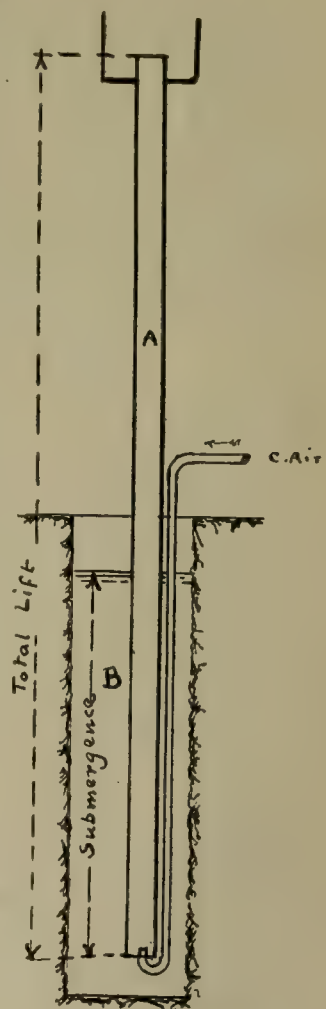


FIG. 3. AIR LIFT.

sure acting by displacement, and the delivery column being made lighter by a separate injection of compressed air. Such is the Starrett pump, which uses an air pressure much lower than would be required in a single displacer, where it must balance the hydrostatic pressure of the discharge column. This pump, which has been tentatively used at the Ward shaft of the Comstock, requires a free exhaust and a timing gear, and its action is consequently intermittent. It escapes to a great extent the main objections to the motor-driven pump, and can operate under water; and while there is no record of its use for a large capacity, it stands at the present time as the only air-lift pump having so far been practically applied to deep mining work.

Air-lifts seem, therefore, to point out a logical direction toward the economical and safe solution of the deep mine pumping problem. A study of this question, extending over several years, and based on former experience with other kinds of air pumps, has led to interesting results which are hereafter briefly presented.

Whatever be the exact behavior of compressed air in raising water up a delivery pipe, it will have yielded all of its useful effect if, in course of the process, it expands from its initial to its final, that is, to atmospheric pressure. Now, if (P_1) is the absolute air pressure (that is, the gauge pressure plus atmospheric) and (P_0) the atmospheric, it is easily found that at any particular place, if the compressed air enters the pump at the same temperature as it entered the compressor, the efficiency (E)—that is, the ratio of the work done by the expansion of the compressed air to the work absorbed in compressing it—is expressed by

$$E = M \left(\frac{P_0}{P_1} \right)^{0.29}$$

when (M) is a numerical factor involving the altitude, and the mechanical efficiencies of compressor and pump.

The conclusion is that a low-pressure air plant is more efficient than a high-pressure one, or, in this particular case, that a low lift is more efficient than a high lift. And, therefore, if water is to be raised to a great height, the idea naturally occurs of cutting this up into a number of shorter divisions, each supplying water to the next one above. This has been suggested as a means of adapting the air-lift to mining work, each division being made longer than the one below, and a great height could thus be reached with a limited number of successive steps, the air pressure increasing from one to another.

A more satisfactory result is obtained by making the subdivisions of equal lengths. The pump column is then formed of a series of equal sections, or units, placed end to end, the air main running alongside of them, and a numerical illustration will give a clear idea of that arrangement and of its results. It will only be mentioned at this time that all the elements of an air-lift of that type can be determined with the same degree of accuracy as the details of an elab-

orate plunger or centrifugal pump. The figures here given are purposely approximate.

We will assume that 2000 gal. of water is to be raised per minute to a vertical height of 1424 ft. Were we to pump water against 1424-ft. head the pressure per square inch at the foot of the delivery pipe would be about 640 lb.; a displacer would have to use compressed air at that pressure and even somewhat higher. The total lift of 1424 ft. will be divided into 100 equal units. Each unit consists of a tank, open at its upper end, and which may be of rectangular cross-section. A vertical eduction pipe is suspended in that tank with its open lower end a few inches above the bottom. Directly under it is the compressed-air nozzle, connected by a branch pipe to the air main. The lower unit is connected with the water-supply, which maintains into it a depth of 11.1 ft. The eduction pipe passes through the bottom of the sec-

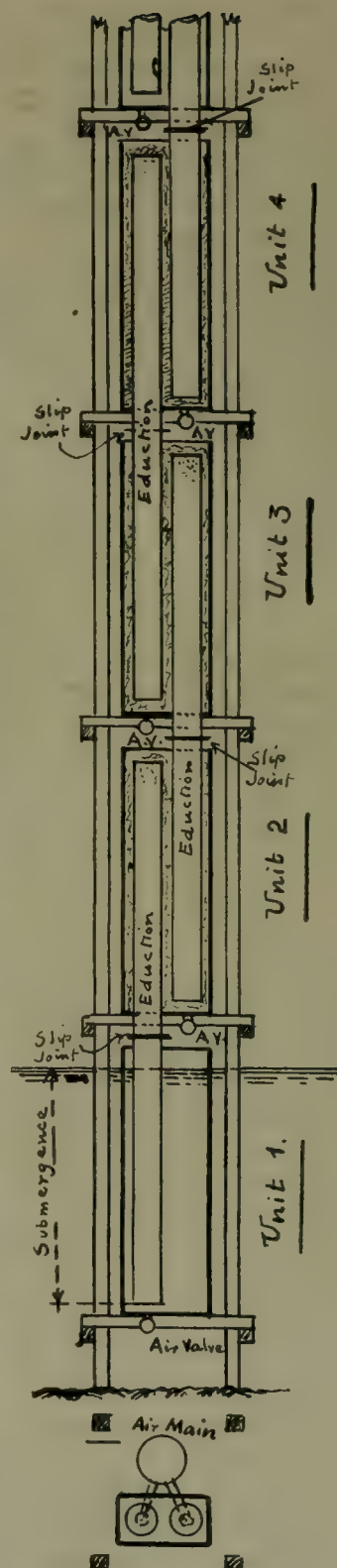


FIG. 4. LOW-PRESSURE AIR LIFT.

ond unit, and has its open upper end 11.1 ft. above that bottom, it is therefore a plain straight pipe open at both ends. The same arrangement is repeated in each unit, that is, each has a separate air jet and an eduction pipe rising to the top of the next. Each unit therefore consists of a rectangular tank, open at the top, and containing two parallel eduction pipes, one for its supply, the other for the discharge.

This being understood, the pump is ready to start, and air is turned on in the lower unit. As the head of water is 11.1 ft., a pressure of 5 lb. per square inch is sufficient. The emulsion of air and water rises up the eduction pipe and overflows into the second tank; the air, completely expanded, escapes in the shaft, while the water fills the space in the second tank not occupied by the eduction pipes. This water is picked up by air jet No. 2 and sent into the third unit, and so on, the same process being repeated through all the successive units to the top. An initial submergence of 11.1 ft. and an air pressure of 5 lb. gauge are all the requisites of the total lift: in the same locality, and with the same type of outfit, they would answer equally well for any other value of that lift.

Low Pressure Air Lift

The annexed diagram, Fig. 4, shows the general arrangement of the pump. Especial attention is called to the following points:

1. Since the units are all of equal length, this 'low-pressure' arrangement consists in splitting up the entire lift into a series of shorter ones with a theoretic submergence of 50%, the total efficiency being obviously the same as in each independent unit, regardless of their number. Whatever the total lift is, the submergence need not be more than the depth of the water in the first unit of the series.

2. The low air-pressure can readily be obtained from centrifugal blowers; this means a great reduction in first cost and maintenance of air-compressing outfit.

3. Whatever be the total lift in the same locality, at no portion of it are the air or water pipes to resist more than 5 lb. pressure to the square inch. Wood stave pipes or rectangular ducts are therefore quite acceptable, so that the pump can be built on the spot and kept in repair with local resources.

4. Each eduction pipe is cut off between two successive units, and a slip joint is used for connection. Any unit can therefore be detached from or attached to the line without disturbing the rest. These units, being identical, may be kept in readiness; any one of them may be placed at any point along the line.

5. In any specific case, the unit intended to form the pump column (and which is quite comparable to a link in a chain) is designed to perform a certain duty; that is, to raise a certain volume of water, at a certain altitude and mean temperature, and with a certain air-pressure. The volumetric ratio of free air to water is thus determined, and such a unit will

fit a 60 ft. lift or a 6000 ft. lift equally well, be it in a mine shaft or in crossing a range of mountains. A change in one of the above elements in the design of the unit influences the others to an extent that can be determined. The simplicity and cheapness of construction make alterations in shape easily practicable.

6. At starting time, all the units are empty except the lower one, and each one is connected to the air main, so that, when air is turned on, it would blow off and be wasted all along the line. It is therefore necessary to provide each unit with an air valve automatically closed and thrown open when water reaches the submergence level in that unit. These valves are all identical and interchangeable, they are of simple design, entirely automatic, and they can be removed and replaced in a moment.

7. The pump requires no foundation, being suspended by cables during the unwatering period, and each unit is supported by the shaft timbers when stationary. The details of its handling deserve and have received special attention.

8. At an assumed altitude of 4650 ft., each unit in the case at hand consumes 500 cu. ft. of free air per minute, making the capacity of the air-compressing plant 50,000 cu. ft. per minute, a figure by no means abnormal with centrifugal blowers. Here appears a unique feature of this type of pump, inasmuch as these 50,000 cu. ft. of air are discharged every minute into the shaft, where they create a powerful draft; this can readily be utilized for ventilation, either by suction up the shaft or by establishing a down draft, and this duty is performed at no additional expense. This twofold service of the air for drainage and ventilation, with the motive power placed in safety, introduces in the equipment of a mine a unique and additional element of economy. The pump will, of course, operate under water, in spite of the low air-pressure, because the first 'active' unit is always the one nearest the surface, those below it (as they might in case of sudden flooding of the shaft) are 'dead' and inoperative, so that the work of the air-compressors is always measured by the actual lift.

These remarks, it is hoped, may suffice to draw attention to a system of mine pumping which escapes most of the objections mentioned against the familiar types of station plants. It does not involve any but simple, well known, and tried principles of action, and yet, it presents some practical and economical advantages of its own. It is not claimed, nor is it true, that the low-pressure lift should in all cases supersede any other types of pump; it has been worked out, and it is specifically intended for high lifts and large volumes of water; and when unwatering and draining a deep mine, it can accomplish some work which a pump of the usual design cannot do economically. It is very much cheaper in first cost than its equivalent in capacity, and it can be repaired with local resources and labor, without resorting to a well equipped and too often distant machine-shop.

The Lake Superior Copper District in 1913

By R. H. MAURER

The copper mines of the Lake Superior copper district of Michigan during 1913 produced approximately 145,000,000 lb. fine copper, a poor showing compared with other years. The normal output of the three counties comprising the copper district is roughly 220,000,000 lb. per year. The decrease this year is directly traceable to unfavorable labor conditions generally, and in particular to the great labor strike which began July 23 and continued in force to the end of the year, though much weakened after the first two months of the conflict. The year opened with 19 producing companies operating almost at capacity, despite a perceptible shortage of labor, a condition that in recent years has become almost chronic in its persistence. It promised to equal, if not surpass, the preceding year in point of production and dividends earned and disbursed, but as the year grew older, labor became more and more scarce, with a consequent decrease in production, particularly noticeable in the outputs of the older and deeper mines. The labor war during the last six months of the year effectually stopped production at a number of important mines, and closed practically all of the newer mines, among which production is merely incidental to development work, but of respectable proportions in the aggregate.

Production

Production during the first six months of the year was just under 105,000,000 lb. copper, or at the rate of 210,000,000 lb. per year, which compares with 218,138,408 lb. copper produced in 1912; 219,840,201 lb. in 1911; 221,462,984 lb. in 1910; and 231,870,496 lb. in 1909. These figures are for copper actually mined during these periods and not smelter returns, which always include more or less copper mined in previous years, and which in 1912 is reported to have been 231,112,228 lb. fine copper. The smelter output will again be greater than the output of the mines, but the difference will be small. There is at the end of this year very little unsmelted copper mineral on hand.

The production of silver is comparatively light. Considerable silver is found associated with the copper in the mines opened on the Calumet conglomerate and Pewabic lodes, all obtained as a by-product in the process of electrolytic refining to which much of the copper is subjected, but the quantity is never sufficiently large to give the district a standing of importance among the recognized silver-producing states. The normal production of silver is about 500,000 oz. per year. As the quantity of silver produced is entirely dependent upon the amount of copper taken from these certain beds, the output this year will necessarily be small, and is not likely to exceed 200,000 ounces.

A table of productions showing the outputs of the several mines as nearly as may be calculated at this time, actual figures in many instances not being available for some months to come, is appended:

Company.	Fine copper 6 mo. ending June 30.	Fine copper total for 1913.
	Lb.	Lb.
Ahmeek	7,893,340	9,100,000
Allouez	3,510,000	4,200,000
Baltic	7,042,000	8,686,000
Calumet & Hecla	29,780,000	53,420,000
Centennial	1,135,000	1,400,000
Champion	9,600,000	11,448,000
Franklin	1,000,000	1,040,000
Isle Royale	3,338,000	4,680,000
Lake	900,000	1,000,000
Mass	1,400,000	1,500,000
Mohawk	4,817,400	5,369,000
Oseola	9,070,000	11,686,000
Quincy	8,374,800	10,894,800
Superior	1,705,000	3,078,000
Tamarack	3,666,000	4,142,000
Trimountain	4,000,000	4,888,000
Victoria	600,000	1,500,000
Winona	1,350,000	1,550,000
Wolverine	4,033,600	4,488,000
Totals	103,215,100	144,069,800

The average price received for the finished metal was just under 15.5 cents per pound, giving the output of the district a gross value of approximately \$22,500,000 and making available for dividends the sum of \$8,344,788, which amount was distributed by nine companies during the twelve months. The market price of Lake copper ruled fully one cent under the average of the previous year. The average cost per pound of copper produced was approximately 13 cents for all companies, compared with 10.25 cents in 1912.

Considering the unusually small production, the dividend showing is most gratifying though it may be added that several of the companies were of necessity forced to draw on surplus accumulations of other years, and the year's disbursements therefore do not truly represent the earning abilities of the several companies during the year just closed.

The mines, or those workings that may properly be termed as such, are with few exceptions in excellent physical condition, and only two are threatened with early exhaustion, namely, the South Kearsarge mine and the Wolverine mine, the former with about four years' life remaining and the latter with an estimated life of about eight years on the Kearsarge lode. Less than one-fourth of the known mineral area of the district has been touched, practically the entire western horizon along the western sandstone remaining unexplored, and though many of the mines are now very deep and approaching the limits of workable depth, this

generation will not witness the exhaustion of these mines excepting those noted and possibly the mines on the Calumet conglomerate, which so far has been found workable only in that part which is owned by the Calumet & Hecla and Tamarack companies. This formation will probably be worked out within the next twenty years. The Osceola mines and the newer mines of the Copper Range company have an assured life of upward of forty years and the 'Old Reliable' Quincy is not expected to turn the corner inside of the next seventy years. An annual production of 200,000,000 lb. copper will probably be maintained for at least twenty years to come. The output may even exceed this figure, and a smaller average annual output is certainly not indicated.

There have been no important new discoveries of copper deposits in this district within the past ten or twelve years, excepting those in the Lake district and on the Mayflower lode, both apparently of limited extent, only partly proved, and of no considerable proportions. As the total copper production of the United States is constantly increasing through the development of other fields, a further decline in the percentage column, if not in actual production, may be expected. The district has been quite thoroughly prospected within certain well defined areas, yet only about one-quarter of the known mineral belt has been explored. The western rim, along the great sandstone contact, marking the presumed limits of the mineral area, for a distance of more than one hundred miles, remains practically untouched. What this horizon may yield or disclose under proper exploitation is problematical. Certainly no man can know positively that the production of copper in this district will cease with the exhaustion of the present mines, many of which undoubtedly will be worked out within the next generation or two, but its position as the premier copper producer, which it rightfully held so many years, is unquestionably lost forever.

The present trouble with the Lake Superior copper district is solely one of labor. Viewed from the standpoint of the mine operator, labor conditions are very unsatisfactory, principally because labor is scarce and partly because the labor strike which began in July has driven, and for more than a year previous did drive, efficient labor away in great numbers to other fields. This condition had to be met by drawing on the unskilled labor market, and unskilled and inexperienced workers are dear at any price. But this is only a temporary condition which must eventually change for the better. In the sixth month of the strike a material improvement is already noticeable. By no means all of the old employees are in sympathy with the strike and the majority have again returned to work in the mines after a short period of idleness. The position of the Western Federation of Miners is greatly weakened, and the strike which was forced by this organization against the wishes of the majority of the mine workers of this field, as has since been ascertained, appears all but ended and certainly is not so formidable as it was

only three or four months ago. The difficulties between the mine operators and this labor union, which at the beginning embraced a minimum wage scale of \$3 per day, a shorter work-day, and recognition of the union, has simmered down to recognition only. The demand for an eight hour day has been granted. An average wage of better than \$3 per day for all workers has been in existence for several years. There remains only the question of recognition of the union. This the operators are unwilling to give and will not give, and the position of the Western Federation of Miners in this district is thus made clear. The sentiment of the general public is against this organization; and the people residing in this district, forming an organization known as the Citizens' Alliance, with 40,000 members (the population of the district is about 85,000), have demanded the expulsion of the paid labor agitator with a polite request that the Western Federation also withdraw.

Late in December the union officials were seriously considering the advisability of continuing the strike and a vote of the strikers will probably be taken. The striking mine workers are beginning to see the hopelessness of their fight after about five months of useless efforts, and the rank and file may now be expected to vote for a return to work.

A brief review of the several companies in the order of their importance by counties follows:

Houghton County

The important producing mines of the Lake Superior copper district are with few exceptions within the confines of Houghton county, and this county also holds the most promising undeveloped copper deposit discovered in recent years. Its copper mines give employment to upward of 15,000 men. The Calumet & Hecla stands high among the largest copper producers of the world. It is the premier dividend payer among the metal mines of the globe, with a total disbursement of \$123,250,000 to date. The total amount of copper taken from its mines now stands in excess of 2,500,000 tons. Depth and declining copper content have had their effect, however, and this great mine will probably be entirely worked out within the next twenty years. The mines on the Osceola and Kearsarge beds can never compensate for the loss in production from the richer conglomerate lode, but may be expected to yield respectable profits over a long period of years to come, and these profits will be greatly augmented by profits derived from the treatment of the millions of tons of mill tailing wasted in earlier operations and now made available through the introduction of greatly improved milling methods.

The Copper Range group of mines is in excellent physical condition with the exception of the old Atlantic mine, which has been idle since 1906. The Baltic has grown somewhat leaner with depth and shows occasional signs of decay, but once again gives promise of increased production. The Trimountain shows continued improvement, and is gradually round-

ing into shape for heavy production. Champion also carries a noticeable betterment in the lower reaches of the mine and again in the newer openings to the southward. The active mines of this combination yielded 25,000,000 lb. copper during 1913, despite unfavorable labor conditions, and the productive capacity does not appear to have been reached.

The Quincy is an old and very deep mine. About one-quarter of the copper bed on which the mine is opened has been entirely worked out. Its holdings, however, are so extensive, and so much unmined ground remains that the life of this Company is estimated at not less than seventy years. The copper content holds steady at about 15 lb. copper per ton. Osceola will within the next few years suffer the loss of a valuable asset in the South Kearsarge mine, which is rapidly nearing exhaustion. This loss will in good measure be offset by a growing betterment noted in the workings of the North Kearsarge mine. The Osceola Branch mine is of no particular promise, but may be worked with profit for a great many years to come. The Wolverine had an exceedingly bad year. Mining operations are confined to the Kearsarge lode. Exploratory operations in the horizon of the Osceola and Old Colony lodes proved unpromising and this work has been suspended. Production also has steadily declined, and the mine will likely suffer exhaustion within the decade. The Tamarack mine is deep and unprofitable. Operations on the conglomerate lode are unsatisfactory, and the Osceola lode shows but little encouragement. The mine is in a hopeless condition, with small chances for profitable operations, except under most favorable labor conditions and a high metal market.

The Isle Royale has been a great many years in the making and has finally attained success. The first dividend disbursement by this Company was made in March, 1913. The mine is expanding wonderfully and promises to reach a productive capacity of at least 15,000,000 lb. within a few years. The Superior has succeeded in developing a valuable copper deposit in two beds in the horizon of the Baltic lode, and is making a creditable showing in copper production, but, unfortunately, without much profit for the shareholders. The Hancock seems to have opened workable copper deposits in several formations and is preparing to begin production on a commercial scale early in the new year. The Winona has all but proved to be a losing venture. Much time and effort was spent during the year in extending underground openings and in providing an efficient concentrating mill that should result in a closer saving of the exceedingly fine copper occurring in this formation. The future of this Company depends upon the successful outcome of experiments involving the use of a new concentrating process, which the Company was giving a trial late in the year.

Keweenaw County

The copper mines of Keweenaw county include a number of important producers which have a com-

bined output of 18,500,000 lb., or approximately 13% of the district's total copper output. This county was of first importance in the early days when mining was confined exclusively to the fissure veins. These were found exceedingly profitable but no deposits of this character are being worked today. About 1500 men find employment in the mines of the district.

The Ahmeek, one of the very richest copper mines of the entire district, has made material advancement in the development of its mine, and the property is now easily capable of yielding 20,000,000 lb. fine copper yearly. It has an assured future of at least 45 years. The Mohawk mine, opened on the northerly extension of the Kearsarge amygdaloid, on which the Ahmeek also is opened, is given a new lease of life by reason of the exceptionally favorable developments in the south area. Development work during the year revealed copper ground of excellent quality at a number of points. The Allouez mine is slowly developing into a producer of importance. Ore reserves have been materially increased, and an era of profitable operations is assured. The Ojibway mine, opened on the extreme north end of the Kearsarge amygdaloid, was forced to suspend operations during the year owing to lack of working capital. Development work gave rather indifferent results, and this is largely responsible for the failure of the Company to secure funds. The Keweenaw Copper Co. passed the entire year in exploratory work and in this obtained fair showings of copper at various points along the strike of the Ashbed lode. The past efforts of this Company to find copper deposits of commercial value were uniformly unsuccessful, and it is therefore gratifying to note that a turn for the better has come. The showings on the Ashbed merit development.

Ontonagon County

Ontonagon county, third and last of the triumvirate of counties comprising the Lake Superior copper district, numbers among its mines the Lake, Mass, and Victoria, ranking in importance in about the order named. There are also numerous prospects, including the White Pine, South Lake, Indiana, North Lake, Algoma, Bohemia, Onondaga, and Adventure. These enterprises give employment to about 1000 men.

The producing mines, Lake, Mass, and Victoria, yielded approximately 4,000,000 lb. fine copper, which was less than 3% of the total output of the Lake Superior district. These mines are not expected to yield in greater proportion for several years, though each can with further development easily double the present rate of production. None of them promises to develop into mines of the first magnitude, and it is by no means certain that any will reach the dividend stage within the decade. Among the prospects, White Pine and South Lake stand well to the front. Both are developing workable copper deposits, and profitable operations in the White Pine are practically assured. The lesser prospects, particularly Indiana, North Lake, and Bohemia have an even chance for success.

Thawing Frozen Ground for Placer Mining

By ARTHUR GIBSON

The term 'frozen ground' refers to ground perpetually frozen, or in other words, ground that never thaws by nature. Such 'frozen ground' is encountered in the extreme northern portion of the American continent, in Alaska, and Canada, and is also found in Siberia.

The process of artificially thawing frozen ground

considerably in the same locality and within short distances. The principal factors governing the cost of thawing are as follows: (1) amount of ice contained per cubic yard, (2) cost of fuel, (3) cost of labor, (4) amount of condensation due to long and poorly insulated pipes, (5) amount of condensation due to low temperatures during the winter, (6) method of



PLACER DRIFT MINING AT NOME. THAWING FROZEN GROUND.

can be accomplished by various methods, either by direct or indirect heating. In direct heating, burning or banked fires are built against the face to be thawed. Indirect heating is accomplished by heating a medium or secondary element, which performs the work of thawing. The secondary elements mostly used are: (1) heated rocks, (2) hot water, or (3) steam. Both experience and practice have proved steam to be the most effective and efficient medium.

The following efficiency and cost data are collected from actual placer-mining operations in the Cape Nome Mining district, Seward Peninsula, Alaska, but will apply to other localities of like nature by proper adjustment of the cost of fuel, labor, board, and local conditions. One frequently hears that it costs so many cents per cubic yard to thaw frozen ground in a certain locality. These statements, although in many instances true and derived from actual operations, are misleading, in that the cost per cubic yard may not only vary with different localities, but may even vary

mining or application, and (7) the scale upon which operations are conducted.

Heat Required to Thaw Frozen Ground

The temperature of perpetually frozen ground on Seward Peninsula, so far as known, remains nearly constant around 28° above zero Fahrenheit, or 4° below the freezing point, excepting close to the surface where the temperature is affected by the atmospheric heat or cold during the summer and winter seasons, or in the immediate proximity of subterranean water channels or thawed ground. I will assume that the frozen gravel deposit contains 2850 lb. of solids and 260 lb. of ice per cubic yard, and it is desired to heat this deposit from 28° above to 36° , or to a temperature 4° above the freezing point. How much heat is then required, expressed in B.t.u.'s, per cubic yard?

The coefficient of thermal capacity (specific heat) for solids is 0.2, that for ice is 0.5, and that for water is 1.0. The latent heat of fusion of ice is taken at 142

COMPARATIVE DATA ON EFFICIENCY AND COST OF THAWING FROZEN GROUND WITH STEAM FOR PLACER
MINING IN CAPE NOME MINING DISTRICT, ALASKA

	Joe Wise & Co. (Joe Wise, Mgr.)	Joe Wise & Co. (Chas. A. Vogel, Mgr.)	Joe Wise & Co. (Chas. A. Vogel, Mgr.)	New Eagle Mining Co. (A. B. Brown, Mgr.)	Otto Olson, operator	Plain Dredging Co. (J. F. Plain, Mgr.)
	1.	2.	3.	4.	5.	6.
Operated during	winter	summer	summer	summer	summer	summer
Class of placer mining	Underground driving and stoping.					Dredging.
Depth below surface	53 ft.	81 ft.	81 ft.	45 ft.	50 ft.	9 to 20 ft.
Thickness of pay-dirt	2.5 ft.	2.5 ft.	2.5 ft.	3.5 ft.	2 ft. 2 in.	.....
Thickness of waste	1.5 ft.	2 ft.	2 ft.	1.5 ft.	2 ft. 4 in.	.....
Total depth of stope	4 ft.	4.5 ft.	4.5 ft.	5 ft.	4.5 ft.	.....
Material, dirt and clay	.....	.....	.....	.....	.....	7 ft.
Material, gravel	4 ft.	4.5 ft.	4.5 ft.	5 ft.	4.5 ft.	7.5 ft.
Swelling of loose dirt	26.8%	.....	.....	.....	.....	25%
Number of boilers	1	2	2	1	1	2
Total boiler horse-power	45	70	70	35	50	85
Steam-points, length	7 ft.	7 ft.	7 ft.	6 ft.	7 ft.	9 to 20 ft.
Steam-points, number	40	90	90	25	46	40
Steam-points working	hor'l.	hor'l.	hor'l.	hor'l.	hor'l.	vert.
Steaming time, hours	12	12	12	8	11	48
Horse-power per steam-point	1.125	0.777	0.777	1.4	1.08	2.125
Depth thawed	8 ft.	7 ft.	9 ft.	7.5 ft.	7.5 ft.	14.5 ft. av.
Left to absorb heat, days	1	2	2	.....	2.5	20 to 30
Ground thawed per day, cu. yd. loose dirt	128	205	257	128.57	327.13	567.25
Ground thawed per day, cu. yd. dirt in place	100.94	.....	.....	.....	.....	453.8
Duty per point per day, cu. yd. loose dirt	3.2	2.278	2.855	5.1428	7.1115	14.18125
Duty per point per day, cu. yd. dirt in place	2.5235	.....	.....	.....	.....	11.325
Duty per foot per hour, cu. yd. loose dirt	0.051	0.02712	0.033994	0.10714	0.092326	0.040751
Duty per foot per hour, cu. yd. dirt in place	0.04	.....	.....	.....	.....	0.032543
Crude oil consumed per day, barrels	4	4	4	2	5	20.95
Crude oil consumed per day, gallons	168	168	168	84	210	880
Crude oil consumed per point per thaw or day, gallons	4.2	1.867	1.867	3.36	4.567	22.00
Crude oil consumed per point per hour, gallons	0.467	0.15558	0.15558	0.42	0.4152	0.9167
Crude oil consumed per cu. yd. loose dirt thawed, gallons	1.3125	0.81951	0.6537	0.65334	0.64195	1.55134
Crude oil consumed per cu. yd. dirt in place thawed, gallons	1.6644	.....	.....	.....	.....	1.93918
B.t.u. consumed per cu. yd. loose dirt	186,921	116,711	93,097	93,046	91,424	220,936
B.t.u. consumed per cu. yd. dirt in place	237,037	.....	.....	.....	.....	276,170
Duty per barrel of oil in cu. yd. loose dirt	32	51.25	64.25	64.28	65.426	27.076
Duty per barrel of oil in cu. yd. dirt in place	25.235	.....	.....	.....	.....	21.66
Number of men employed per day for thawing	4	4	5	11	3	3.5
Duty per man per day, cu. yd. loose dirt thawing	32	51.25	51.4	42.85	109.04	162.07
Duty per man per day in cu. yd. dirt in place	25.235	.....	.....	.....	.....	129.66
Cost of crude oil per barrel delivered	\$2.97	\$3.30	\$3.30	\$2.90	\$2.71	\$2.52
AVERAGE TOTAL COST PER DAY						
Crude or fuel oil	\$11.88	\$13.20	\$13.20	\$ 5.80	\$13.55	\$52.79
Labor and board	20.50	27.82	34.90	20.45	21.05	25.73
Repairs and renewals	7.50	7.50	7.50	2.50	7.50	3.89
Rent, 50-hp. boiler	.....	.....	.....	.....	.....	1.67
Total operating cost	\$39.88	\$48.52	\$55.60	\$28.75	\$42.10	\$84.08
AVERAGE COST PER CUBIC YARD LOOSE DIRT						
Crude or fuel oil, cents	9.28	6.44	5.13	4.51	4.14	9.31
Labor and board, cents	16.01	13.57	13.58	15.91	6.44	4.54
Repairs and renewals, cents	5.86	3.66	2.92	1.94	2.29	0.68
Rent, 50-hp. boiler, cents	.....	.....	.....	.....	.....	0.29
Total operating cost per cu. yd. loose dirt, cents	31.15	23.67	21.63	22.36	12.87	14.82
Total operating cost per cu. yd. in place, cents	39.51	.....	.....	.....	.....	18.53

¹Assumed values based on excavated dirt swelling 25% over dirt in place.

²Number of men employed per day thawing ahead of the dredge is given as 3.5. This is thus explained: the night pointman also acts as oiler on the dredge during the night and his time is thereby divided into one-half for the thawing and one-half for the dredge.

Columns No. 1, 2, and 3 refer to the Linda Association claim on Center creek; No. 4, Bench 1, Center Creek; No. 5, the Tundra Association; and No. 6, the Otter creek property.

B.t.u. per pound. Then:

	B.t.u.
2850 lb. of solids raised 8°, from 28° to 36°	
$2850 \times 8 \times 0.2$	4,560
260 lb. ice raised 4°, from 28° to 32°	260×4
$\times 0.5$	520
260 lb. ice at 32° to water at 32°	260×142
	36,920
260 lb. water raised 4°, from 32° to 36°	$260 \times$
4×1.0	1,040
Total heat required for the ice	38,480
Total heat required per cu. yd. of ground.	43,040

This plainly illustrates the rapid increase of heat required for only a small increase of ice per cubic yard, and it shows further that under these conditions the ice requires 92.5 times as much heat as the solids. With crude oil of a fuel value of 18,000 B.t.u. per pound or 142,416 B.t.u. per gallon; or with coal of a

according to the number of men employed.

The table presented contains only the actual operating expenses, no charges for management, interest on investment, or depreciation of the outfit being considered or included. No. 1 to 5, inclusive, are the figures for underground stope-mining where the steam points are used in a horizontal position. No. 6 contains the data with regard to thawing ahead of a dredge where the steam points are used in a vertical position.

The fuel used in all of the above cases is California crude oil, averaging 17.5 B., weight 7.912 lb. per gallon, and containing 18,000 B.t.u. per pound or 142,416 B.t.u. per gallon.

The foregoing data are compiled from the common practice among some of the best miners on Seward Peninsula, Alaska, but which could no doubt be improved under scientific management. Judging from the fuel consumption, it is evident that it requires



SETTING A 20-FT. STEAM POINT.



ARRANGEMENT FOR THAWING AHEAD OF DREDGE.

fuel value of 12,000 B.t.u. per pound; and assuming the efficiency of boiler and distributing plant at 50%, there will be required in the above example to thaw one cubic yard of frozen ground:

$$\begin{array}{rcl} \frac{43,040}{9000} & = & 4.782 \text{ lb. of crude oil, or} \\ \frac{43,040}{71,208} & = & 0.604 \text{ gal. of crude oil, or} \\ \frac{43,040}{6000} & = & 7.173 \text{ lb. of coal.} \end{array}$$

The variation in the cost of fuel noted in the accompanying data is due partly to the fact that in general the prices have been raised during the last year, although some unexpired contracts maintain the former and lower prices; and partly to the different freight rates, which are proportional to the various distances between the supply station at Nome and the mines, being lower during the winter than the summer season.

The cost of labor for this particular work, firemen and pointmen, is \$3.50 and \$4, respectively, during the winter, and \$5.50 and \$6, respectively, during the summer season. Board, including fuel and cooks' wages, ranges from \$1.08 to \$1.35 per man per day,

from 80 to 100% more fuel during the winter than during the summer for underground drift-mining. Fuel for thawing ahead of a dredge appears very high. This is principally due in this case to the ground, which contains between 60 and 85% ice. Labor, duty per man per day for thawing, varies to a great extent, as it depends largely on the composition of the deposit, whether it is sand, light or coarse gravel, or ground containing large rocks which render the driving of the steam points difficult.

Miners frequently overlook some of the most vital factors relative to the most efficient and economical means of thawing, such as: ascertaining and gauging the proper distance between the steam points; the correct time of steaming; the proper time for the dirt to lie idle between thawing and excavation to evenly absorb and equalize the heat transmitted. The success of the venture depends greatly on the proper adjustment of these factors. The thawing of deep ground for dredging purposes has so far proved more or less unsuccessful, due principally to the steam condensing and losing its greatest heating value before reaching the end of the steam point. This, however, is only a matter of application and can be adjusted under a proper system.

Rhodesian Crushing Plants

The varying characteristics of Rhodesian ores in the different mining fields of Matabeleland and Mashonaland have resulted in the employment of various types of reduction and treatment plants at the different mines. With the exception of the battery of Nissen stamps running in the City Deep mill, all the reduction plants of the Witwatersrand are of practically uniform pattern, and consist of ordinary gravitation stamps and tube-mills. The stamps are of varying weights in different mills, and there are two or three sizes of tube-mills employed; otherwise the reduction plants at work from one end of the Reef to the other are of the same type and design. The Transvaal Chamber of Mines output sheet is thus a very different schedule from that issued by the Rhodesian Chamber of mines, in so far as details of crushing plant are concerned. The Rhodesian statement, apart from the numerous small 'dolly' plants in operation, shows that, in addition to stamps, the following types of crushing plant are in use: Chilean mills, Gates rolls, Huntington mills, grinding pans, pneumatic mills, Eureka crushers, and internal rollers. The list is as follows:

Matabeleland

Agincourt: 5 stamps and 1 grinding pan.
 Bushtick: 24 stamps and 3 tube-mills.
 'C': 10 stamps and 1 Chilean mill.
 Carry: 1 Huntington mill.
 Colleen Bawn: 6 stamps and 1 grinding pan.
 Lonely Reef: 20 stamps and 3 tube-mills.
 Nelly: 2 Huntington mills.
 Old Nic: 15 stamps and 4 grinding pans.
 Winifred: 1 internal roller.
 Cinderella: 1 Eureka crusher.
 Collingwood: ball-mill.
 Gaika: 5 stamps and 1 Chilean mill.
 Globe & Phoenix: 40 stamps and 10 grinding pans.
 Gothic: 15 stamps and 2 grinding pans.
 Red Hill: 1 Chilean mill.
 Selukwe (Columbia): 1 Chilean mill and 3 grinding pans.
 Wanderer: 4 Gates rolls.

Mashonaland

Battlefields: 2 Chilean mills.
 Brilliant: 7 stamps and 1 grinding pan.
 Concession: 5 stamps, 1 Chilean mill, and 2 grinding pans.
 Dowry: 1 pneumatic mill.
 Dreadnought: 1 Chilean mill.
 Giant: 30 stamps and 2 tube-mills.
 Pickstone: 10 stamps and 1 Chilean mill.
 Shepherds: 5 stamps and 1 tube-mill.
 Thistle-Etna: 1 Chilean mill.
 Eldorado Banket: 20 stamps, 2 Chilean mills, and 8 grinding pans.
 Kimberley Mashonaland: 6 stamps and 2 tube-mills.
 Louise Grand: 1 Huntington mill.

It will be evident from the above that there is considerable scope existing in Rhodesia for the various makes of crushing appliances, other than gravitation stamps. Any new type of crushing or fine-grinding machinery, provided it does effective and economical work, appears to be assured of a fair trial; and success, once established, is likely to induce other properties to take the device up.—*South African Mining Journal*.

Detection of the Platinum Metals in Cupellation Beads

*It has long been known that the presence of small amounts of platinum in cupellation beads causes a surface crystallization visible to the naked eye, and according to experiments by C. O. Bannister and G. Patchin, the following conclusions are arrived at: (1) In the silver-gold beads the crystallization of silver and of gold is distinctly traced in the structure. The visual appearance of beads composed of equal amounts of gold and silver is shown to be similar to that of beads containing over 1.6% of platinum. (2) It is shown to be possible by a simple microscopic examination to detect platinum in cupellation beads when present below 1.6%; that is to say, when present below the amount necessary to cause crystallization visible to the naked eye. (3) The presence of iridium in small quantities may be detected in silver beads by the strained appearance of the crystals caused by internal stresses. (4) The presence of traces of rhodium may be detected by a crystallization of the beads in which the facets of the crystals are distinctly visible. When over 0.03% of rhodium is present, this is indicated by a bluish gray color and a large amount of spitting. (5) Ruthenium is indicated in cupellation beads by a black crystalline deposit firmly attached to the bottom edge of the beads, and in the experiments carried out was always associated with a herringbone-like structure when examined by the microscope. (6) Palladium causes a structure similar to that found in the presence of platinum, but yields satisfactory evidence of its presence by the coloration of the parting acid. (7) No specific indications are afforded, by the tests carried out, of the presence of osmium. (8) The indications obtained of the presence of iridium are found to apply equally well to osmiridium.

Milling plants on the Comstock lode in 1875, according to the *Virginia Chronicle* of December 1913, contained the following equipment:

Mills	41	Agitators	20
Stamps	890	Clean-up pans	29
Pans	352	Capacity of mills, tons	
Settlers	156	per day	1400

Several of these mills were treating tailing only.

*Abstract from *Bulletin* No. 111 of the Institution of Mining and Metallurgy.

Evolution of Suction-Gas Power in Western Australia

By J. C. AULDRO

The first suction-gas plant at Kalgoorlie was installed on the Great Boulder mine in 1907 for firing roasting furnaces. The experiment proved a failure, as it was found that there was not sufficient heat in gas generated from charcoal when it came to forced work, and the management reverted to the wood-fired furnaces to get the required output from them. In 1908 a suction-gas plant was installed on the Great Boulder No. 1 Co.'s St. George mine at Mt. Magnet, but proved a source of annoyance for a time until it was understood. About the same time Messrs. Moss Bros. installed a small plant at their treatment works at Kalgoorlie. In 1909 two suction-gas engines of 50 hp. each were installed in Kanowna to drive custom stamp-mills, and, in the same year, six suction-gas engines varying from 30 up to 80 hp. were installed in small treatment plants around Kalgoorlie. Although giving general satisfaction and requiring little attention, even from laymen, there was a constant liability to intermittent trouble from the sudden over-heating of the cylinder, which no one could explain. At this time Mr. Truman, a custom mill operator, installed an 80-hp. engine on the Mt. Ferrum mine, and discovered that the cause of the trouble was the opening of the air valve too wide, and excessive heat resulting from an excess of hydrogen in the burning gas. Mr. Truman generously made his discovery known, and, since then, no complaints regarding suction-gas plants have been heard, as it was proved that any excess of heat could be immediately checked by regulating the air-valve. Since then the number of these engines has largely increased, and is still increasing. At all the outside centres, such as Ora Banda, Leonora, Mt. Morgans, Black Range, Meekatharra, and Bullfinch, suction-gas power has quite superseded steam for operating treatment plants. In spite of the economy which can be effected by their adoption, gas engines are unlikely to supersede steam on the large mines at Kalgoorlie, as large electric plants have been installed. The great advantage of suction-gas plants is that they require little attention and practically no technical knowledge. So far as Western Australia is concerned all the plants were operated by charcoal-gas generators well into 1912, when the Cambridge generator, previously tried in New Zealand, was introduced. This generator has a down instead of an up draft, and can be fired with wood, shavings, or sawdust, in addition to coal, lignite, coke, or charcoal. In January, 1913, Messrs. Jordan and Degenhart, two engineers on the staff of Bewick, Moreing & Co., devised the Commonwealth generator, also a wood consumer. By tests with a 200-hp. Crossley generator, using charcoal costing \$14.16 per ton against a Commonwealth generator using wood costing \$3.84 per ton, they found that the cost of power could

be reduced from 30 to 20 cents per ton of ore treated, the reduction being 7.5c. in fuel and 2.5c. in upkeep. The proportion of charcoal consumed to wood being 100 to 172. The test was made with a 200-hp. Crossley engine, single cylinder, 24-in. diameter by 32-in. stroke and working at 166 revolutions per minute. This drove a 20-stamp-mill of 1250-lb. stamps, Krupp tube-mill and vacuum-filter, treating 185 tons of ore per day. The comparative cost of fuel per brake horse-power hour tested at Kalgoorlie is as follows: steam, with wood costing \$3.12 per ton, 0.70c.; suction gas, with charcoal costing \$14.16 per ton, 0.64c.; and Commonwealth gas generator, with wood costing \$3.12 per ton, 0.30 cents. There are now three down-draught wood-gas generators on the market, the Cambridge, Commonwealth, and Akroyd, for all of which points of superiority are claimed. The Commonwealth is easily getting ahead of its rivals, and is being installed on



A 250-HP. COMMONWEALTH GENERATOR USING WOOD IN 6-FT. LENGTHS. THIS SUPPLIES GAS FOR A 220-HP. TANDEM GAS ENGINE DEVELOPING 183 I.H.P. CONSTANT, AT THE QUEEN OF THE HILLS MINE, MEEKATHARRA, WESTERN AUSTRALIA.

many of the mines, managed by the firm of Bewick Moreing & Co. Three of these generators of 380 hp. each, and consuming 6-ft. lengths of wood, are shortly to be installed on the Sons of Gwalia mine at Leonora, to operate a 660-hp. 4-cylinder Kynock gas engine, and two Crossley engines of 400 and 167-hp., respectively. Similar generators of 200-hp. have been installed on the Yuanmi and Queen of the Hills mines. Except on the larger mines these suction-gas plants are in charge of laymen with other duties to attend to, as no engineer's certificate is required, no technical knowledge appears to be essential, and firing has only to be done twice a shift.

Discussion

Readers of the MINING AND SCIENTIFIC PRESS are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment. Insertion of any contribution is determined by its probable interest to the readers of this journal.

Tin Mining in Tasmania

The Editor:

Sir—The successful exploitation of very low-grade mines always calls forth the admiration of mining men in parts of the globe where, on account of expensive transport and inefficient labor, the working of such mines is an impossibility. Therefore, everyone engaged in tin mining in this country will have read with interest the account of the Anchor mine in Tasmania, in the *Mining and Scientific Press* of October 18, 1913. At this property ore containing as low as 2.38 lb. of tin per ton is treated by stamp-milling and concentrating.

Any tin miner in Bolivia, and probably in other parts of the world, excepting Australia, would consider himself to have attained perfection in tin dressing, if he could succeed in making an average mill tailing of 2.3, or even 3 lb. of tin per ton. Assays of tailing at the leading mines of Cornwall are given as 3 to 6 lb. metallic tin per ton for sand, and 7 to 9.5 lb. for slime, according to *The Mining Magazine* of April and June 1913. In Bolivia, where the minimum tin content of ore milled is 2 to 3%, and might average 8%, losses are much higher, even in modern and well equipped plants. As an example, I will mention that the lowest tailing assays, which I have ever obtained from a fine grained 6% ore was 0.32% for the sand, and 0.65% for the slime, corresponding to 7.2 and 14.6 lb. metallic tin per long ton, respectively. Tailing assays from other mills here are difficult to obtain because the tailing is not automatically sampled.

It is to be regretted that no particulars are given about the methods of concentrating the low-grade material at the Anchor mine. From the published data I tried to figure the extraction of tin in the milling process, but found a strange discrepancy. This was that the tin in the concentrate amounted to 302,003.07 lb., which had been recovered from 104,732 tons of ore containing 2.38 lb. per ton. According to this, the quantity of metallic tin in the millheads was only 249,262.6 lb., from which 302,003 lb. was obtained, if the concentrate is calculated in long tons, and 269,645.6 lb., if the short ton is used. These figures call for extractions of 120 and 108%, respectively. However perfect the method of dressing may be at the Anchor mine, it is obvious that these results are impossible, and some mistake must have been made in the data, probably in the tin content of the ore. On such low-grade material an extraction of 50% would be very good work, as is proved by the results of the Cornwall Tailings Co., England, which, in spite of all

efforts, cannot raise its extraction above 40%. This Company is treating material of 19 lb. metallic tin per ton, seven times richer than the ore at the Anchor mine is supposed to be. On the other hand, Tasmanian tin ores have a reputation of being very pure, and it might be possible to get a better recovery than in Cornwall, although the ore is so much poorer. I hope it will not hurt the feelings of the engineer in charge of this Tasmanian tin mine if an extraction of 50% is assumed. A tin content of 5.76 or 5.15 lb. per ton is arrived at, depending whether the long or short ton has been used for the weight of the concentrate. These figures look more reasonable, and agree better with results from another Tasmanian mine, namely, that of the Mount Bischoff Tin Mining Co., which recovers about 7 lb. metallic tin per ton of ore.

It is easy to prove that ore with 2.38 lb. tin per ton could not be profitably treated with a working cost of \$0.84. If the average price of tin during 1912 averaged £205, the value of one ton of concentrate of 71.6% was £146 15s., less smelting charges of about £6, according to *The Mining Magazine* of March 1912. This leaves a value of about £140 15s., equal to \$680 per ton of concentrate, or \$0.425 per pound of tin. Therefore an extraction of 1.97 lb. tin per ton would be required to pay expenses, corresponding with an extraction of over 82% on 2.38-lb. ore. Such an extraction is impossible with a ratio of concentrating of nearly 700 to 1, and rock of this grade does not deserve the name of ore. Anyhow, it is remarkable enough, that material of 5 to 6 lb. tin per ton can be worked at a profit, and I am certain that it would be greatly appreciated by the tin mining community, here and elsewhere, if Tasmanian engineers would give a detailed description in the technical press of the mining and treatment methods of an ore which would be considered waste in most other countries.

M. G. F. SÖHNLEIN.

Machacamarca, via Oruro, Bolivia, November 23.

[The last report of the Anchor Tin Mining Co. showed a loss of \$8500 on the year's operations, showing that Mr. Söhnlein is correct as to the property being worked at a loss, yet not nearly so much as his figures would indicate. The Anchor tin mine is known as being the lowest grade in the world, and everything is in its favor for cheap work. Mt. Bischoff costs total \$1.15 per ton, using similar methods of treatment. It might interest Mr. Söhnlein to know that in New South Wales, dredges are handling gravel containing 1 lb. and under of tin per cubic yard, at a profit. Of course dredging is considerably cheaper than open-cut mining and stamp-milling, yet these results are obtained. Tasmania produces 3700 long tons of black tin, 65% metallic, per annum, and this comes from low-grade mines where the tin ore is either treated by hydraulicking, or simple mining and milling methods. Most of the black tin produced in Tasmania is treated by the Mt. Bischoff smelter at Launceston, and metallic tin is exported.—EDITOR.]

Special Correspondence

BUTTE, MONTANA

REVIEW OF THE MINERAL INDUSTRY, 1913.

No new mines of importance were opened in Montana coalfields during the year. The three principal producing fields are Red Lodge in Carbon county, Roundup in Musselshell county, and the Belt field in Cascade county, supplying respectively the Northern Pacific, the Milwaukee, and the Great Northern railway systems. Statistics issued by the state coal mine inspector estimate the 1913 production at 3,365,000 tons. Except for railway use the increase of production from Montana coalfields was not important. Wyoming on the south, and Alberta on the north furnish better coal for retail consumption, while the coke industry in Montana is dead. The clean hard coke now used at Montana smelters comes from Colorado and Canada. The strike of the coal miners in the Trinidad fields of Colorado is having an indirect effect on the Montana coal trade. Much of the coal used in southwestern Montana comes from the Wyoming fields, but the coal scarcity in Colorado has made a better market there for the Wyoming coal, so that Montana customers have been neglected. This has undoubtedly increased the sales of Montana coal at home. In western Montana, some attempt has been made to mine and market the Miocene lignites. Their poor storage qualities, high ash, and low heating power restrict their use to limited markets near the mine. The immediate future of the coal industry in Montana looks none too bright. Beside the better coal which comes in from neighboring states, it now appears that the railways and other power consumers are to use hydro-electric power in place of coal. The Anaconda Copper Mining Co. has taken the initiative and displaced nearly all its steam plants with electricity from water-power. In like manner electric locomotives have displaced steam traction almost entirely on the Butte, Anaconda & Pacific railway. Now comes the Chicago, Milwaukee & St. Paul railway with plans matured and equipment in part ordered for the electrification of 450 miles of its main line from Harlowton, Montana, to Avery, Idaho. No definite announcements have been made so far by the other transcontinental roads; but the prediction can be safely made that they will all be electrified within the next few years. Not that water-power can supply them all, but gas engines in power-plants at the coal mines will displace the present wasteful system of separate power units with each train load.

There was no production of oil and gas in Montana in 1913, but mention is made of it here because of the several serious attempts which have been made during the year to find commercial fields. Across the state from north to south, east of the Rocky Mountains, more or less drilling has been done, but so far without success. The zinc-mining industry in Montana is particularly interested in the possible development of natural gas. The heaviest burdens which the zinc mines of this state have to bear are the freight rates to, and treatment charges of, the zinc smelters in the Mississippi Valley.

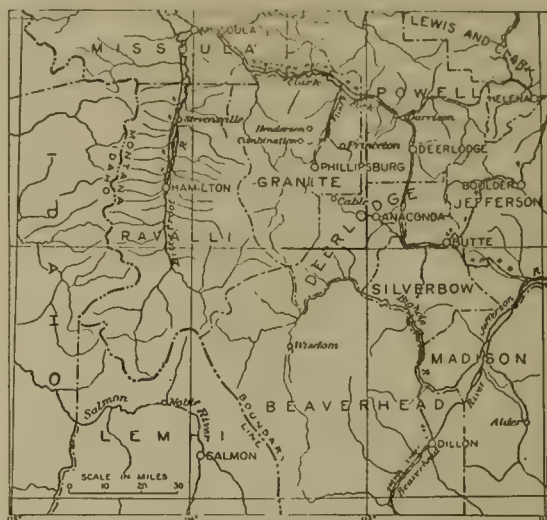
The one operating cement plant in Montana, at Trident, on the Mississippi river, has had a successful year, and is said to have been operated nearly to capacity, which is 1500 bbl. per day. South of Livingston, near Gardiner, another cement plant is in course of erection.

No phosphate rock is mined in Montana as yet, but the U. S. Geological Survey has done a lot of prospecting for it, and has reserved a number of areas where it has been found. The smelters have so far taken no active steps toward the use of sulphuric acid in the manufacture of fertilizer.

The sapphire mines at Yogo, in Fergus county, are reported to have had a prosperous year.

The important gold producing counties are Madison, Silverbow, Broadwater, Fergus, Blain, and Lewis and Clark. The source of the gold varies widely. In Madison county the four dredges of the Conroy Mining Co. are the chief producers. In Silverbow county the gold is a by-product of the copper ore, and does not amount to much. It takes 5,000,000 tons of ore to yield 30,000 oz. of gold, which means about 12¢. per ton. The milling ores are found in Fergus and Blain counties, both of which contain several cyanide plants. Many other counties of the state yield various amounts of gold, but are not comparable in importance with those above mentioned.

Silverbow county so far exceeds all other counties of the state in silver production that the others need hardly be mentioned. It should produce close to 11,000,000 oz. again, while the rest of the state may total 1,500,000 oz. The silver from Butte, in Silverbow county, is chiefly a by-product of the copper ore, averaging about two ounces per ton of ore mined. Jefferson and Granite counties are the others which each produce several hundred thousand ounces of silver. The ore is mostly shipped to smelters for treatment, and is not milled



MAP OF WESTERN MONTANA.

in local plants. Beaverhead county will show an increased silver production for 1913, because of the reopening of the Hecla district.

Copper production is of course the most valuable mineral industry of Montana. The other copper districts of the state are hardly worth mentioning. Their sponsors keep heralding them as 'second Buttes,' but there are only three other counties that will pass the 100,000 lb. mark for the year. These are Beaverhead, Broadwater, and Granite counties.

The Coeur d'Alene produces more lead in a day than Montana does in a month. Montana has no important lead mines. The lead which Montana produced in 1913, came from ores mined chiefly for their precious metal content. Many counties in the state ship some lead ore, but most of it comes from Jefferson, Silverbow, Beaverhead, Cascade, and Lewis and Clark counties. If electric smelting of complex sulphides proves practicable, there are many idle mines in Montana which will be able to ship a lead product.

Zinc mining is becoming an important industry at Butte. For 1913, Montana will be credited with about 85,000,000 lb. of zinc, nearly all from the Butte & Superior mine at Butte. For Butte, the zinc outlook is bright, and it is probable that other mines will become zinc producers within the next few years. In other districts the zinc mines have not shown much progress. The zinc generally occurs with other sulphides

which prevent satisfactory wet concentration. If the hydro or electro-metallurgists bring forth something practical the situation will be changed, but under present conditions there is no promise of important zinc production in any other part of Montana but Butte.

Tungsten has been found in several localities in Montana, but apparently not under commercial conditions as yet, for no production is reported for 1913. There has been some talk of the molybdenum in Emigrant cañon, Park county, but no shipments have been made, to my knowledge.

No railroads have been built in Montana during the past year primarily to open up mining country, but some have been built which benefit mineral districts. The Chicago, Milwaukee & St. Paul has built branches in Fergus county, improving transportation conditions to several mining districts. Both the Milwaukee and the Great Northern have been building through parts of eastern Montana, which may contain commercial coalfields and possibly oil and gas. A railroad used principally for ore transportation is the first in Montana to adopt electric locomotives. The Butte, Anaconda & Pacific railway is now using electric haulage on both its passenger and freight trains. The electric power comes from Great Falls, 130 miles distant.

The mining industry is considerably interested in hydro-electric developments in Montana. Power is made cheaper, cleaner, more dependable, and less expensive to install; and for the hydro-electric processes it is indispensable. Most of the developed water-power in the state is on the Missouri river and its headwaters in various places. In addition, however, the Clarke fork of the Columbia at Thompson Falls is being harnessed, and power from that source will soon be available. At present the hydro-electric plants in Montana can furnish 72,000 horse-power.

No unexpected developments of importance were made in the Butte mines in 1913. No new mines of importance have come to the front. The disseminated copper of the Butte & Duluth mine has been proved by drilling to be more extensive than was anticipated. The Butte & Superior Copper Co. has its zinc mine on a better producing basis. The Anaconda company has begun prospecting for zinc in the old Nettie mine west of Big Butte, and will sink a deep shaft there. The Rainbow Lode Development Co. is prospecting for zinc east of the Butte & Superior; its shaft is nearly 1000 ft. deep now.

The Southern Cross mine in the Georgetown district has been shipping steadily to the Anaconda smelter. Its present rate of production is 250 tons per day. The Barnes-King Mining & Development Co. has had the most successful year of its existence. It bought the North Moccasin mine in Fergus county and paid for it out of profits from the mine. The Company is also prospecting the Plegan-Gloster mine at Marysville. The mines in the Little Rockies, in Blaine county, were not particularly active in 1913. The Ruby Gulch Co. was running until the mill burned down last fall. The Keating mine and the Ohio mine in the Radersburg district were producing during the year, but no new developments of importance were made in Radersburg.

PLATTEVILLE, WISCONSIN

REVIEW OF THE WISCONSIN ZINC INDUSTRY, 1913.

In all respects save one, 1913 was the greatest year that the Wisconsin zinc-lead fields ever experienced. There was as much exploration of ore ranges in the centre of active mining operations and virgin ground as during the boom period of 1906. While there were only a few new power, mining, and concentrating plants built during the year, it was one of the best years considered from the viewpoint of building operations. The high prices for metal which started with the year were reflected in exceedingly good prices for ore, and mining companies all over the field, acting on the presumption that another such year as 1912 would be enjoyed in the field, ex-

erted extra efforts to secure a maximum production. A steady decline in prices for spelter set in about the middle of February, which continued throughout the remainder of the year, and the cheerful conditions prevailing soon after the first of the year gave way to discouragement, a curtailed production, in some quarters reduction of working forces, and in others a complete shut-down indefinitely. From the standpoint of profits, the past year gave little to the producer compared with 1912. One thing especially noteworthy, and to the great credit of the operators, is the fact that wages were maintained all the year in spite of declining markets. Another feature, equally noticeable, proved conducive to the fine production reported, was in the competition between ore buyers, particularly the lower grades, in which the Mineral Point Zinc Co. almost eclipsed the other smelters. The increased offerings enabled many low-grade producers to keep operating who otherwise might have been compelled to suspend operations altogether.

The principal producers in the field during the year were the New Jersey Zinc Co.; the Wisconsin Zinc Co., a subsidiary organization of the American Zinc, Lead & Smelting Co., under



NATIONAL ZINC CO.'S SEPARATING PLANT.

the personal management of Homer S. Snow; the Vinegar Hill Zinc Co.; the Cleveland Mining Co.; and the Frontier Mining Co. A conservative estimate of purchases made in the field by the New Jersey Zinc Co. was about \$1,000,000. The Wisconsin Zinc Co. purchased the East End and Federal mines, and 500 acres of mining lands in the New Diggings district. The Vinegar Hill Zinc Co. operated seven mines scattered over the field, in addition to a large ore-separating plant at Cuba. The Frontier Mining Co. developed and equipped six mines, built an electrostatic separating plant of the Huff type at Linden, and made a large output of ore. Milwaukee capitalists were active in five of the fifteen mining camps of the field. The Cleveland Mining Co. installed two new modern mining equipments, besides performing considerable useful prospect work, and developing two new zinc ore producers.

Reviewing the field by districts the following more important events transpired: The New Jersey Zinc Co. purchased the Highland, Franklin, and Minter mines at Highland, at a cost of \$250,000. All were more or less equipped. The central power-plant of the Kennedy mine was enlarged and remodeled at great cost, two new mines were developed, and a pump shaft with complete equipment at a cost of \$10,000. The O. P. David mine at Montfort, the only producer in this district, developed new orebodies and completed a new shaft, also pumps and a Lawson aerial tram. The Linden district boasted six active producing mines, the Ross Bros., Glanville, Optimos No. 1 and 2, Hinkle, and Saxe-Pollard. Big finds of zinc ore were made in all except the Hinkle. Mineral Point showed little mining activity. The Mineral Point Public Service Co. increased its capacity to furnish electric power for the northern half of the field. Heavy consignments of carbonate of zinc ores were delivered to the New Jersey Zinc Co., from Colorado, New

Mexico, and Arizona. The Milfin district reported shipments of zinc ore from three stations, Harker, Rewey, and Livingston. From Livingston came the ores of the Coker mine, owned by the New Jersey Zinc Co. Also the ores from the Rundell & Ellsworth mines, the property of the Vinegar Hill Zinc Co. The Pent Mining Co., of Milwaukee, shipped from Rewey and Harker. The Grunow, Peacock, B. M. & B. and Lucky Six mines, active all year, delivered ore to Harker. The Biddick mine, a new property, was developed and equipped. Heavy purchases were made in this district by the New Jersey Zinc Co. The Slack mine passed out of existence and the equipment offered for sale. Platteville saw a very large decline in output, due to a long list of unexpected events. The great Empire mine, for eight years a steady producer, paid \$250,000 in dividends, and was worked out. Also the Homestead was exhausted. The Klar-Piquette mine, the heaviest dividend payer of this field, closed down the last week in December on account of prices. The only active producer during the year was the East End mine. The Empire roasters ran double shift on ores from the Wisconsin Zinc Co.'s mines. These two gave to Platteville the showing it made for the year. Cuba City witnessed much prospecting and the amalgamation of the Midway, Board of Trade, Jarrett, and Little Dick mines into one parent organization to be known as the Little Dick Mining Co. The Wicklow was abandoned. At Elmo near at hand the Vinegar Hill developed the Masbruch mine. A double complement of 18-in. cross-head lift pumps, the heaviest in the field, were installed here. The Benton district took the lead over all its competitors for the year with a production of over 46,000,000 lb. of zinc ore. Six new mines were developed, equipped, and placed in operation, the Martin, Bull Moose, San Souci, Hird, North Blende & Ewing. The Frontier Fox, Crawhall, Indian Mound, Ewing, and Lawyer & Temple mines gave to this district its splendid output. About 20 low-grade producers with equipment were put out of commission during the year. New Diggings furnished the sensations of the year. Here, two new ore ranges were proved by drills, exceeding in extent anything ever before discovered in this field. The first was found on the Thompson land adjoining the Crawhall mine on the east. An east and west deposit was determined to be over 1100 ft. long, from 40 to 65 ft. thick, and about 200 ft. wide. Shullsburg experienced an 'off' year. Hazel Green prospered through the operations of the Kennedy and Cleveland mines, both of which averaged four cars of ore per week, all delivered to Mineral Point. Two new mines were developed by the Cleveland Mining Co., the Lawrence and Scrabble Creek. Both were supplied with independent plants operated by electricity. The Witherbee estate was purchased and will be mined from the Cleveland side. Four-ton electric motors are being used here for tramming ore to mill.

The production of ores for the year 1913, for the Wisconsin zinc-lead field, by districts, is shown below:

Camp.	Zinc, lb.	Lead, lb.	Sulphur, lb.
Benton	46,010,000	1,048,600	39,331,650
Hazel Green	31,276,000	776,900	82,000
Platteville	30,132,000	560,170	4,130,500
Galena	26,458,000	1,004,390	2,385,500
Livingston	24,722,000	140,000	.....
Linden	20,476,000	606,830	3,274,880
Cuba	18,571,000	1,029,680	6,924,690
Shallsburg	18,396,000	949,820	.....
Harker	6,836,000	119,270	.....
Highland	2,886,000	100,000	.....
Montfort	2,648,000	161,610	.....
Mineral Point	2,365,000	59,200	.....
Rewey	1,382,000	.....	.....
Dodgeville	608,000	70,000	.....
Potosi	308,000	40,000	.....
Total	233,074,000	6,666,510	56,127,220

The above figures show actual deliveries from producing mines, but included in same is the refined ore from separating plants. The Mineral Point Zinc Co. shipped during the year to the smelters 430 cars of roasted zinc ore equal to 31,520,000 lb. Among smelter representatives, the output was divided as follows: Mineral Point Zinc Co. 51,521 tons; Grass-elli Chemical Co., 21,059 tons; National Separating Co. 11,343 tons; Illinois Zinc Co., 8495 tons; Empire Roasters, 8260 tons; M. & H. Zinc Co., 6636 tons; Linden Zinc Co., 2799 tons; Joplin Separator Works, 2824 tons; American Zinc Co., 2550 tons; Wisconsin Separating Co., 550 tons; Sandoval Zinc Co., 30 tons; total, 116,537 tons. There was left in storage at various places in the field between 4000 and 5000 tons of concentrate.

H. S. Snow, general manager for the Wisconsin Zinc Co., when interviewed on the prospects for the current year, said: "I am optimistic and think things will be better. I don't look for anything big, but for a fair market." With conditions fairly normal, Wisconsin should be able to produce not less than 150,000 tons of zinc ore during the present year. No appreciable gain in the production of lead ore need be anticipated. Sulphur production will be less than that shown for the year just past.

JOHANNESBURG, TRANSVAAL

NATIVE LABOR.—WHITE MINERS AND STRIKES.—GOLD OUTPUT.

The outlook for the Rand gold-mining industry is not very bright. The darkest cloud is the chronic scarcity of native labor; in fact, it may be stated that there is less available for the mines today than has been the case for many years. During the winter months, May to September, there is always a shrinkage, but this year the scarcity of natives was much accentuated by the ill advised strike in July. This drove many of the more intelligent natives home to their *kraals* at the first available opportunity. The result was that, in July and August alone, the labor supply was depleted to the extent of 20,000 natives at the gold mines alone. Fortunately, the shrinkage of natives has decreased month by month, until by the beginning of the year it is anticipated that a slight gain may be shown in the returns. Up to July 1913 the output of gold on the Rand was showing the usual steady increase, the May figures creating a highly creditable record; but the strike and the attendant riots so upset the industry that the growth of the first six months has been converted into a loss. The total gold output for the year will for the first time in the history of the Rand record a decline. Several thousand Europeans have been dispensed with from the mines, work is almost impossible to obtain, and the closing down of several deep and low-grade mines has not tended to improve matters. The strike brought no material advantages to the men, simply because they had no substantial grievances, but it has created a bad feeling between themselves and their employers, and a condition of affairs not altogether pleasant to contemplate. The agitators and socialists have made the best of their opportunity to create ill feeling between the men and their employers.

On December 11 Sir Llonel Phillips, one of the leading managers of the Eckstein group, was shot in the street while proceeding from the Corner House to the Rand Club for lunch. He was highly respected by everyone, and this dastardly attempt on his life has given rise to the expression of much indignation. Fortunately the shots did not prove fatal, and the victim is progressing favorably.

The Chamber of Mines reports a serious decline in the gold output for November when compared with October. The decrease for the whole of the Transvaal was no less than 44,945 oz., of which the Rand alone is responsible for 43,195 oz. The shorter month is to some extent responsible for this, but usually the output materially improves during the last two months of the year. This year the continued shrink-

age of native labor has made such an improvement impossible. The total Transvaal output for November was 673,486 oz., valued at £2,860,788, of which 644,320 oz., worth £2,736,897, came from the Witwatersrand. It was confidently expected that the November output would at least reach a total of £3,000,000, and it is clear that the total gold output for 1913 will fall short of that recorded for the preceding year. The Rand, however, still possesses some recuperative power in reserve, and with an amelioration in the native labor position, progressive outputs will again become the order of the day.

NEW YORK

BRADEN MINE.—FIRST NATIONAL COPPER.—CHEAP SHARES.

Braden showed some improvement in output during December, presumably as a result of the 'all-star' staff now in charge of technical operations, Pope Yeatman and Walter Broadbridge having been on the ground for some time. It is somewhat difficult to judge the state of affairs at Braden by output figures, since the production during July was little more than one-half that in June, and the October output was double that for September. During December, the new mill at the Braden treated 93,600 tons of 2.15% ore, but only made a 70% recovery of the copper. The old mill treated 10,359 tons of 1.99% ore, with an average recovery of 80%. It is evident that the new mill is being used to keep up the output while the old one is being readjusted to obtain better results. When both mills are tuned up, and if the mine can furnish enough ore, which is perhaps open to doubt at present, the monthly output of the Braden should show a big increase.

New York is much interested in the reports from the First National, at Coram, and while it is, of course, premature to suppose that all problems have been overcome because the results during the first two days seem good, they are at least decidedly encouraging. Before getting excited over First National, it is well to remember that the California mine and the holding company are two different things. The mine is owned by the Balaklala Consolidated Copper Co., capitalized at \$10,000,000, and was reported to have about 2,000,000 tons of 2.6% copper ore and large reserves of lower-grade material, so it has a future as a producer if it can operate at a profit. The jubilation over solving the sulphur difficulty ought not to obscure the fact that the ore contains almost as much zinc as it does copper, and nothing has been said as to what effect this is likely to have on the processes for recovering the copper. If, by any chance, the zinc could be recovered as well as the copper, the mine ought to be very profitable. However, the \$10,000,000 stock of the Balaklala company is held by the First National Copper Co. with a capital of \$3,000,000. The shares of this concern are \$5 par, \$3.75 having been paid on them, and were boosted up as high as \$8 at one time by Lawson's well known methods. Recently they were up to nearly \$4, but declined to \$3 as a result of market operations. First National has been traded in a good deal on the Curb, but is not one of the favorites of the outside market, where Tonopah Merger, Canadian G. & S., Big Four, West End, Braden, Giroux, and various Cobalt companies lead in the number of sales recorded.

Speaking of the Curb, it is interesting to note that the so-called assets of J. Thomas Reinhardt were sold at auction last week at an average rate of little better than two shares for a cent. What they were like is indicated by the fact that no purchaser appeared for large blocks of Porcupine Northern, Central, and Southern, while North Carolina state bonds of a face value of \$108,000 sold for \$165.

And in talking of making the best of a bad thing, it is evident that the Assets Realization Co. is having heavy going. This is a company which makes a business of resuscitating moribund organizations, and not long ago it took

over the Heinze ventures in addition to a long list of others. Now it seems to be in need of assistance itself, for shareholders are being solicited to subscribe to an issue of \$1,000,000 in 6% notes. This organization holds about 450,000 shares of Stewart, and that stock has been declining, perhaps in the fear that it will be found necessary to put this on the market.

LONDON

AFFAIRS OF THE GREAT COBAR COPPER COMPANY.

The directors of the Great Cobar Copper Co. have had an anxious time during the past year, and their worries culminated this week when the election of two of their number was challenged by the 'insurgents and dissentients.' The result of the poll was a near thing, and the vote of censure was only defeated by a narrow margin. As readers of the *Mining and Scientific Press* are aware, the Company owns the Cobar copper mine, situated inland in New South Wales. For many years the zone of secondary enrichment yielded immense profits to the Australian owners. These men, being sagacious in their day, knew that orebodies do not persist in depth forever. If they were not fully aware of the principle of the impoverishment of the mineral deposit in depth, they knew that profitability did not extend downward indefinitely. As they were interested in Cobar commercially rather than geologically, they wisely decided to realize future expectations in ready cash, and complacently received the suggestions of their friends to find buyers in London. After one or two futile attempts, the deal was effected in 1906 on an unusually grand scale even for London. The vendors received £800,000 in cash and £206,000 in shares. Large sums of money were raised for the reorganization of the development scheme, and for the building of a modern metallurgical plant. The share capital amounts to £932,710 and there are £667,300 debentures. The engineers on whose reports the Company was formed were C. M. Rolker, J. D. Kendall, and W. J. Barnett. Strangely enough, their estimates as regards copper content have not been verified in practice, for the recovery is nearer 2% than the 3.5% mentioned. Moreover the gold and silver have not provided as useful an addition to revenue as was expected. The Company also purchased the Chesney copper mine, and coal properties near Lithgow. The Cobar ore was highly basic and considerable silicious flux had to be purchased. Subsequently an amalgamation was effected with the Cobar gold mine which contains silicious gold ore with a small amount of copper. The two ores made an efficient smelting mixture. There were many mistakes in connection with the smelter. To begin with, the American firm that secured the contract through its English representative, repudiated the terms on which the contract was based, and the work of estimating and distributing orders for the plant had to be done a second time. Then when the plant was ready all sorts of mishaps occurred, and the directors made a scapegoat of the manager. They exhibited perspicacity when they invited H. C. Bellinger to come from Montana to straighten out the smelter. He did so well that they appointed him general manager. This venture, however, did not bring prosperity, and they and others are now blaming Mr. Bellinger, when they should probably more justly be blaming the contrariness of the ore deposit. He has resigned and the management has been placed in the hands of Bewick, Moreing & Co., whose Australian representative, G. C. Klug, is to be in charge. As far as can be ascertained, Mr. Klug is not to be continuously resident, and is only to make periodical visits, still retaining control of the many interests of his firm. People in London think this a peculiar arrangement, and argue that if Mr. Bellinger could not attend to administration, mining, and metallurgy, when the whole of his time was devoted to the Company's work, how can Mr. Klug be effective when only putting in one-sixth of his time. The explanation surely must

be that separate sub-managers are to be appointed for the mine and the smelter, as has already been done in connection with the concentrator, where G. A. Laird has recently been put in control. This reminds me that the concentration plant erected at the Chesney mine gave trouble owing to no qualified man being on the spot. The Chesney ore is silicious and not high in copper and gold. Consequently it has to be concentrated. The ore is amenable in fogs, but the losses on tables are serious, so that the Minerals Separation flotation process has been adopted. The jig department has not been at all satisfactory, but on the other hand, the flotation plant, by recovering 77% of the metallic content of the tailing and of the re-ground jig-middling, has done extremely well. No doubt Mr. Laird will soon put things on a more satisfactory footing. The worst feature of the position at Cobar, however, is the present condition of the orebodies. The northern orebody which was lost below No. 10 level, has not yet been found, though the workings are now down to No. 14 level. The central orebody shows a diminution in area, and a creep in the southern and central orebodies has rendered 150,000 tons unavailable for stoping, at any rate for the present. It is convenient here to give some figures relating to present output and reserve, the figures being for the year ended June 30, last. During this time 222,377 tons of Great Cobar ore was smelted, together with 45,779 tons from the Cobar gold mine, 8738 tons of concentrate from Chesney, and some purchased ore, making a total of 288,172 tons. This yielded 5811 tons of copper, 27,136 oz. gold, and 127,543 oz. silver. The average copper content recovered equaled 2.017% of the ore treated. According to Mr. Bellinger, the ore reserve was 1,468,749 tons averaging 2.5% copper. At the Cobar gold mine, the reserve is estimated at 308,545 tons averaging 1.7% copper and 6.8 dwt. gold. At the Chesney, the orebody is narrowing with depth and the ore reserve is estimated at 612,986 tons averaging 2.58% copper. The accounts for the year show a working profit of £81,925, and £34,355 was brought in from the previous year. Out of the balance, £40,009 went to debenture interest, and £57,500 to the purchase of debentures, while £48,414 was written off the account for reorganizing the metallurgical department, an expense incurred a few years ago. The seriousness of the situation may be gauged by the fact that W. Pellew-Harvey, a director who joined the board on the absorption of the Cobar gold mine, felt it his duty to take action and to visit the mine, at the same time studying similar practice to be found elsewhere in Australia. His report has been issued by the directors, and it will be found that in many cases he is unable to agree with Mr. Bellinger's estimates. Mr. Pellew-Harvey is known in the west of America, and he is eminently a reliable man. Another inspection was made during the past year, this time by C. S. Herzig who went on behalf of a London group financially interested in the Company. His report was much more optimistic. Because his more hopeful prognostications have not been fulfilled, this group commenced the agitation to which I referred at the beginning of this letter. A meeting of dissentients was called a month ago, when Rowland Feilding, a mining engineer, and F. Kimber Bull, a lawyer, made an attack on the present board of directors. When the regular yearly meeting of shareholders was held last week, the re-election of the chairman, Andrew Haes, and of W. J. Barnett, a director, was opposed, and the names of Messrs. Feilding and Bull were put forward as alternatives. The polling showed that a large amount of genuine dissatisfaction exists among shareholders, for the old hands were re-elected by a not very substantial majority.

The Cobar mine was expected to produce 10,000 tons of copper per year, double the amount that has been possible. The profits were expected to be sufficient to redeem £100,000 debentures every year and provide also handsome dividends to the shareholders. The debenture holders have received their interest, but an insignificant amount of the debentures has been redeemed. The present position is far from satisfactory.

BRITISH COLUMBIA

THE BRITANNIA MINE AND OPERATIONS -- THE INDIAN RIVER DISTRICT.

During the past year, the Britannia Mining & Smelting Co., that owns the Britannia mine, on Howe sound, acquired nearly all of the mineral claims adjacent to and along the strike of the mineralized zone, thereby securing a solid block of ground nearly five miles east and west by about a mile wide north and south. The amount of mineralization in the area has always been recognized as of great extent, and the Company has proved by working openings in one portion of the property, known as the Fairview zone, that the mineralization extends to a depth of over 2000 ft. below the summit of the ridge, that it has a length of upward of 1200 ft. along the strike of the zone, and a minimum width of approximately 500 feet. The Britannia mine is on the coast range, which is built up principally of granitoid rocks, mostly coarse quartz diorites or grano-diorites, and the mineralized zone of this property occurs in an inclusion consisting largely of slate alternating with a dark intrusive, probably a diorite-porphyr, usually crushed and altered into a greenish chloritic schist. In treating the low-grade ore, concentration is used, and the most successful process so far attempted has been by the Minerals Separation flotation process. The concentration is in the ratio of about 4 to 1. The production from this property during 1913 was 212,000 tons of ore containing about 1.5% copper, 40c. in gold, and from 0.5 to 1 oz. silver per ton. The equipment is to be enlarged shortly by the installation of a new concentrating mill with a daily capacity of 2000 tons. The system of transportation of the ores from the mine to the beach is being improved by the construction of a double-track gravity tramway, one mile long, with an average grade of 15%; also a 'switchback' track, five miles long, with a 3% grade, on which gasoline locomotives will be used; a 9 by 12-ft. tunnel 3600 ft. long, and a 1200-ft. vertical chute connecting the tunnel with the upper mine workings.

The Indian river rises in the mountains about 8 miles to the southeast of the head of Howe sound, and flows south, emptying into the north arm of Burrard inlet, some distance east from the city of Vancouver. The headwaters of this river are situated about 6 miles east from the main workings of the Britannia mine. Although trails have been covered by Indians and trappers in this country for many years past, it is only within the last three years that any mineral discoveries have been reported in the neighborhood of the headwaters of the Indian river. The prospectors who made these discoveries for a long time considered that the mineralized zone was an extension of the Britannia country, but an examination which was made last summer showed that the general geology is practically the same in both localities, yet the wide zone of schists in which the Britannia orebodies occur is lacking on this portion of the Indian river, so far as at present known. Outcrops of chalcocopyrite are, however, found in a zone some 500 ft. wide, with a northwest and southeast strike, and so far as at present known having a length of about 10,000 ft. and appearing to be rather paralleling the Britannia zone than as an extension. Because of the heavy growth of underbrush, prospecting has been difficult. Although about 12 mineral claims, each 1500 ft. long by 1500 ft. wide, have so far been located along this zone, yet it is impossible until more work has been done to connect up the various outcrops along the line of strike. It would appear, however, as though there were a large number of lenticular deposits of copper ore in a quartzose gangue rather than a well defined continuous lead. Some of the outcrops have a width of from 10 to 25 ft., as proved by stripping and open-cut work, but in no case could be found sufficient work done to establish the length of any one outcrop beyond 100 feet.

General Mining News

ALASKA

It is estimated that 35 dredges were operated in Alaska in 1913, and that these produced gold to the value of about \$2,650,000, as against \$2,200,000 in 1912. There were also 6 or 8 dredges which, for one reason or another, were not operated in 1913. A number of others are under construction or planned for, according to Alfred H. Brooks of the U. S. Geological Survey.

Eight copper mines were operated on a productive basis in 1913. It is estimated that about 42,000 tons of ore yielded 19,700,000 lb. of copper valued at \$3,014,000, \$160,000 of gold, and \$150,000 of silver. The decrease of over 9,000,000 lb. in copper production compared with the previous year is due to the fact that the largest producer was practically closed down for about four months.

The Katalla oilfield continues to be the only place of any importance in the petroleum industry in Alaska. Another well was drilled in 1913 to a depth of about 800 ft. This, and some of the old wells, by pumping furnished petroleum for a small refinery. The gasoline, which is of high grade, finds a ready market at the settlements on Prince William sound and Cook inlet.

About 15 placer mines were operated in the Kenai peninsula during 1913, but work was hampered by low-water conditions. Most of these were only very small operations, but one relatively large hydraulic plant was at work on Resurrection creek, and two smaller ones on Bear creek. Prospecting dredging ground on Kenai river was continued. The hydraulic plant on Crow creek, north of Turnagain arm, was operated throughout the open season.

CORDOVA

(Special Correspondence.)—The last payment, on the total of \$146,000, on the option of the Smith-Monahan properties on Valdez creek, has been paid by the Valdez Creek Placer Mines Co. One mile of 36-in. pipe was ordered from the Joshua Hendy Iron Works of San Francisco, and this has been shipped to the property. By July 1, 1914, it should be complete. The daily capacity will be about 4000 cu. yd. of gravel.

Cordova, December 25.

FAIRBANKS

About 150 placer mines were operated in the Fairbanks district for a whole or a part of 1913. These gave employment to about 1000 men in winter and 3000 in summer. Preliminary estimates indicate that the value of the placer gold production was about \$3,450,000.

IDITAROD-INNOKO

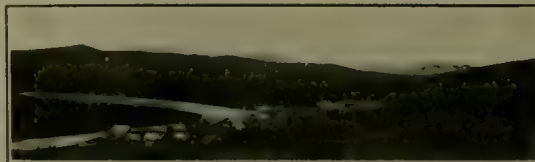
As in the other Yukon camps, the shortage of water greatly hampered mining operations. This condition, together with the fact that certain claims were not worked because they were being combined into large holdings for the purpose of exploiting in a large way, led to a great curtailment of gold output compared with the previous year. Preliminary estimates indicate that the value of the gold production from the Iditarod-Innok districts was about \$2,000,000, of which about \$200,000 is to be credited to the latter area. There was some prospecting of lode claims, but the cost of mining is so great that few have been attracted to quartz development, according to Alfred H. Brooks of the U. S. Geological Survey. In the Iditarod region the largest production came from the mines on Otter and Flat creeks, but mining was also done on Happy, Willow, Moore, and Chicken creeks and in Glen gulch. The dredge on Flat creek was operated throughout the summer, and plans have been made to install a boat

on Otter creek. The chief activity in the Innoko district in 1913 was on Little creek, where a considerable area of rich new placer ground was discovered. Work was continued on Spruce and Ganes creeks. Ophir creek is worked out and practically abandoned. Yankee creek ground has been acquired by a dredging company, and mining is at a standstill pending the construction of a dredge.

NOME

Trade at Nome during the season of 1913 was as follows: Vessels arrived, 43, of 79,143 tons register; general merchandise from United States, 15,534 tons; fuel oil, 6719 tons; coal, 13,841 tons; lumber, 1,386,937 board feet; placer tin exported, 100 tons; and gold, 135,313 oz. Passenger arrivals were 1795, and departures 2943.

Thirty-one dredges were operated for a part or the whole of the summer, on the Seward Peninsula, according to Alfred H. Brooks of the U. S. Geological Survey, with an estimated gold recovery of a value of \$1,800,000. These dredges had



COUNCIL, ALASKA.

a combined daily capacity of 33,300 cu. yd. Four new dredges were erected in 1913, and several others were in course of construction. Others are contemplated. In addition to 31 operated, there were 6 dredges idle in 1913. Of the dredges engaged in productive mining, 11 were in the Nome, 11 in the Solomon, 5 in the Council, 1 in the Kougarok, and 4 in the Fairhaven, and 1 in Port Clarence district. Of other than dredge mining there was very little.

RUBY

According to H. M. Eakin, placer mining in the Ruby district, as a whole, has shown considerable advancement over the previous year in spite of certain unfavorable circumstances. The distribution of profitable placers has proved more irregular than was expected, so that after working out limited areas many plants have had to take up prospecting for new deposits rich enough to be worked instead of continuing actual mining. The season of 1913 was exceptionally dry, so that only the plants equipped with pumping apparatus could work at full capacity. All told, there were 41 plants engaged in actual mining in the Ruby district, operating 38 claims on 14 different creeks and employing a total of about 230 men. There were also a number of prospecting outfits working on these and neighboring creeks. Of the 41 plants, 33 are equipped with steam machinery, aggregating over 750 hp. The other 8 plants use manual methods.

ARIZONA

COCHISE COUNTY

A fire occurred on the 200-ft. level of the Czar mine on December 31, but the helmet crew put it out after 24 hours' fighting. Surveyors are working on the site in the Warren district chosen by the Copper Queen company for its new concentrating plant. This will treat the low-grade ores proved on Sacramento hill.

GILA COUNTY

(Telegraphic Correspondence.)—The Inspiration flotation plant has started work, and high recoveries are being made. Miami, January 13.

(Special Correspondence.)—During December the Miami mill treated 102,000 tons of ore yielding 3,300 lb. of copper.

Development of the Captain orebody is being actively carried on. The 420-ft. or main tramming level is 75% completed, and work on the sublevels is under way. An electric pump of 2000 gal. per minute capacity has been installed on the McLean ranch, near Burch, where the Company recently sunk a 24-in. well, 120 ft. deep. It is capable of furnishing a large amount of water, and is to be used as a reserve, in addition to the Old Dominion supply.

The Inspiration 600-ton flotation test-mill is in operation. It will probably be worked three shifts per day with 25 men. Rudolph Gahl will be metallurgist, C. E. Singer, of Los Angeles, chemist; G. E. Hunt will be in direct charge of the mill, and J. G. Flynn and C. G. Dressel will act as shift bosses under him. J. L. Greninger will represent the Minerals Separation Co. locally. Construction work at the concentrating plant is proceeding satisfactorily. The ore-storage bins and sampling mill will soon be ready for the corrugated-iron covering. Another part of the incline conveyor housing between the bins and coarse-crushing plant was completed during the week. The American Bridge Co. has this work in hand. Concrete is being poured for the air-compressor foundations at the main east and west shafts. About 50 carpenters and helpers have been laid off, as the form work here is finished. Concrete for the retaining walls at the concentrator site is still in progress, but is nearly completed. In December there was 4200 ft. of development covered in the Inspiration mine. Further raises are being driven under the Joe Bush ore dump.

Work at the Old Dominion mine in 1913 showed good results generally, especially on the lower levels. It is intended to install two 1200-gal. electric pumps at 1800 ft. when the 'A' shaft is completed to that point. Skips replaced cages in September last, and the new crushing and sampling system was brought into use. Two 100,000-cu. ft. per minute fans were started at the Kingdon and 'C' shafts respectively. The United Globe end of the mine showed satisfactory results. A large quantity of machinery was erected at the 'A' shaft and mill. The copper output in 1913 was about 30,000,000 pounds.

Globe, January 9.

GREENLEE COUNTY

On New Year's day the old smelter of the Arizona Copper Co. was shut down for good. It has been in operation for about 35 years. The new plant is on the San Francisco river below South Clifton. To a depth of 5 ft. around the old plant, the ground is being excavated for treatment.

PINAL COUNTY

The annual report of the Iron Cap Copper Co. states that development in 1913 covered 1610 feet. At 650 ft. the slope is 485 ft., and at 800 ft. it is 47 ft. long. Ore shipments totaled 4899 tons yielding 763,822 lb. of copper. The year's profit was \$38,460.

YAVAPAI COUNTY

The Crosby mine is down 300 ft., \$4 ore has been opened, and at 200 ft. another shoot has been recently cut. There is a 10-stamp mill and cyanide plant on the property.

CALIFORNIA

AMADOR COUNTY

The Kennedy Company is being sued by Lingi Tonelli for \$10,000 damages, for personal injuries sustained in the mine early in December. The case will be heard in San Francisco.

The contract for building the Plymouth mill is to be awarded before the end of the month by Burch, Caetani & Hershey at San Francisco.

The first of the four tailing wheels built by the Kennedy M. & M. Co. was tested last Saturday and found to work satisfactorily by the officers of the Company. Argument in the Kennedy Extension-Argonaut case was concluded the same day.

COLORADO COUNTY

Freight rates on ores between San Francisco, Sacramento, and points on the Placerville branch of the Southern Pacific railway have been reduced as follows:

Value of ore per ton	Present rate.	New rate.
\$50 to \$75	\$2.75	
\$60		\$2.10
\$70		2.25
\$80		2.40
\$100		2.50

NEVADA COUNTY

The annual meeting of the Le Duc Mining Co. was recently held in San Francisco. B. A. Penhall is general manager and vice-president. The long raise to the surface at the mine is finished, and several veins were cut. At the Golden Center mine, Grass Valley, the water is being removed by an air-lift pump, after which an electric pump will be lowered. The Idaho-Maryland mine has been shut down temporarily. Local miners have leased the Rose Hill at Grass Valley.

PLUMAS COUNTY

Gravel mining in the southern part of the county is likely to see a revival. A bond and lease has been taken on the Claybanks mine by W. H. Loftus of Los Angeles. The property is said to be an extension of the drift from the Feather Fork mine.

SIERRA COUNTY

At the Tightner the new shaft is down over 100 ft., the vein being followed. It is 7 ft. wide at this point. The stamp-mill is working full time.

SISKIYOU COUNTY

A silver-copper property is being developed on Rail creek by the Isabella Copper Mining Co., composed of Oakland people. The vein is an extension of that in the Dewey mine, near Gazelle. The McKeen mine, near Callahan, has been bonded to J. S. Bagg and associates.

SHASTA COUNTY

The Field process plant at Redding is now being tested.

TULUMNE COUNTY

The Springfield Tunnel & Development Co., at Sonora, has driven its new 8 by 8-ft. drainage tunnel 100 ft. It is at sufficient depth to drain the gravel deposit. The Company's capital has been increased from \$200,000 to \$500,000. Marysville men are developing claims near the App mine.

The Providence mine has opened rich ore on the 300 and 500-ft. levels, and the stamp-mill is working. J. F. Bluett is superintendent. Work has been started at the New Albany. The Draper is being unwatered. The owners of the Golden Dawn are sanguine as to its prospects. Twenty men are employed at the Garfield. Eastern capitalists are arranging to open the Seminole and Mayflower claims. The Black Oak shaft is being deepened 200 ft. below the 1700-ft. point. Shaft sinking will also be done at the Starr King. In the Syndicate mine driving is in progress on the 200-ft. level.

COLORADO

LAKE COUNTY (LEADVILLE)

The ore and metal output of Leadville during 1913 was as follows, according to *The Herald Democrat*:

Ores:	
Lead carbonate, tons	16,984
Iron, tons	83,275
Sulphide, tons	121,676
Zinc sulphide, tons	52,689
Zinc carbonate, tons	157,286
Silicious, tons	21,450
Total	453,360

Metals:

Gold, ounces	49,261
Silver, ounces	3,315,270
Lead, pounds	23,498,390
Copper, pounds	2,059,911
Spelter, pounds	84,751,468

The total value was \$9,040,359, against \$11,182,616 in 1912. Leadville's total mineral output to date is valued at \$406,451,061. In the same journal, James M. Knight reviews the year's work and present situation of the Leadville district. He considers that the current year will be one of progress. The unwatering of the 'down town' properties will be started at an early date. From Carbonate hill the greatest tonnage of ores was mined, the Western Mining Co. being the principal producer. Carbonate of zinc came from the Wolfstone, and lead ore from the Henriette claims. The Company's daily output was 400 tons of ore from 700 ft. depth, and 200 men were employed. From the Star Consolidated Mines Co.'s lessees about 350 to 400 tons of carbonate of zinc, argentiferous iron and lead ores were produced daily. About 100 men are employed. The Castle View produces 75 tons of ore, while the Yankee Doodle and Little Giant were actively operated. At Iron Hill, the Iron-Silver Mining Co. shipped large quantities of iron, lead, copper, and zinc ores, employing about 250 men. A number of lessees are working. The Louisville has been equipped



MAP OF COLORADO

with a new hoist, and 75 tons of iron sulphide was shipped daily. Ore worth \$50 per ton has been opened in the Belgian. About 150 tons of zinc sulphides per day was extracted from the Colonel Sellers. The A. Y. & Minnie shipped zinc carbonates part of the time, but only iron ore has been hoisted. At Adelaide Park the old Adelaide property has been worked right along by the owners and lessees. The Fairplay produced about 20,000 tons of ore. A cyanide plant is to be erected to treat low-grade ore. Breece hill is the centre of the gold-bearing area. The Ibex is the largest gold producer in Lake county. Six shafts are worked under lease, and 50,000 tons of gold, silver, lead, copper, and zinc ores were mined. Very rich shoots are occasionally cut. Proposed development by the Dividend Mining Co. at the Big Four claims is important. The main shaft is to be sunk to 1000 feet. Fair tonnages of ore have been extracted from the St. Louis, Garbutt, Fanny Rawlings, Bobby Burns, Penn Leasing Co., and others. Twenty-two sets of lessees are working in the Monarch Mining Co.'s claims at South Evans. At the Walker claim the Mosquito Range Co. let a contract to drive an adit until ore was cut, about 400 feet. At Big Evans gulch a considerable amount

of work was done. At Birdseye the Cosmopolitan adit was driven 900 ft., cutting promising stringers of gold ore. The usual quantity of work was done at the mines on Fryer hill, Canterbury hill, Yankee hill, Rock hill, California gulch, Ball mountain, Empire gulch, Iowa gulch, and other parts of the district. The Philadelphia Leasing & Development Co. has opened 20,000 tons of ore on Yankee hill. The Yak tunnel was advanced into the Diamond and Vega ground near the head of Big Evans gulch. An interior shaft was sunk 110 ft. from near the heading, and at 100 ft. drifts driven to the ore-bodies. Thirty leases are being worked, and the tunnel is in good order. Half Moon and Lackawanna gulches received great attention during the year, on account of the good showing in the Mt. Champion mines. In the Dick Turpin claim the ore is found near a fault in the granite formation. The trend is north and south with a southeast dip. The shoot is 350 ft. long. Rich gold and copper ore is found on the hanging wall of the lode, while low-grade ore is mined next to it. The average value is \$12 per ton. The mill is treating 100 tons daily. All equipment is driven by electricity. The main adit of the Lackawanna Belle Mining Co. is in 500 ft., equal to 350 ft. depth. Three raises are in ore 6 ft. wide averaging \$20 per ton. Great results are expected from this district in 1914.

TELLER COUNTY (CRIPPLE CREEK)

The gold production of Cripple Creek during 1913 was valued at \$14,435,520, against \$14,006,741 in 1912, making a grand total of \$324,786,741, according to *The Cripple Creek Times*. At the local mills, at Colorado City, and the smelters, a total of 966,906 tons of ore was treated. The treatment of low-grade ore at the local plants is of interest as shown by the following table:

Plant.	Tons.	Average value.	Gross value.
Portland, Battle mountain.....	179,918	\$2.97	\$ 532,866
Stratton's Independence, Battle mountain	131,026	2.67	349,887
Colburn-Ajax, Battle mountain..	54,994	3.27	179,905
Gaylord-Dante, Bull hill	17,700	2.95	52,315
Wild Horse, Bull hill	13,865	3.38	46,910
Kavanagh-Jo Dandy, Raven hill.	19,315	2.10	40,600
Isabella mines, Bull hill	9,290	2.13	20,760
Rex M. & M. Co., Ironclad hill...	2,700	1.68	4,400
Total	428,808	\$2.86	\$1,227,643

The men engaged in treating this class of ore are: Thomas B. Crowe of the Portland, Arthur H. Finn of the Wild Horse, Philip H. Argall of Stratton's Independence, E. H. Colburn, Jr. of the Ajax, Thomas Kavanaugh of Rex-Jo Dandy mills, Edwin Gaylord of the Gaylord mill, and J. B. Neville of the Free Coinage mill.

Dividends during 1913 were as follows:

Golden Cycle Mining Co.	\$ 405,000
Cresson Con. G. M. & M. Co., estimated.....	300,000
Portland Gold Mining Co.	300,000
Elkton Consolidated Mining & Milling Co.....	200,000
Vindicator Consolidated Gold Mining Co.....	180,000
Stratton's Independence, Ltd., estimated	120,000
Strong Gold Mining Co., estimated	150,000
Mary McKinney Mining Co.	104,740
El Paso Con. Gold Mining Co.....	61,280
Stratton's C. C. M. & D. Co.	60,000
Gold King Mining Co.	10,000

Total	\$ 1,891,020
Profits of leasing companies and lessees, estimated.	350,000

Grand total	\$ 2,241,020
Dividends prior to 1913	38,128,544

Total to 1914	\$42,260,624
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On January 20 the Portland company will pay 2c per share, equal to \$60,000. The Vindicator Consolidated will pay 3c. per share on January 25, equal to \$45,000.

OURAY COUNTY

Mineral production of the county in 1913 was valued at \$1,558,825, made up by crude ore and concentrates, \$1,088,950; bullion, \$459,875; and coal, \$10,000. Thirty-two properties contributed to the output. The local smelter received 4000 tons of mine and mill products.

SAN JUAN COUNTY

The San Juan region of Dolores, La Plata, Ouray, San Juan, and San Miguel counties produced in 1913 \$4,116,000 in gold, 2,847,000 oz. of silver, 21,165,000 lb. of lead, 3,630,000 lb. of copper, and approximately 8,000,000 lb. of zinc, compared with \$4,115,345 in gold, 2,562,096 oz. of silver, 20,752,156 lb. of lead, 3,000,173 lb. of copper, and 6,375,073 lb. of zinc in 1912. There was an increase for gold of \$7000 in Dolores, \$163,000 in La Plata, \$115,000 in San Juan; and a decrease of \$61,000 in Ouray and of \$224,000 in San Miguel county. There was an increase for silver of 105,000 oz. in Dolores, 200,000 in San Juan, and 71,000 in La Plata, while there was a decrease of 93,000 oz. in San Miguel county. Dolores county (Rico) made a large increase in the yield of copper, lead, and zinc, but the production of lead fell off heavily in San Miguel and Ouray counties. The yield of gold bullion in Boulder county decreased one-half and there was also a decrease of 2000 oz. of gold in ores smelted, but the silver output increased 100,000 oz. and the lead 470,000 pounds.

The American Smelting & Refining Co. reports the following yield from San Juan county ores smelted at its works: Gold, \$413,069; silver, \$493,796; lead, 7,556,391 lb.; and copper, 1,022,988 pounds.

The Frisco Tunnel Co., at Animas Forks, is starting a 100-ton mill. Emil Hensen is manager.

IDAHO

Figures prepared by the State mine inspector, Robert N. Bell, show the following output of Idaho in 1913:

Lead, pounds	325,000,000
Zinc, pounds	30,100,000
Copper, pounds	8,887,000
Gold, ounces	65,000
Silver, ounces	10,107,000
Value for state	\$24,360,000
Value for Shoshone county (Coeur d'Alene).....	21,924,000

An average of 40 cars of ore or concentrate per day is shipped from the latter district.

SHOSHONE COUNTY

On the 1000-ft. level of the Success mine, a shoot of good zinc ore has been opened. At 860 ft. a shoot has been driven on for 265 ft., being still in ore. The mill is being improved by the addition of a magnetic separator, a 3 by 30-ft. drying tube for concentrate, and a process for reducing metal losses in slime. H. F. Samuels controls this property, and C. C. Samuels is in charge of the mill. At the Paragon, near Murray, the shaft is being sunk to nearly 300 ft. depth. From the upper workings of the mine, lead and zinc ores are shipped. The Amazon-Manhattan adit, to connect with the Interstate-Callahan, is in 1400 ft. The Marsh mine, at Burke, is producing 150 tons of silver-lead ore per day. Development on No. 5 level is highly encouraging. On January 3 the Bunker Hill & Sullivan paid dividend No. 196, amounting to \$81,750.

MICHIGAN

HOUGHTON COUNTY

(Special Correspondence.)—Every time a United States Government official comes to Houghton, the labor agitators ascribe his visit to the probability of the Government taking control of the mines, and giving them to the strikers. In

this way the ignorant miners are deluded. Men are returning to work every day and new men are coming in to the district. The Copper Range is adding 8 to 12 men daily, and the Quincy is importing Germans, quite desirable citizens. The Calumet & Hecla continues normal operations, so does the Superior, and the Osceola is approaching that point. At the Keweenaw mines, progress is not as rapid. But the attitude of all of the men is antagonistic to the Western Federation of Miners.

Houghton, January 8.

NEVADA

LANDER COUNTY

The Kimberly United Mines Co.'s property, near Hilltop, has been examined by A. L. Moore of San Francisco. He states that the area is well mineralized, and recommends extending the Joker adit, also erecting a 20-ton mill for testing purposes. The main vein runs through three claims, and has been opened in the Joker adit for 97 feet. The Gold Star adit is in 250 ft., and a large tonnage of \$15 to \$20 gold ore has been opened. The Oro shaft, 70 ft. deep, is in a good shoot of ore.

LYON COUNTY

The two new converters at the Mason Valley company's smelter started work on January 3. They have a capacity of 4,000,000 lb. of copper per month, and will save the expense of shipping matte. At the Empire-Nevada, the Miami company has completed one drill-hole and has moved the rig to another position. Smelter returns for the first six days of December 1913 show that Nevada-Douglas shipped 759 dry tons of ore with an average copper content of 8.09 per cent.

NYE COUNTY

The Carrava Mining & Milling Leasing Syndicate is to erect three six-roller Chilean type of mills at its property at Carrava. High-grade gold-bearing ore has been shipped, and there is a large tonnage of milling ore on dumps and in the leases.

Tonopah mines produced 10,538 tons of ore worth \$257,150 during the week ended January 10. A large shoot of \$12 ore has been opened on the 500-ft. level of the West End mine. The Montana mill is making a recovery of 92.6%, and the bullion output is increasing each month. The Halifax vein has been opened in trachyte at 1100 ft., about 280 ft. south-east of the Halifax shaft. Dividend No. 18, of 25c. per share, has been paid by the Belmont company. During the quarter ended November 30, revenue amounted to \$924,523, and net profit was \$531,716. The surplus was \$1,430,969.

STOREY COUNTY

Two Byron-Jackson pumps in the joint incline of the Crown Point and Belcher have lowered the water below the 1500-ft. level. The station is in good order, but the level has caved in places.

WHITE PINE COUNTY

Two more Star churn-drills, of 1400-ft. capacity each, have been ordered by the Consolidated Copper Mines Company. The Company has purchased 50 dump cars from the Nevada Consolidated for handling the overburden to be moved from the first steam-shovel pit at Riepetown. The Giroux company has three drills working on the Ora claim.

NEW MEXICO

LUNA COUNTY

Rich gold and silver ore has been opened in the Bi-Metallic Mining & Milling Co.'s mine near Deming in the Sierra Blanca range.

OREGON

JOSEPHINE COUNTY

The Afterthought mine on Thompson creek has been sold to Michigan and Illinois men for \$12,000. A good deal of ore has been opened by adits, and assays give high returns in gold.

SOUTH DAKOTA**POTTER COUNTY**

Drilling at Gettysburg has passed through several inches of oil sand, also a seam of coal 15 ft. thick.

UTAH**Piute County**

Nine miles southwest of Marysville is a large deposit of pink rock which contains 11% of potash salts and 37% of aluminum oxide. The Florence Mining & Milling Co., which owns a large part of the deposit, is about to erect a plant costing \$50,000 for preparing the material for market. Development has proved several million tons of mineral according to J. F. Gibbs in *The Salt Lake Tribune*.

SUMMIT COUNTY

A contract has been awarded to J. A. McIlwee for the completion of the Snake Creek tunnel near Park City. This heading is in 6700 ft., 1200 ft. below the surface and in limestone. The total length of the tunnel will be 14,350 feet. About 4000 gal. of water is flowing from the workings.

TOOLE COUNTY

Sixty miles south of Wendover, on the Western Pacific railway, in the Willow Springs district, high-grade copper and lead ore has been opened by the Western Pacific Copper Company. This ore was cut near the bottom of a 250-ft. incline shaft.

CANADA**BRITISH COLUMBIA**

(Special Correspondence).—Diamond-drilling will be done at the San Diego group of claims, on the Kitsault river, about six miles from the head of Alice arm. A good deal of work has already been done on the property, and a considerable tonnage of ore averaging 3.2% copper, and \$2 in gold and silver, has been proved. A horse trail has been made from the head of the arm. S. J. Eubank and D. F. Jones control these claims.

Prince Rupert, January 3.

The electric power-plant, smelter, and other equipment of the Granby company at Anox is complete, and should be in proper running order by February 1.

Equipment worth about \$30,000 was purchased recently in Spokane, Washington, for the Silver Hoard mine, near Ainsworth. This will be installed in the spring. The machinery includes a 3400-ft. Riblett aerial tramway. A hydro-electric plant is to be installed for light and power purposes in the mine, consisting of a Westinghouse generator and Cassel water-wheel. The hoist will be electrically driven. An Ingersoll air-compressor has been delivered. High-grade silver-lead ore has been opened at 200 ft., and ore reserves total 100,000 tons. So far 1394 tons of good ore has been shipped. W. S. Hawley is general manager.

ONTARIO

During the period ended December 2 the Hollinger mill treated 13,140 tons of ore averaging \$15.17 per ton. The recovery was 96.16% at a cost of \$1.40 per ton for treatment. The profit was \$118,990. Porcupine mines in 1913 are estimated to have produced gold worth \$4,330,000.

During 1913 La Rose Consolidated made a profit of \$951,000. During December the Niipissing high and low-grade mills treated 161 and 6268 tons of ore, respectively, and the refinery produced 674,984 oz. silver. Hydraulic prospecting was stopped on December 8. A 2-in. vein was cut in the Keewatin country assaying 500 oz. per ton. Important developments took place in the R. L. 400 lot. The draining of Cobalt lake has been started.

CHILE

During December the Braden mine produced 2,122,000 lb. of copper, the largest output in the company's history. The

old mill treated 10,359 tons of ore averaging 1.99%, and the new mill treated 93,612 tons averaging 2.15% copper, with 80.88% and 69.78% recoveries, respectively.

COLOMBIA

The Pato dredge recovered gold worth \$13,400 from 18,000 cu. yd. of gravel during the week ended December 23. Clayey water interfered with washing during the period. Results of operations have given rise to a good deal of correspondence in certain financial papers in London.

The Oroville Dredging Co., Ltd., has purchased the San Francisco gravel property, of 400 acres, which adjoins the Pato property on the Nichi river. The price paid is reported to be \$51,000. The results of five drill-holes on California hill, Pato concession, gave an average of 12c. per cubic yard.

MEXICO**JALISCO**

The treatment plant for the Cinco Minas Co., in the Hostotipaquillo district, is now in operation. Louis Baird, an English mining man, who was captured by bandits at the Espada camp during the second week in December, has been released on payment of \$500. The ransom asked was \$3000.

HIDALGO

(Special Correspondence).—The new San Francisco shaft at the Santa Gertrudis is lined with steel through its whole depth. It was sunk 30 ft. south of the old San Francisco shaft. A fine head-frame has been erected over the new shaft and is connected with the mill bins by a belt-conveyor. The San Guillermo shaft has been giving trouble for some time past.

Pachuca, December 4.

Mexico

(Special Correspondence).—The Rincon mine has been operated during the year, shipping 100 tons of high-grade ore per month to the smelter until recently. Twenty stamps are working, producing bullion and concentrate. Power has been short, and another 1000-hp. power-plant is being erected below the one at Pedregal. This will supply power for the rest of the mill, and electric pumps on No. 6 level of the mine. These have been 'drowned' for a year. Shaft-sinking has been stopped on account of water, but as work has been done below the shaft bottom, raising will be adopted to deepen the shaft. The Real de Arriba Mining Co. is employing a number of men.

Temascaltepec, December 4.

SONORA

Mineral exports from Sonora through the port of Agua Prieta show a slight decline in value and tonnage during December. A total of 344 cars was shipped, equal to 13,630 tons. Twelve properties were on the shipping list. El Tigre company shipped 77 bars of silver-gold bullion weighing 12,518 lb. The estimated value of exports in Mexican currency were: copper, \$1,676,800; silver, \$434,000; gold, \$197,500; total, \$2,308,300.

The Cananea Consolidated mines, mill, and smelter are operating at about 66% capacity. James S. Douglas, general manager, estimated that 24,000 tons of ore would be milled and 35,000 tons smelted in December. Development underground amounts to 5000 ft. per month. The mill at El Plano mine, 90 miles southwest of Sasabe, is to be restarted at an early date. Two companies are working in the Boludo portion of the Altar placer district. In the Magdalena district, La Mina de Plata stamp-mill is to be enlarged. The Sublima mine, 10 miles from Nacoziari, is shipping ore averaging 10 oz. silver and 10% copper. Ore from the Cobre Verde, 6 miles from Cobullona, returns 8 oz. silver and 20% copper. Shipments of ore assaying 20 oz. silver, \$1 gold, and 40% lead are going to El Paso from the Nacoziari Consolidated mine. A mill is being erected.

Schools and Societies

A School of Mines is to be started at Halleybury, Ontario, in conjunction with the present High School.

The mining engineering department of the UNIVERSITY OF ILLINOIS is adding further rock-drilling equipment to its plant.

The IDAHO MINING ASSOCIATION will meet at Boise on January 20, and important subjects will be discussed. Harry L. Day is president of this society.

The CANADIAN MINING INSTITUTE will hold its sixteenth annual meeting at Montreal on March 4, 5, and 6. Seventeen valuable papers are promised for discussion.

The Southern California section of the AMERICAN INSTITUTE OF MINING ENGINEERS met at Los Angeles on January 15. The subject discussed was 'Geology Applied to Mining.'

The UNIVERSITY OF ILLINOIS is to establish miners' and mechanics' institutes, under the direction of the Department of Mining Engineering. These branches are to prepare men to pass the tests required by the state before they can hold official positions about the mines.

The CLEVELAND ENGINEERING SOCIETY held its regular meeting on January 13, an inspection trip two days later, and a special meeting is to be held on January 20. A week later the semi-monthly meeting will be held, when J. C. Gillette will present an illustrated paper on 'Natural Gas.'

HEALD'S ENGINEERING SCHOOL, of San Francisco, graduates have recently received appointments through the U. S. Civil Service Commission. One is with the topographical drafting office of the Department of War; another is in a similar office of the Department of Agriculture; while the third is in the engineering department of the Department of War.

At the UNIVERSITY OF NEVADA, Reno, an Industrial Safety Conference will be held on January 26 and 27. This will include a number of discussions on the 'safety first' movement, demonstrations, motion pictures suitable for the occasion, first-aid work, and other kindred subjects. There will be an influential and representative gathering of power and mining companies, state officials, and workers in the field.

San Francisco members of the AMERICAN INSTITUTE OF MINING ENGINEERS completed the organization of a local section, January 12, by the adoption of by-laws and the election of the following officers: Chairman, S. B. Christy; vice-chairman, H. C. Hoover; secretary-treasurer, Abbott Hanks; additional members of the executive committee, C. W. Merrill and F. W. Bradley. The meeting followed an enjoyable dinner at the Engineers' Club, at which 34 were present.

The MASSACHUSETTS INSTITUTE OF TECHNOLOGY, Boston, has issued its *Bulletin* of 534 pages, covering the officers and students, statement of requirements for admission, and a description of the courses of instruction. Students must be 17 years of age, and qualified to study the subjects chosen. Courses may be taken in all mining and engineering subjects. Instruction is given in aviation and warship construction. Many scholarships and fellowships are offered to certain graduates.

The MASSACHUSETTS INSTITUTE OF TECHNOLOGY is receiving students from all countries, the latest being two from Russia. From this country they are generally sent by the Russian government, although occasionally they come of their own initiative. An increasing number of students are coming from foreign countries. Additions to the laboratory consist of a Hyde flotation unit, an Elmore flotation test plant, a hindered settling, open-spigot classifier, a Sturtevant crusher and accessories, and a McCully crusher. A Halberger electric furnace of 8-lb. copper capacity is to be installed.

Personal

C. R. CORNING is in Paris.

J. V. N. DORR has gone to Cobalt.

R. M. NYE has been in San Francisco.

E. C. HUTCHINSON was at Jackson last week.

HOMER L. CARR has returned from Colombia.

ROSS B. HOFEMANN left yesterday for London.

A. E. DRICKER is in Egypt, returning to London.

ARTHUR C. NAHL, of Triunfo, Baja California, is at Berkeley.

W. H. STORMS is in Amador county on professional business.

R. G. CASEY, Jr., sailed for Sydney on the *Sonoma* this week.

S. F. SHAW is temporarily at the Horn Silver mine, Frisco, Utah.

A. C. BOYLE has returned to Laramie, Wyoming, from New York.

C. G. GUNTHER has returned to New York from the island of Cyprus.

C. S. HERZIG has removed his offices to 1 London Wall buildings, London.

SIDNEY L. WISE is now associated with the Mines Management Company.

L. C. GRATON is spending several weeks in geological studies at Globe, Arizona.

D. L. C. HOOVER is now with the Cia. Metalurgica Nacional, Matahuala, S. L. P.

LOYAL W. TRUMBULL is now state geologist of Wyoming, succeeding C. E. Jamison.

KARL EILERS is in the West, expecting to return to New York by the middle of February.

T. WALTER BEAM, of Denver, was in San Francisco this week, after an inspection along the Mother Lode.

L. G. HUNTLEY has returned to the Tampico oilfields in Mexico, after spending the holidays at Pittsburgh.

LYOUD B. SMITH has returned from the West Indies, where he has been making examinations of oil properties, and is now in Oklahoma.

C. P. NIELL, former Commissioner of Labor, is now a director of the American Smelting & Refining Co., in charge of safety and sanitation work.

N. H. DARTON made an address on 'Mine Gases' before the A. I. M. E. on January 16, giving an account of extensive investigation of this subject made under the auspices of the Bureau of Mines.

THE properties and departments of the Consolidated Mining & Smelting Co., of Canada, have been in charge of the following gentlemen during the past 15 months, according to the report of R. H. Stewart, the general manager: S. G. Blaylock, assistant general manager; T. W. Bingay, comptroller; James Buchanan, superintendent of smelter; M. H. Sullivan, assistant superintendent of smelter; J. F. Miller, superintendent of refinery; M. E. Purcell, superintendent of Centre Star group of mines; E. G. Montgomery, assistant superintendent; F. S. Peters, superintendent Le Roi mine; C. H. McDougall, St. Eugene and Sullivan mines; K. B. Carruthers, Molly Gibson mine; W. A. Cameron, Slocan Lake properties; and W. M. Archibald, J. M. Turnbull, and A. W. Davis, mining engineers.

Obituary

H. T. CROOKSHANK, an Englishman working in the cyanide department of the Real del Monte mill at Pachuca, was electrocuted recently while throwing a switch.

W. S. COPELAND was killed at Cripple Creek, Colorado, December 19, by falling down the Jo Dandy shaft. Mr. Copeland was well known as a mine manager and owner of sampling works in the district.

Monthly Copper Production

AHMEEK COPPER MINING CO., Kearsarge, Michigan. \$1,250,000 in \$25 shares; 24,796 shares owned by Calumet & Hecla; 1800-ton mill at Hubbell; concentrate smelted by Calumet & Hecla smelter. Total in 1913, 9,100,000 pounds.

ALLOUEZ MINING CO., Allouez, Michigan. \$2,500,000 in \$25 shares; controlled by the Calumet & Hecla, which owns 43,000 shares and \$250,000 in notes of the Company; ore is milled by the Lake Milling, Smelting & Refining Co., in which the Allouez owns half. Total in 1913, 4,200,000 pounds.

ANACONDA COPPER MINING CO., Butte, Montana. \$108,312,500 in \$25 shares; controlled through Amalgamated Copper Co. by Thos. F. Cole, J. D. Ryan, and Standard Oil interests; 10,000-ton concentrator and smelter at Anaconda; 5000-ton concentrator and smelter at Great Falls, Mont.; also 70-ton electrolytic refining plant at Great Falls. Production figures include copper from all companies which ship custom ore to Anaconda smelters.

Month.	Pounds.	Month.	Pounds.
June	21,500,000	October	18,400,000
July	21,181,000	November	25,250,000
August	22,500,000	December	25,100,000
September	22,600,000		

ARIZONA COPPER CO., LTD., Morenci, Arizona. \$379,974 in 5s. shares; controlled by Edinburgh investors; mill at Morenci is being enlarged to 3000-ton capacity and a new 1200-ton smelter near Clifton has just been started.

Month.	Pounds.	Month.	Pounds.
June	3,000,000	October	3,550,000
July	2,600,000	November	2,800,000
August	1,800,000	December	2,920,000
September	1,800,000		

BRADEN COPPER CO., La Junta, Chile. \$2,332,030 in \$10 shares and \$4,000,000 in 6% convertible bonds; entire stock held by Braden Copper Mines Co.; \$12,000,000 in \$5 shares; \$5,000,000 in convertible bonds; controlled by Guggenheim interests; two mills at La Junta; 3000-ton capacity smelter at Raucagua.

Month.	Pounds.	Month.	Pounds.
June	1,808,000	October	2,600,000
July	1,046,000	November	1,532,000
August	1,572,000	December	2,122,000
September	1,322,000		

BRITISH COLUMBIA COPPER CO., LTD., Greenwood, B. C. \$2,958,545 in \$5 shares; controlled by Newman Erb; 600-ton sampling plant and 2500-ton smelter.

Month.	Pounds.	Month.	Pounds.
June	634,238	September	626,761
July	618,379	October	688,000
August	700,000	November	692,383

CALUMET & ARIZONA MINING CO., Warren, Arizona. \$6,285,710 in \$10 shares; has absorbed the Superior & Pittsburg Copper Co. by stock exchange; controlled by Hoatson and other Lake Superior interests; 3000-ton smelter at Douglas.

Month.	Pounds.	Month.	Pounds.
June	3,000,000	October	4,500,000
July	3,800,000	November	4,600,000
August	4,500,000	December	6,300,000

CALUMET & HECLA MINING CO., Calumet, Michigan. \$2,500,000 in \$25 shares; controls the Ahmeek, Allouez, Centennial, Isle Royale, La Salle, Osceola, Tamarack, and Superior copper mining companies as well as a number that are non-productive; controlled by Agassiz and Shaw interests; 2 mills on Lake Linden, capacity 15,000 tons; smelter Hubbell, Mich.; electrolytic refinery and smelter at Buffalo, N. Y.; figures include output of subsidiaries. Total in 1913, 53,420,000 pounds.

CANANEA CONSOLIDATED COPPER CO. S. A., Cananea, Sonora, Mexico. Capital \$20,000 in shares of \$100; entire stock owned by Greene Consolidated Copper Co.; \$10,000,000 in \$10 shares; 945,320 shares are held by Greene-Cananea Copper Co.; \$50,000,000 in \$100 shares, which is controlled by Thos. F. Cole and J. D. Ryan; 2 mills and smelter at Cananea, 3000-ton capacity.

Month.	Pounds.	Month.	Pounds.
June	2,908,000	October	3,160,000
July	3,328,000	November	3,150,000
August	3,186,000	December	3,000,000
September	3,148,000		

Output of Lake Superior mines estimated.

CENTENNIAL COPPER MINING CO., Calumet, Michigan. \$2,250,000 in \$25 shares; 44,350 shares are held by Calumet & Hecla Mining Co.; ore milled by Lake Milling, Smelting & Refining Co. Total in 1913, 1,400,000 pounds.

CERRO DE PASCO MINING CO., Cerro de Pasco, Peru. \$10,000,000; entire stock held by Cerro de Pasco Copper Co.; \$60,000,000 in \$1 shares which is owned by Cerro de Pasco Investment Co., which is controlled by J. B. Haggin, and Morgan estate; 3000-ton smelter at La Fundicion; monthly production figures not given out; output in 1912 was 45,000,000 lb. copper.

CHINO COPPER CO., Santa Rita, New Mexico. \$3,500,000 in \$5 shares; 121,200 shares are held by Guggenheim Exploration Co.; controlled by Sherwood Aldrich and C. M. MacNeill; 5000-ton mill at Hurley, N. M.; concentrate smelted at El Paso.

Month.	Pounds.	Month.	Pounds.
June	3,904,300	October	4,914,944
July	4,831,200	November	4,402,909
August	6,050,867	December	4,275,009
September	4,435,873		

CONSOLIDATED COPPER MINES CO., Ely, Nev. \$3,000,000 in \$5 shares; \$3,000,000 in convertible bonds; is a recent merger of the Groux, Butte & Ely, Chairman, and Copper-mines companies, controlled by Thos. F. Cole, Wm. B. Thompson, Charles F. Rand, and Jas. Phillips, Jr.; reduction plant not yet built; production so far derived solely from Groux; ore treated at Nevada Con. smelter.

Month.	Pounds.	Month.	Pounds.
June	616,742	September	204,307
July	607,779	October	160,911
August	541,189	November	136,539

COPPER QUEEN CONSOLIDATED MINING CO., Bisbee, Arizona. \$2,000,000 in \$10 shares; owns 100,000 shares of Greene-Cananea; almost all its stock is held by Phelps. Dodge & Co., Inc.; \$44,995,000 in \$100 shares; 4000-ton smelting plant at Douglas, Ariz. Total in 1913, 85,389,630 pounds.

Month.	Pounds.	Month.	Pounds.
June	6,292,480	October	7,653,153
July	7,439,864	November	6,473,792
August	7,590,994	December	8,182,452
September	7,775,560		

COPPER RANGE CONSOLIDATED MINING CO., Palmdale, Michigan. \$39,369,200, in \$100 shares; owns 99,659 shares of Baltic M. Co., 99,699 shares Copper Range M. Co., 99,345 shares of Tri-mountain M. Co., half interest in Champion Copper Co., 16,332 shares of Copper Range R. R. Co., and \$870,000 in Copper Range R. R. bonds; controlled by Wm. A. Paine; production is derived from the Baltic, Champion, and Trimountain companies, each of which mills its ore; concentrate is smelted by Michigan Smelting Co., Houghton, which is owned by mining companies. Total in 1913, 24,996,000 pounds.

DETROIT COPPER MINING CO., Morenci, Ariz. \$1,000,000 in \$25 shares; owned by Phelps. Dodge & Co.; 1300-ton mill and 350-ton smelter. Total in 1913, 22,352,299 pounds.

Month.	Pounds.	Month.	Pounds.
June	1,750,601	October	1,861,178
July	1,549,224	November	1,922,352
August	2,187,223	December	2,021,034
September	2,102,818		

EAST BUTTE COPPER MINING CO., Butte, Mont. \$3,000,000 in \$10 shares; owns 83% of the stock and all bonds of the Pittsmtont Copper Co., which holds 90% of the stock and all bonds of Pittsburgh & Montana Copper Co.; controlled by W. A. Paine; 350-ton mill and 1000-ton custom smelter.

Month.	Pounds.	Month.	Pounds.
June	1,020,613	September	1,233,018
July	1,060,257	October	1,040,977
August	1,162,006	November	1,002,190

FRANKLIN MINING CO., Demmon, Mich. \$4,166,650 in \$25 shares; controlled by R. M. Edwards and the U. S. S. R. & M. Co.; 1000-ton mill. Total in 1913, 1,040,000 pounds.

GRANBY CONSOLIDATED MINING, SMELTING & POWER CO., LTD., Phoenix and Hidden Creek, British Columbia. \$14,849,565 in \$100 shares; controlled by General Chemical Co. interests; 4400-ton smelter at Grand Forks and 2000-ton smelter at Anyox.

Month.	Pounds.	Month.	Pounds.
June	1,789,000	September	1,824,560
July	1,654,000	October	1,779,552
August	1,827,300	November	1,888,767

LAKE ROYALE COPPER CO., Houghton, Mich. \$3,750,000 in \$25 shares, owns a \$50,000 interest in the Lake Superior Smelting Co., owned by Calumet & Hecla, 2200-ton mill on Portage lake. Total in 1913, 4,680,000 pounds.

MASON VALLEY MINES CO., Yerington, Nev. \$770,000 in \$5 shares, \$1,000,000 in 6% convertible bonds; controlled by W. H. Thompson, 1000-ton smelter at Thompson, Nev., also smelts ore of Nevada-Douglas Copper Co. and custom ore; smelter production.

Month.	Pounds.	Month.	Pounds.
June	1,132,000	October	1,062,000
July	990,000	November	1,174,000
August	966,000	December	1,372,000
September	918,000		

MIAMI COPPER CO., Miami, Ariz. \$3,319,690 in \$5 shares; \$1,433,000 in 6% convertible bonds; controlled by General Development Co. (Lewishohn interests); 3000-ton mill at Miami; concentrate smelted at Cananea. Total in 1913, 33,944,796 pounds.

Month.	Pounds.	Month.	Pounds.
June	2,612,650	October	2,862,050
July	2,890,000	November	3,517,800
August	3,097,500	December	3,301,316
September	2,688,600		

MOCTEZUMA COPPER CO., Nacozari, Sonora, Mexico. \$2,000,000; entire stock owned by Phelps, Dodge & Co.; 2000-ton mill, concentrate smelted by Copper Queen. Total in 1913, 36,694,013 pounds.

Month.	Pounds.	Month.	Pounds.
June	3,438,793	October	3,178,136
July	2,693,006	November	3,517,800
August	3,542,047	December	3,139,613
September	3,024,121		

MOHAWK MINING CO., Mohawk, Mich. \$2,500,000 in \$25 shares; controlled by Stanton interests; 3000-ton mill, Traverse Bay; concentrate smelted by Michigan Smelting Co. Total in 1913, 5,369,000 pounds.

NEVADA CONSOLIDATED COPPER CO., Ely, Nevada. \$10,000,000 in \$5 shares; has absorbed the Cumberland-Ely Copper Co.; controlled by American Smelter Securities Co. through the Utah Copper Co., which owns half of the Nevada Con. stock; the Nevada company owns the Steptoe Valley Mining & Smelting Co., \$10,000,000; 16,000-ton mill and 1500-ton smelter at McGill, Nevada.

Month.	Pounds.	Month.	Pounds.
June	6,344,863	October	5,898,330
July	5,403,919	November	5,443,047
August	5,989,973	December	5,500,000
September	4,441,671		

NEVADA DOUGLAS COPPER CO., Mason, Nev. \$4,054,800 in \$5 shares, \$276,900 in 6% convertible bonds; also \$158,200 6% refunding bonds; controlled by A. J. Orem; ore smelted at Mason Valley smelter.

Month.	Pounds.	Month.	Pounds.
June	392,288	September	426,070
July	399,451	October	583,330
August	354,760	November	678,120

OHIO COPPER CO., Bingham, Utah. \$12,292,700 in \$10 shares, \$1,326,000 in 6% convertible bonds; 3500-ton mill at Lark, Utah; concentrate smelted at Garfield.

Month.	Pounds.	Month.	Pounds.
June	579,400	September	685,900
July	601,700	October	720,000
August	689,400	November	796,000

OLD DOMINION COPPER MINING & SMELTING CO., Globe, Ariz. \$4,050,000 in \$25 shares; 155,245 shares are owned by the Old Dominion Co., which is owned by Phelps, Dodge & Co.; 300-ton mill, 2400-ton smelter. Production figures include custom ore smelted. Total in 1913, 30,810,000 pounds.

Month.	Pounds.	Month.	Pounds.
June	2,511,000	October	2,037,000
July	2,526,000	November	2,150,000
August	2,524,000	December	2,613,000
September	2,679,000		

OSCEOLA CONSOLIDATED MINING CO., Osceola, Mich. \$2,403,750 in \$25 shares; owned by Calumet & Hecla; 2 mills, 4000-ton capacity, at Torch Lake. Total in 1913, 11,686,000 pounds.

PHELPS, DODGE & CO., Inc. \$44,995,000 in \$100 shares; controlled by C. H. Dodge, James Douglas, and others; owns the Copper Queen, Moctezuma, Detroit, and Burro Mountain Copper companies, Stag Canon Fuel Co.; indirectly controls Old Dominion, United Globe, and Commercial Copper Mining

Output of Lake Superior mines estimated.

Co., members of the firm control the El Paso & Southwestern railway, and have large interests in the Rock Island and Great Northern railways. Production figures include all properties under its control and copper derived from custom ore, the latter ranging from 750,000 to 1,000,000 lb. per month. Total in 1913, 154,454,444 pounds.

QUINCY MINING CO., Hancock, Mich. \$2,750,000 in \$25 shares, controlled by W. R. Todd, 4500-ton mill at Mason, 340-ton smelter at Ripley.

RAY CONSOLIDATED COPPER CO., Ray, Ariz. \$11,975,740 in \$10 shares; controlled by Sherwood Aldrich and C. M. MacNeill; 8000-ton mill at Hayden, Ariz.; concentrate smelted in A. S. & R. smelter adjoining.

Month.	Pounds.	Month.	Pounds.
June	4,392,612	September	4,470,551
July	4,097,177	October	4,871,516
August	4,401,000	November	4,753,000

SHANNON COPPER CO., Metcalf, Ariz. \$3,000,000 in \$10 shares; controlled by N. L. Amster; 500-ton mill and 1000-ton smelter at Clifton. Total in 1913, 13,640,000 pounds.

Month.	Pounds.	Month.	Pounds.
June	924,000	October	1,216,000
July	880,000	November	1,110,000
August	1,248,000	December	1,078,000
September	1,232,000		

Total in 1913, 13,640,000 pounds.

SHATTUCK ARIZONA COPPER CO., Bisbee, Ariz. \$3,500,000 in \$10 shares; controlled by Duluth investors; ore smelted at Calumet & Arizona smelter.

Month.	Pounds.	Month.	Pounds.
June	1,059,625	September	1,163,237
July	1,019,388	October	993,224
August	1,001,624	November	995,429

SOUTH UTAH MINES & SMELTERS, Nowhouse, Utah. \$4,300,000 in \$5 shares, \$1,300,000 in 6% convertible bonds; controlled by Samuel Nowhouse; 1000-ton mill; concentrate smelted at Tooele, Utah.

Month.	Pounds.	Month.	Pounds.
June	142,817	September	249,323
July	195,254	October	239,453
August	230,410	November	232,032

SUPERIOR COPPER CO., Calumet, Mich. \$2,500,000 in \$25 shares; owned by Calumet & Hecla. Total in 1913, 3,078,000 pounds.

TAMARACK MINING CO., Calumet, Mich. \$1,500,000 in \$25 shares; owned by Calumet & Hecla; 2 mills, 3500-ton capacity, at Torch Lake. Total in 1913, 4,142,000 pounds.

TENNESSEE COPPER CO., Copperhill, Tenn. \$5,000,000 in \$25 shares; \$1,500,000 in 6% convertible bonds; controlled by Jas. Phillips, Jr., and Lewishohn interests.

Month.	Pounds.	Month.	Pounds.
June	1,379,220	October	1,392,162
July	1,295,804	November	1,688,000
August	1,143,019	December	1,700,000
September	1,309,985		

UNITED STATES SMELTING, REFINING & MINING CO. \$44,871,150 in \$50 shares; copper production chiefly derived from its subsidiary, The Mammoth Copper Mining Co., Kennett, California.

Month.	Pounds.	Month.	Pounds.
September	1,750,000	November	1,700,000
October	1,658,436		

UNITED VERDE COPPER CO., Jerome, Ariz. \$3,000,000 in \$10 shares; owned by W. A. Clark; 1000 to 1200-ton smelter at Clarkdale; monthly figures not given out, estimated at about 3,000,000 lb. Total in 1913, 37,750,000 pounds.

UTAH CONSOLIDATED MINES CO., Bingham, Utah. \$1,500,000 in \$5 shares; owns the Highland Boy Gold Mining Co. and 5000 shares of International Smelting & Refining Co. stock; ore smelted at Tooele.

UTAH COPPER CO., Bingham, Utah. \$15,625,990 in \$10 shares; owns half of Nevada Consolidated; controlled by A. S. & R. Co., Sherwood Aldrich, C. M. MacNeill, and W. B. Thompson; 2 mills, 20,000-ton capacity, at Garfield; concentrate smelted at Garfield plant of A. S. & R. Company.

Month.	Pounds.	Month.	Pounds.
June	11,637,949	October	10,236,575
July	9,849,043	November	10,787,426
August	10,900,000	December	10,450,000
September	11,992,780		

WOLVERINE COPPER MINING CO., Kearsarge, Mich. \$1,500,000 in \$25 shares; owns \$80,000 interest in Michigan Smelting Co.; controlled by J. R. Stanton; mill on Traverse bay treated 385,500 tons during last fiscal year. Total in 1913, 4,488,000 pounds.

The Metal Markets

LOCAL METAL PRICES

San Francisco, January 15.

Antimony	9	— 9½c
Electrolytic copper	15½	— 15½c
Pig lead	4.35	— 5.30
Quicksilver (flask)		\$39.50
Tin	41	— 42½c
Spelter		6½ — 6½c
Zinc dust, 100 kg. zinc-lined cases, 7½ to 8c. per pound.		

EASTERN METAL MARKET

(By wire from New York.)

NEW YORK, January 14.—The copper market is weak and there is little demand for the metal. Lead market is easy, with quotations ranging from 4.05 to 4.10. Spelter is steady with quotations at 5.20 to 5.30. Tin is firm with spot and January quoted at 36.85 to 37.10, March 36.85 to 37.15, and April 37 to 37.37. Antimony is dull, with Cookson's quotation at 7.45 to 7.60. The National Lead Co. reports a normal business for this season of the year, and a dividend has been declared by the Amalgamated Copper Co. Mining stocks in general are up and a greater interest is being manifested.

SILVER

Below are given the average New York quotations in cents per ounce, of fine silver.

Jan. 8	58.00	Average week ending	
" 9	57.50	Dec. 3	57.22
" 10	57.75	" 10	58.23
" 11 Sunday		" 17	57.79
" 12	57.75	" 24	57.77
" 13	57.75	" 31	57.52
" 14	57.75	Jan. 7	57.50
Monthly averages.		" 14	57.75
Jan. 1912	1913	July 1912	1913
Jan. 56.25	63.01	Aug. 60.67	68.70
Feb. 59.06	61.25	Sept. 61.32	59.32
Mar. 58.37	67.87	Oct. 62.95	60.53
Apr. 59.20	69.26	Nov. 63.16	60.88
May 60.88	60.21	Dec. 62.73	58.76
June 61.29	59.03	Dec. 63.38	57.73

The San Francisco mint bought 451,916.34 oz. of silver in the open market in December. The prices in 100,000-oz. lots ranged from 57.98 to 58.62c. per ounce. A shipment of silver worth \$168,000 was sent from San Francisco to Hongkong in December. The holdings of silver in Shanghai on December 24 amounted to \$26,184,000 in currency, and \$1,460,000 in bars.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date		Average week ending	
Jan. 8	4.13	Dec. 3	4.15
" 9	4.10	" 10	4.00
" 10	4.10	" 17	3.90
" 11 Sunday		" 24	4.02
" 12	4.10	" 31	4.15
" 13	4.10	Jan. 7	4.15
" 14	4.10	" 14	4.10
Monthly averages.			
Jan. 1912	1913	July 1912	1913
Jan. 4.43	4.28	Aug. 4.71	4.35
Feb. 4.03	4.33	Sept. 4.54	4.60
Mar. 4.07	4.32	Oct. 5.00	4.70
Apr. 4.20	4.36	Nov. 5.08	4.37
May 4.20	4.34	Dec. 4.91	4.16
June 4.40	4.33	Dec. 4.20	4.02

COPPER

Quotations on copper as published in this column represent average wholesale transactions on the New York market and refer to electrolytic copper. Lake copper commands normally 1-5 to 1-4c. per lb. more. Prices are in cents per pound.

Date		Average week ending	
Jan. 8	14.15	Dec. 3	14.41
" 9	14.08	" 10	14.13
" 10	14.00	" 17	14.17
" 11 Sunday		" 24	14.28
" 12	13.90	" 31	14.56
" 13	13.85	Jan. 7	14.39
" 14	13.85	" 14	13.97
Monthly averages.			
Jan. 1912	1913	July 1912	1913
Jan. 14.09	16.54	Aug. 17.19	14.21
Feb. 14.08	14.93	Sept. 17.49	15.42
Mar. 14.68	14.72	Oct. 17.56	16.23
Apr. 15.74	15.22	Nov. 17.22	16.31
May 16.03	15.42	Dec. 17.31	15.08
June 17.23	14.71	Dec. 17.37	14.25

There was little of interest to record in the New York copper market for last week. Before January 8 everybody was waiting to see what the Copper Producers' figures would be, and after these were published they continued to wait for something to turn up. At the end of the week, 30-day copper was available at 14½c. from the big dealers and at 14½c. from small sellers. Exports of copper for the week ended January 8 totaled 12,689 tons, against 6147 tons a year ago. At this rate the month will show about 100,000,000 pounds. Some of the large consumers venture the statement that a good deal of this metal is merely being sent on consignment, and will soon show itself in increased foreign stocks.

QUICKSILVER

The primary market for quicksilver is San Francisco, California, being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending		Dec. 31	40.00
Dec. 18		Jan. 8	39.50
" 24		" 15	39.50
Monthly averages.			
		1912.	1913.
Jan.	43.75	39.37	July 43.00 41.00
Feb.	46.00	41.00	Aug. 42.50 40.50
Mar.	46.00	40.20	Sept. 42.12 39.12
Apr.	42.25	41.00	Oct. 41.50 39.37
May	41.75	40.25	Nov. 41.50 39.75
June	41.30	41.00	Dec. 39.75 40.00

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date		Average week ending	
Jan. 8	5.08	Dec. 3	5.00
" 9	5.08	" 10	5.00
" 10	5.08	" 17	5.00
" 11 Sunday		" 24	5.16
" 12	5.08	" 31	5.13
" 13	5.08	Jan. 7	5.02
" 14	5.08	" 14	5.08
Monthly averages.			
Jan. 1912	1913	July 1912	1913
Jan. 6.42	6.88	Aug.	7.12
Feb. 6.50	6.13	Sept.	6.96
Mar. 6.57	5.94	Oct.	7.45
Apr. 6.63	5.52	Nov.	7.36
May 6.68	5.23	Dec.	7.32
June 6.88	5.00		7.09

TIN

New York prices control in the American market for tin, since the metal is almost entirely imported. San Francisco quotations average about 5c. per lb. higher. Below are given average monthly New York quotations, in cents per pound:

Monthly averages.			
Jan. 1912	1913.	July 1912	1913.
Jan. 42.53	50.45	Aug.	44.25
Feb. 42.96	49.07	Sept.	45.80
Mar. 42.58	46.95	Oct.	48.64
Apr. 43.92	49.00	Nov.	50.01
May 46.05	49.10	Dec.	49.92
June 45.76	45.10		49.80

During the past year tin has maintained its reputation as giving one of the most erratic and fluctuating markets in the world. Price changes were, as follows: The year opened at New York with 50.45c. per lb.; the highest price was 50.875c.; lowest, 36.725c.; the term closing at 37c., making an average of 43.6544c. per pound. Supplies were 62,533 tons from the Straits, 3175 from Australia, 14,800 from Banca, and 2200 from Billiton, with 9953 tons standard in United States and England, a total of 92,661 tons. This is an increase of 1914 tons on the previous year. Deliveries were 17,897 tons in London, 15,522 in Holland, 10,283 on the Continent, 43,900 at U. S. Atlantic ports, and 2000 at U. S. Pacific ports, making a total of 89,602 tons, a decrease of 6372 tons. To compute the grand totals of supplies and deliveries, about 25,000 tons should be added to the preceding figures. The visible supply at all points and about at December 31, 1913, was 13,893 tons. This year's increase in the visible supply is due chiefly to the smaller deliveries in America, amounting to 5600 tons. L. Vogelstein & Co. state that estimates of the Straits production in 1914 do not show as large an output as in 1913. The last season was the best there for 20 years. All told, the prospects are good for starting a reversal of the statistical position, and even without such reversal, and assuming that all the adverse factors with which the market has contended during the past year were to continue, the visible would only be back to figures at end of 1911 and prices are lower now than then.

The Stock Markets

SAN FRANCISCO STOCKS AND BONDS (San Francisco Stock and Bond Exchange.)

BONDS					
January 14.					
Listed.	Bid	Ask	Unlisted.	Bid	Ask
Associated Oil 5s	97½	99	General Petroleum 6s	—	49
E. I. du Pont pfd	84	—	Natomas Consol. 6s	—	30½
Unlisted.					
Am. Oil 5s	80	—	Pac. Port Cement 6s	99½	—
			Santa Cruz Cement 6s	84	—

STOCKS					
Listed.	Bid	Ask	Unlisted.	Bid	Ask
Amalgamated Oil	80½	83	Noble Electric Steel	—	3
Associated Oil	43½	43½	Natomas Consol.	2	2½
Glant	81½	86½	Riverside Cement	50	—
Pac. Oil Borax, pfd.	66½	—	Santa Cruz Cement	38	—
Pacific Crude Oil	—	35c	Stand. Port. Cement	18	20½
Sterling O. & D.	—	1½			
Union Oil	56	—			

NEVADA STOCKS

(By courtesy of San Francisco Stock Exchange.)
San Francisco, January 15.

Atlanta	.16	Mizpah Extension	.32
Belcher	.62	Montana-Tonopah	1.12
Belmont	7.85	Nevada Hills	.38
Big Four	.12	North Star	.39
Cash Boy	.07	Ophir	.16
Florence	.30	Pittsburg Silver Peak	.35
Goldfield Con.	1.43	Round Mountain	.43
Goldfield Oro	.08	Sierra Nevada	.07
Halifax	1.25	Tonopah Extension	1.97
Jim Butler	.81	Tonopah Merger	.62
Jumbo Extension	.16	Tonopah of Nevada	6.25
MacNamara	.09	Victor	.26
Mexican	1.17	West End	1.25
Midway	.39	Yellow Jacket	.82

COPPER SHARES—BOSTON

(By courtesy of J. C. Wilson, Mills Building.)
January 15.

Bid	Ask	Bid	Ask
Alloues	\$ 36	Mohawk	\$ 43½
Aris, Commercial	4½	Nevada Con.	15
Butte & Superior	33½	North Butte	28½
Calumet & Arizona	64½	Old Dominion	50½
Calumet & Hecla	420	Oscuela	77
Copper Range	37½	Quincy	61
Daly West	2½	Shannon	6½
East Butte	11½	Superior & Boston	2½
Franklin	3	Tamarack	30
Granby	76½	U. S. Smelting, com.	39½
Greene Cananea	31½	Utah Con.	9½
Ile-Royale	21	Winona	2½
Mass Copper	2½	Wolverine	45½

NEW YORK CURB QUOTATIONS

(By courtesy of E. F. Hutton & Co., Kohl Building.)
January 15.

Bid.	Ask.	Bid.	Ask.
Braden Copper	6¾	Mason Valley	3¾
Braden 6s	145	McKinley-Dar.	1
B. C. Copper	2	Mines Co. Am.	2½
Con. Cop. Mines	2¾	Nipissing	7¾
Davis-Daly	2	Ohio Copper	¾
Dolores	¾	San Toy	15
El Rayo	1	Sioux Con.	1
Ely Con.	3	Stand. Oil of Cal.	288
First Nat.	3	Tri Bullion	¾
Giroux	1¾	Tuolumne	½
Iron Blossom	1¾	United Copper	¾
Kerr Lake	4½	Wetlauffer	7
La Rose	1¾	Yukon Gold	2

NEW YORK STOCK EXCHANGE

(By courtesy of J. C. Wilson, Mills Building.)
January 15.

Bid	Ask	Bid	Ask
Amalgamated	\$ 74½	Miami	\$ 23½
Anaconda	31½	Nevada Con.	15
A. S. & R.	66½	Quicksilver, com.	1½
Calif. Pet.	27½	Ray Con.	18½
Chino	39½	Tenn. Copper	34½
Guggenheim Ex.	46	U. S. Steel, pfd.	109½
Inspiration	15½	U. S. Steel, com.	82½
Mexican Pet.	57½	Utah Copper	51½

LONDON QUOTATIONS

(By cable, through the courtesy of Cuthbert & Powell Co., New York.)
January 15.

	£	s.	d.		£	s.	d.
Alaska Mexican	1	7	8	Kern River Oilfields	0	6	1
Alaska Trendwell	8	0	0	Mexico Mines	5	1	2
Alaska United	1	7	8	Messina	1	10	0
Arizona	1	17	8	Oroville	9	15	0
California Amalg	0	1	3	Pacific Oilfields	0	1	9
California Oilfields	0	0	0	Rio Tinto	96	10	0
Camp Bird	0	11	3	Santa Gertrudis	0	16	8
El Oro	0	13	9	Stratton's	1	1	2
Esperanza	0	17	6	Tanganyika	1	17	8
Granville	0	10	0	Tomboy	1	7	8

AUSTRALASIAN

January 15.

	£	s.	d.		£	s.	d.
British Broken Hill	1	16	9	Mount Boppy	0	16	0
Broken Hill Prop	1	15	0	Mount Elliott	4	0	0
Golden Horse-Shoe	2	13	9	Mount Lyell	1	5	0
Great Boulder Prop	0	15	0	Mount Morgan	4	3	9
Ivanhoe	2	16	9	Walhi	2	12	8
Kaiguri	1	15	0	Walhi Grand Junction	1	5	0

Petroleum Production

The following table, compiled by the U. S. Geological Survey, shows the estimated output during the past year:

State.	1913, bbl.	1912, bbl.
California	98,000,000	86,450,767
Oklahoma	62,500,000	51,427,071
Illinois	22,000,000	28,601,308
Texas	14,000,000	11,735,057
Louisiana	12,000,000	9,263,439
West Virginia	11,000,000	12,128,962
Ohio	8,000,000	8,969,007
Pennsylvania	7,000,000	7,837,948
Wyoming	3,000,000	1,572,306
Kansas	2,000,000	1,592,796
Indiana	900,000	970,009
New York	800,000	874,128
Kentucky	500,000	484,368
Colorado	200,000	206,052
Other states	100,000	—
Total	242,000,000	222,113,218

Coinage at Mints

The Bureau of the Mint reports the coinage executed at the mints of the United States during the year 1913 was as follows:

Denomination.	Pieces.	Value.
Double eagles	596,338	\$11,926,760.00
Eagles	508,071	5,080,710.00
Half eagles	1,324,099	6,620,495.00
Quarter eagles	722,165	1,805,412.50
Total gold	3,150,673	\$25,433,377.50
Half dollars	1,326,627	663,313.50
Quarter dollars	1,975,413	493,853.25
Dimes	20,270,622	2,027,062.20
Total silver	23,572,662	\$3,184,228.95
Five cents	73,659,239	3,682,961.95
One cent	98,437,352	984,373.52

Total minor	172,096,591	\$4,667,335.47
Total coinage	198,819,926	33,284,941.92

For Philippine Islands government:	Value.
20 centavos (948,565 pieces)	\$189,713.00
10 centavos (1,360,693 pieces)	136,069.40
1 centavos (5,000,000 pieces)	5,000.00

BANK CLEARINGS in the United States in 1913 totaled \$169,551,826,803, against \$173,952,914,911 in 1912.

The Oil Situation in 1913

According to David T. Day, of the U. S. Geological Survey, operation in other countries in 1913 may be summarized as follows: Prospecting extended to remote regions of South Africa, southern Chile, Patagonia, many islands of the Pacific, China, Japan, and the East Indies. The work of most interest to the United States was that in the West Indies, Central America, and South America, on account of the approaching completion of the Panama canal. In Venezuela, American capitalists were actively prospecting in many regions, chiefly along the northern border. More than 20 field parties were engaged in exploration.

In Colombia, English, American, and Canadian oil interests were concerned with concessions for the development of large areas where, though no large oil wells have been developed, the seepages of oil and asphalt are so significant as to lead to the hope of a large addition to the supply of fuel oil. The Cowdray interests withdrew from Colombia in the latter part of the year.

Delay has been experienced in developing the oilfields of Argentina, owing apparently to the desire of the government to retain the oil as a national monopoly. In Chile a governmental commission examined the oil and gas indications in the Magellan region and made a favorable report. In Ecuador the Cowdray and other interests carried on a vigorous campaign for the acquirement and development of areas showing oil indications in the interior, as well as in the region of the old wells near the coast. Interest was shown in the possibility of finding oil in Panama, Costa Rica, Nicaragua, and Honduras, but there has not yet been time for a significant result. In the islands of the West Indies prospecting for petroleum was active in Haiti, where a small oil well was drilled near Azua. In Cuba drilling for oil was resumed near Havana, Cardenas, and Motembo. Explorations for oil were also active in Barbados.

In Mexico development work was remarkably active considering the unsettled condition of the country, and it resulted in the development of several large wells in the neighborhood of the great gusher at Potrero del Llano. Another large gusher was obtained at Los Naranjos, on the shore of Tamiahua lagoon, which indicated a considerable addition to the total oil supply. The 8-in. pipe-line of the Mexican Eagle Oil Co. was completed from Potrero del Llano to Tampico. The refinery of this Company between La Barra and Tampico is nearing completion. Among many other interesting developments in Mexico was the continued interest in the Topila oilfield, near Tampico, where, in spite of many wells going to salt water, the unusually large gushers occasionally obtained have stimulated continual drilling operations.

A feature of importance for the United States was the development of a large fleet of tank steamers for coastwise and trans-Atlantic trade. Imports of Mexican oil were extended to several refining centres of the United States.

The general interest in the development of new oilfields which characterized the year 1913 extended to Alberta and Saskatchewan, in Canada. Although explorations in Saskatchewan gave either natural gas or else entirely negative results, a well 27 miles southwest of Calgary, in Alberta, struck oil of very light gravity, causing much excitement, and a large territory in that region was taken up by prospectors for oil. This oil excitement extended to the region north of Edmonton, in Alberta, where on Athabaska river and its tributaries large bodies of so-called 'tar sands' have been known for many years. Work has continued in the developing of the natural gas, petroleum, and oil-bearing shales of New Brunswick.

In Russia the production of oil declined significantly in the larger fields, but meanwhile the Ural-Caspian field was actively exploited. This field is reached by steamers to the

north shore of the Caspian sea. Exploration in the Ural-Caspian field north of the present oil wells has been extended over many miles and has shown that the area, while spotted, gives promise of further development. Exploration in this field is impracticable in winter.

In Galicia deep boring is tending to check the decline in the oil supply, and the exploitation has been actively carried forward in all regions where indications have been noted in the past. It is probable that the government of Hungary will develop the gas wells in the region of Kisarmas. In Rumania oil production continued active in spite of the severe fire in the Moreni field. The chief contribution to the industry by the government was the development of a pipe-line system from the producing fields to Constanza, on the Black sea. In Japan production was greatly helped by the introduction of the rotary system of drilling.

World's Production of Gold and Silver, Mint Estimate for 1912

Countries.	Gold. Value.	Silver. Ounces (fine).
North America		
United States	\$ 93,451,500	63,766,800
Canada	12,648,800	31,625,451
Mexico	24,500,000	74,640,300
Africa		
Transvaal	188,293,100	984,672
West Coast	7,286,000	.....
French Colonies	2,044,600	73,286
Rhodesia	14,226,900	158,572
Australasia	54,509,400	14,737,944
Europe		
Austria-Hungary	2,043,200	1,840,297
France	1,812,100	429,831
Germany	78,100	4,984,677
Great Britain	27,800	113,769
Greece .....	.....	803,750
Italy	11,000	447,761
Norway .....	.....	247,988
Portugal	2,300	205,822
Russia	22,199,000	200,094
Servia	251,100	24,132
Spain .....	.....	5,152,626
Sweden	20,300	32,202
Turkey	500	1,509,133
South America		
Argentina	107,300	81,996
Bolivia and Chile	175,000	4,049,856
Brazil	3,570,600	40,610
Colombia	2,971,700	587,683
Ecuador	406,500	22,642
Peru	492,200	8,351,563
Uruguay	111,000	.....
Venezuela	623,500	122,303
Guiana (British)	879,800	724,235
Guiana (Dutch)	407,300	.....
Guiana (French)	3,050,600	.....
Central America	3,030,400	2,845,954
Asia		
British India	11,055,700	93,649
China	3,658,900	.....
East Indies (British)	1,352,000	.....
East Indies (Dutch)	3,387,100	465,980
Indo-China	74,700	.....
Japan	4,467,000	4,932,852
Korea	2,852,600	12,224
Siam	56,500
Total	\$466,136,100	224,310,654

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EDITORIAL

DISCOVERY that the hot waters at Idaho Springs, Colorado, contain 25 times the amount of radium in the springs at Joachimsthal, accounts for the optimism long radiated from 'Idaho,' as the initiated call that one of Colorado's best loved minor cities.

A NEW editor has been chosen for 'The Mineral Industry,' the highly useful annual established in 1892 by R. P. Rothwell. Mr. G. A. Roush, who takes up the work this year, is assistant professor of metallurgy at Lehigh University and one of the active members of the Electrochemical Society. That he is excellently qualified for his new duties will be conceded by all who read his review of electrometallurgy in 1913 which we printed January 3. Incidentally, we were in error in stating that he was associate editor of *Metallurgical and Chemical Engineering*.

EXCESSIVE use of powder underground is to a considerable extent the result of unthinking habit, as is suggested elsewhere by Mr. R. Noblett. We recall an instance where the miners were firm in the faith that four sticks were needed to break each hole. Quiet tests by the engineer and the foreman showed that three would do the work. Thereupon a carload of powder was bought made in a special size so that four sticks contained the same amount of explosive as had formerly been put in three. The miners continued to use the four sticks, the rock broke as well as ever, and powder costs fell 25 per cent. Other cases might be cited.

CHEAP hydro-electric power has been responsible for the growth of large and varied electrochemical industries in Norway and Sweden, and one more analogy between Alaska and Scandinavia is suggested by the article by Mr. E. P. Kennedy on the Long Lake power project that we print this week. We published December 2, 1911, some interesting notes on the situation in Norway and Sweden. Mr. Kennedy proposes to develop power at a cost of \$3.43 per horse-power year, which compares favorably with costs in Norway of \$4 to \$7 and in Sweden of \$7 to \$11. In a subsequent article Mr. W. P. Lass will point out the possible uses of this power. In the meantime, Mr. Kennedy's estimates of construction costs may be received with entire confidence, as they are based upon long personal experience in directing work in the region.

BELIEVING that an ounce of prevention may be better than a pound of damage suits, the Anaconda Copper Mining Company has recently adopted a plan which, it is hoped, will greatly reduce the number of accidents in its mines. The Company offers a prize of \$1000 to the foreman in whose jurisdiction there are the smallest number of accidents during the year, and a second prize of \$250 to the foreman reporting the next lowest number. Surely \$1250 a year could not be spent to better advantage, for the promotion of a keen rivalry between the foremen should result in the instillation of a spirit of carefulness into the miners which will be more valuable than insurance, both to the Company and the workmen themselves.

THE annual meeting of the Mining and Metallurgical Society, held in New York, January 14, was a particularly pleasant affair. Following the usual dinner, informal talks were given by Messrs. Sidney Jennings, Parke Channing, Allen Rogers, and others, and the discussion of the latest things in mining ranged from Alaska to Chile. Mr. J. F. Kemp, the newly elected president of the Society, discussed in his best manner a new method for getting metals out of the ground without mining, and Mr. D. M. Riordan told of early experiences in the Southwest. It was announced that Mr. J. R. Finlay had been elected vice-president, Mr. W. R. Ingalls, secretary-treasurer, and Messrs. J. Parke Channing, Hennen Jennings, P. N. Moore, and H. Foster Bain, councillors.

WASHINGTON dispatches indicate that a lively interest is being taken in the bill now before Congress that proposes to give to the President power to withdraw radium lands from entry and to the Secretary of the Interior to lease these lands or otherwise provide for mining the ores so as to secure needed radium for government hospitals. A vigorous protest against any further land withdrawals has been made on behalf of Colorado, in which state the known lands occur. We printed January 3 an authentic account of the arrangement existing between the Bureau of Mines and the National Radium Institute, which, by the way, draws its ores from lands already in private ownership, and we have also published full details regarding the pitchblende deposits of Gilpin county. In a matter of so much potential importance to human life and health, it is surely better that the technological developments should be public and free to all, as is provided in the present plans of the Radium Institute and the Bureau of Mines. It would also seem good sense, if the Government owns radium-bearing ground and has the necessary technical information, as it presumably will have as a result of the arrangement with the Radium Institute, to reserve a supply of ore for its own hospitals. There are large sources of supply now in private ownership, and the power that it is proposed to give the President would by no means convert Colorado into the howling wilderness that a few of our more excitable friends seem to vision.

Oroville Dredging Limited and Its Future

The resumption of dividends by the Oroville Dredging Company, Limited, and the recent announcement of the purchase of a tract of rich gold gravel land adjoining the Pato property in Colombia, brings this Company into the limelight. The dividend of six pence per share, payable March 1, will gladden the hearts of the many shareholders who have patiently waited for four years to receive some returns on their seemingly unfortunate investment; and a continuation of dividends is to be hoped for, as a result of the satisfactory earnings now being made from the dredge on the Pato property. The California properties of this Company are nearing exhaustion, most of the dredges have had to be abandoned or dismantled, and of the three boats still in commission, there are only two which can be expected to last until the ground can be exhausted. According to a report by Mr. Theodore J. Hoover, dated May 16, 1913, the remaining ground at Oroville will be dredged in five years with a total net yield of approximately \$500,000. Mr. Hoover states that "there is no prospective value in the Oroville business, and * * * the limits of our income and profits are very definitely fixed." Inasmuch as the annual profits after 1913 from Oroville are not expected to exceed \$68,000, it is evident that the shareholders will have to rely largely upon the operations in Colombia for their dividends and the return of capital invested. The revenue from the properties in California since they were acquired in 1905 has been far from satisfactory. Dividends amounting to \$1,383,000 have been paid, and a further sum of about \$500,000 is expected from the yield in 1913 and that of the next five years, when the properties will be exhausted. The total yield, therefore, will fall short of the capitalization of the Company by about a million and a half dollars. The discontinuance of dividends was considered necessary in order to acquire another property from which the inevitable loss on the California properties might be recouped. In 1909, therefore, the Pato property in Colombia was secured, and the earnings from the California dredges for the past four years have been used in equipping the new property.

The Pato concession contains over 20,000 acres, but of this vast area only 310 acres has been proved to contain gold gravel having a satisfactory average value. Mr. C. H. Munro made a thorough examination of this ground and sampled it, reporting the average gold content to be 31 cents per cubic yard. The total net value of the tested area was stated to be approximately \$1,750,000, which amount was expected to be realized in seven years, working with one dredge. Unfortunately, the expenditures have been double the amount anticipated when the property was examined, with the inevitable result that the expected profit from the Pato property will be materially reduced unless further prospecting shall reveal new areas of pay-gravel. Pato has proved to be a most expensive ac-

quisition. On July 31, 1913, according to the Company's published reports, the Pato company's indebtedness amounted to about a million and a half dollars, consisting of the 8 per cent income notes, and interest thereon, due the Oroville Dredging Company \$1,266,000; further cash advances by the Oroville Company (\$118,000); and a loan from the Consolidated Gold Fields of South Africa, with interest (\$151,000). The Oroville company had advanced to the Pato from its own surplus and reserves, and from money which it had borrowed, over \$1,000,000 for the purpose of equipping the latter property. Inasmuch as the Oroville Dredging, Limited, owns 75 per cent of the stock of the Pato company, it is evident that if the profitable ground of the latter should prove to be confined to the 'tested area,' having an average recoverable value as previously determined by the engineers, the Oroville company's share of the profits will come to about \$1,300,000—an amount only slightly in excess of the cash actually advanced. On this basis we find that the total amount of dividends previously paid, together with revenues expected from the properties in California and Colombia, comes to approximately \$3,200,000, as against the Oroville company's capitalization of \$3,500,000. Inasmuch as no disbursements to shareholders can be considered as dividends unless the return of the entire amount of the capital is assured, it is apparent that the payment of actual dividends upon Oroville stock must depend upon the discovery of additional profitable ground in the Company's property in Colombia.

With regard to results at the Pato property, it is interesting to note that actual dredging was not commenced until about February 1, 1913, but the results since then have greatly exceeded expectations. During the six months ended July 31, 1913, about 450,000 cubic yards was dredged with a yield of 14.79 cents per yard at a working cost of 12.49 cents. The latter figure, it is to be noted, is based upon six months only. The ground dredged was below the tested area, and supposedly barren, so the results were unexpectedly encouraging. After August 1, when the tested area was reached, 458,000 cubic yards was excavated, which contained an average of 74.15 cents in gold per cubic yard. The yield was more than double the average value calculated from the results of drilling the 310 acres in question previous to the purchase of the property, and from this fact some have been inclined to infer that the original estimates of the engineers were far too low. Such an assumption is unfair both to the engineers and to the shareholders, for it is well known that the richer gold gravels are usually found in well defined channels or in certain areas of limited extent, and the gravel now being dredged may well be in a channel where the gold content is higher than the average of the whole tract. Mr. Munro, after a thorough examination of the ground, calculated an average value of 31.31 cents per cubic yard. From our knowledge of the accuracy with which gold grav-

els can be tested, and the undoubted ability of Mr. Munro, we believe that the dredging of the entire 310 acres will prove Mr. Munro's figure to be very nearly correct. The dredging of ten or fifteen acres of 74-cent gravel at this time merely means that the recovery from the rest of the gravel area may be considerably less than 31 cents per yard. It is evident that the dredge is now digging some of the best ground the Company owns. The fact that the few acres already dredged contained twice as much gold as the average calculated by the engineers most assuredly does not prove that the higher value per yard will be found throughout the entire extent of the tested area.

With respect to the prospects of finding additional areas of dredgable gravel on the Pato concession, Mr. W. A. Prichard is reported to have cabled that the concession is now found to include nearly 40,000 acres; that California hill is of small area, and the gravel there averages 12 cents per yard; and that there are other placer deposits on the Pato property which are "well worthy of investigation." It is extremely gratifying to know that the territory is so vast, and it is to be hoped that it may be found to contain many good placer deposits, but the fact remains that the Pato property is merely an undeveloped prospect except for the tested area and California hill. At the latter place the drilling has not proved gravel containing a very satisfactory amount of gold, for it is not probable that a limited area of 12-cent gravel can be worked at a reasonable profit. The value of the concession, beyond the tested area, therefore, is entirely prospective and speculative. It is quite possible that systematic prospecting and drilling may reveal valuable gold gravel deposits in other parts of this enormous property, and we sincerely hope that this may be the case, but at the present time there seems to be little definite information upon which to base the rather optimistic reports which are now being circulated.

The most recent announcement contains news which is surely intended to fill the hearts of the shareholders with hope, and to advance the price of the stock. It is stated that the San Francisco property of 400 acres, adjoining the Pato on the other side of the Niehi river, has been purchased for the trifling sum of \$51,000, and that from the results obtained by drilling, Mr. Prichard has proved 90 acres of pay gravel, averaging 70 cents per cubic yard, with a depth of 48 feet. Mr. Hoover calculates that, if these results are confirmed, the area should yield a profit of about \$3,500,000, after allowing 10 cents per yard for operating costs, and about \$500,000 for equipment. It must have startled the Oroville directors to learn that a veritable bonanza had lain almost at their doors for four years, perhaps quite unsuspected; and that this could now be purchased for a song! However, they bestirred themselves sufficiently to keep the cables hot until the money was transferred before the option had expired. We congratulate the Company, and trust that the reports may in due time be fully confirmed.

What is the Matter With Prospecting?—III

A SYMPOSIUM

Charles A. Chase: I think that money is available in considerable amounts for finding and developing prospects. The second source of money consists of property in the hands of individuals who are doing some exploratory and development work. I think that additional money will be found when prevailing conditions are better. Government aid does not seem to be necessary at this time. It seems to me that the money to be obtained regarding prospecting conditions is money to be used for prospecting in which you say that we would not require license. If we do require a permit license I am sure that with future increased amounts of new money will be available for new work. I seem to me that this is the logical answer to your whole letter.

Coal Engineer: I should say that leaving aside external monetary conditions occasioned by national legislation and uncertainties, money is readily available in adequate amounts for finding and developing prospects, though capital exercises the major portion of the profits through majority of stock ownership. The man who wants all cash for his prospects and retains all the stock ownership of the resultant successful exploration is not welcome at the least. It is, of course, difficult to get money readily in any considerable quantity because of the highly speculative nature of most of the undertakings, but money is available for the legitimate mining enterprises conducted by reputable engineers. I think it might be said money is available if actual conditions, risks and returns could be clearly shown and truthfully measured. I do not believe in government aid to prospectors except through the publications and maps of the Geological Survey. Prospecting methods have necessarily been improved as the more conspicuous deposits have been discovered and already mined, but the expense of prospecting has correspondingly increased. A better market for undeveloped mineral lands might possibly be created by educating capital toward securing really competent specialists to report on undeveloped mineral lands, not merely from the technical standpoint of the government geologist, but from that of the commercial engineer to whom capital looks for its safeguards and returns. This would tend to reduce risks and create better public sentiment.

Starly A. Easton: I believe that there is just as much money now available for finding and developing prospects as ever before. In fact, I am inclined to think that there is a good deal more money available. I do not believe in government aid to prospecting and prospectors—that is direct financial assistance. The art of prospecting can be encouraged by the Government by giving the prospector a free hand and assuring good treatment to the prospector and those helping him in their first search, and in the work following upon a discovery. Further prospecting must be accompanied by a great deal more development work than heretofore. The big, prominent, rich outcroppings have all been found in every country that has even been partly explored. What is required now is prospecting by development work, either by claim drilling, sluicing by ditch or pressure, or shaft or tunnel development, and in connection with the most careful study of the areal geology. In order to justify such expense and labor the locator and his associates must know they will not be disturbed in possession of the ground they are investigating and must feel that if they succeed in disclosing mineral of value, they will be able to get title from the Government to enough area to protect them from litigious neighbors. The principal requirement above public interest, financial backing, or other factor, is the protection of the prospector and his associates in their possession and development of the land, by providing some method by which title to undeveloped and partly developed mineral land or land which is sufficiently promising in mineral possibilities to justify serious investigation, can be safely and surely secured. While it is true that no new districts are being advertised at this time, still it will be found that around such big mining centres as Butte or the Coeur d'Alene new mineral bodies are being continually opened, not only in new properties, but in the extensions of the workings of the older mines. These new developments add vastly to the mineral resources of the country, but are not advertised, nor, in fact, is anything known of them except to those directly connected with the work.

F. Lynwood Garrison: It is certainly not true that money is no longer available for finding and developing prospects, quite the contrary, in fact, for in my opinion there is more money to be had for this purpose than ever before, and will continue to be as long as the gambling spirit is in human nature. The thing is to take advantage of this trait and see that it is wisely and effectually directed. This money can be made available by proper representations regarding the prospect, claim, or mine, as the case may be. But

* In preparing this third of the series on "What is the Matter With Prospecting," the first of which appeared in the "Annual Review Number," we would like for the benefit of those who did not see the first of the series, that the content of this symposium has been abstracted from letters received from some of the new national members of the profession. Under this scheme of assistance to the mining fraternity, we take pleasure in thus presenting their individual viewpoints. Editor.

this information should be obtained by a skillful and trustworthy mining engineer, or by one whom he knows to be competent and reliable. It is preferable, however, that the engineer himself should have examined the property. The only way the Government is likely to be able to help prospecting and prospectors is by having better mining laws. It has done, and is still doing, much through the Geological Survey in the way of providing reliable maps and other data. Prospecting methods and conditions certainly can be improved, and naturally such betterment would be most quickly effected if the work were in the hands of a competent mining engineer. A better market for undeveloped mineral lands can be created by a stronger public sentiment against fake promotions and charlatan engineers and geologists. The postal laws can always be invoked to check this kind of fraud, if people would take the trouble to go to the proper authorities with well assured facts. In my opinion, fraudulent promotion in metal mining has been a great deterrent to the legitimate development of the country. Of course, dishonest promoters would go out of existence if there were not so many foolish and avaricious people with money ready to put in their schemes. We cannot hope to eliminate the fools, but we could make it very hot for the promoters that use the mails.

Andrew C. Lawson:—It is my impression that the ancient and honorable profession of prospecting is suffering from atrophy. It is my further impression that the reason for this is that the prospector does not get his proper share of the value of his prospect when it proves to be valuable. It requires capital to make a mine out of a prospect, or even to develop it to that stage at which the probability of its having the makings of a mine becomes apparent. Money is as a rule spent freely on prospects only where these have high-grade ore, or where, if the grade is low, a vast tonnage is in evidence at the surface. The only way of securing money for the development of a large proportion of these prospects is the organization of prospecting and development companies to engage in the business of mining venture, as distinguished from buying a sure thing. It is my belief that if such companies were to act on competent advice, so as to minimize the chances against them, their winnings in the long run would be large; and these should be shared with the prospectors who make the lucky finds. I do not believe in government aid to prospecting and prospectors. I believe the time has come when prospecting may be done on geological principles, to a very considerable extent, along lines that are impossible for the ordinary prospector; but the highest geological skill will be required for the direction of such work, and many blanks will be drawn for one prize. A better market for undeveloped mineral lands would be secured: (1) by the suppression of fake mining companies which undermine the public confidence in mining ventures; (2) by disposing of mineral lands by lease only; (3) by systematic exploration of such lands

by prospecting and development companies so that their value may become known, (4) by improving transportation facilities in new districts, (5) by encouraging the development of agricultural and other industries in mining districts to the end that they become stable instead of ephemeral communities, (6) by doing away with the apex law so that costly litigation may be minimized and greater security of tenure obtained; (7) by the extension of geological surveys in greater detail than has hitherto been customary.

Mining Engineer: As far as the writer's observation extends, it is true that money is no longer available in adequate amounts for finding and developing prospects as regards the outside public, but this does not apply to the majority of those actively and continuously interested in mining affairs. There seems no possible way of renewing interest which shall show itself in a readiness to furnish additional money for such purposes save by either (a) a largely increased price in metals, which shall make profitable many small mines now unworked, or (b) a recurrence of that psychological condition known as a 'mining boom.' Under no conditions is aid to prospectors a function of the Government. Such an attempt would result in abuses of the worst form with no satisfactory returns. There are thousands of prospects throughout the United States which would find development if the owners did not demand outrageous prices for them. The actual chances for the old-fashioned prospector are by no means what they were in the days of the earlier mining booms. The time has come for capital, wisely directed, to assume some of the risks of prospecting and development; but, naturally, capital does not stand ready to do this if in addition to the inevitable prospecting risks it must pay unreasonable prices or assume unreasonable contracts on undeveloped properties. After all, possibly a good dose of hard times may be the best cure for all this mining woe. A cure of this sort is even now in progress in the Joplin district, where a familiar process is being repeated. That district is well dubbed the 'Poor Man's District.' Whenever the price of zinc ore reaches a level unprofitable for the low-grade mines, so that wage-work is scarce, the miners turn to prospecting by leasing, reasonably sure that the chances for finding some mineral are worth taking. New discoveries are being made from week to week in that district, and when the price of zinc ore again advances, it is a reasonable expectation that there will be a number of new large producers as the result of the present stress. In a general way this same condition may follow throughout the whole country.

W. Lindgren:—I emphatically do not believe in government aid to prospecting and prospectors except in the line of improving communications in the wilder and more distant regions.

E. A. F. Penrose, Jr.:—I believe there is plenty of available capital for developing mining prospects when

it is to be used legitimately and is not to be handicapped by too much legislative interference. It was the encouragement given by our Government to the honest effort of individuals, that originally developed and fostered the mining industry of the West. If we attempt to interfere with this by too many restrictions, I think we will find that prospecting and the development of mines will lose much of their old activity. I believe that the federal and state governments can do much good for the miner in making geological surveys and topographical maps, but I do not think that they ought to exercise too much paternalism over the individual who is legitimately trying to succeed by his own efforts. I do not believe that the Western miner wants to be patronized in this manner. Give him his freedom of action in his honest efforts and he will generally make good without having to be taken care of.

Wm. Fleet Robertson:—The question as to whether new mines are being found as rapidly as is necessary to keep pace with the demand for the metals is, it seems to me, best answered by the prices of the metals on the markets; and as there is no great upward tendency over any extended period, the answer seems to be in the affirmative. The following answers to your stated questions can only be assumed to be of local application to British Columbia. In my opinion it is not true in a general sense that adequate amounts of money are not available for prospecting. Such an investment is naturally a 'speculation' and in recent years the great increment in land and timber values has absorbed the larger part of the speculative money here, with resulting diminution of speculative money for prospecting and developing of prospects. A reaction is now automatically setting in, and mineral property will soon again receive its legitimate amount of speculative money. The picturesque prospector of the street or saloon has been largely replaced by a much less noisy, better-equipped individual who has his business associates, before whom he lays his prospects. It is simply a change of method, which you may call the effect of civilization, or civilization, as you choose. Many big companies and financial syndicates maintain a staff of junior engineers and mine examiners ready to examine anything reasonable. The large companies in British Columbia will send an engineer to make at least a cursory examination of almost any sort of a prospect presented by a prospector. Government aid cannot be given as financial aid to individuals or properties, as this would be open to the suspicion of government favoritism, and also because such aid would in many cases be abused. Government aid may properly consist of: (a) making trails and roads to facilitate access to districts, including bridging of streams and arranging for ferries; (b) facilitating the easy acquirement by prospectors of claims at nominal cost, with security of titles. In British Columbia a prospector may stake and record a claim 1500 by 1500 ft. (about 52 acres) for \$2.50.

This record holds the land for one year, and if during that year \$100 worth of work is done on the claim and recorded, for a fee of \$2.50 the title is renewed for another year, and so on from year to year. When \$400 worth of work has been done, and a survey by a land surveyor has been recorded, a Crown grant (equivalent to a patent in the United States) can be obtained for \$25. This title is unassailable, excepting by the Government on a charge of fraud. If the property is worked to the extent of \$200 a year it is exempt from all taxation. (c) By having vertical boundaries to mineral claims, and no extralateral rights to tempt litigation to freeze the poor man out. (d) Exploratory work in new district with published reports on the same to indicate likely areas for the prospector to investigate. (e) Free qualitative determinations of all minerals sent in, and advice as to the advisability of making exact tests on the same. (f) Advice in the office and field to all wishing information in mining matters. These aids are all given in British Columbia. A better market for undeveloped mineral claims can be created by restoring confidence in the veracity and ability of the prospecting class, sadly shaken in past years. The public has found by bitter experience that mining is used as a cloak to cover a multitude of swindles, and in consequence people are getting very cautious. The unscrupulous middleman is more to blame in this respect than the prospector. The prospector should be educated as to the true value of a prospect, so that the price asked therefor would not be prohibitory to any sane man intending to develop it. This can be done only by making him realize fully the risks of loss that are undertaken by the purchaser.

W. H. Shockley:—My experience is that none of the larger exploration companies, or important mining companies who are looking for mines, will furnish any money for prospecting. This is also true of the individual capitalists with whom I am acquainted. And I might as well have said at once that I do not know any source from which a prospector can get money for developing a prospect. I do not know any way in which money can be made available, except by raising it by taxation. I see no special need of giving prospectors government aid at present. I do not think it possible to improve prospecting methods or conditions to make the available funds adequate. I see no way in which a better market for undeveloped mineral lands can be created.

Henry W. Turner:—In my opinion it is a fact that money is no longer available in adequate amounts for finding and developing prospects. No doubt additional money could best be made available by showing directors and heavy investors that it costs less to get good mines by trying and developing promising prospects than it does by paying large prices for developed orebodies, with the attendant heavy expenses for examination. Only by developing will the present large companies of the world be able to keep up the

metal production. I do not think that government aid to prospecting and prospectors is at all necessary. A better market for undeveloped mineral properties could be created if the Government would give a special concession of time, say six months, to companies or individuals for prospecting mineral lands, as is done in Mexico. If the prospector were assured possession of his ground for prospecting purposes for a reasonable period of time, no doubt more prospecting would be done.

Horace V. Winchell:—It is true that funds are no longer available for prospecting and developing mining properties. Additional money is not likely to be available until the law is changed so as to give exclusive possessory title to the locator and prospector during the time in which he is trying to make a discovery. I do not believe in government aid to prospectors. Prospecting methods and conditions can be so improved as to make available funds adequate. Undeveloped mineral lands will be in greater demand just as soon as there is such a change in the definition of what constitutes mineral lands as to make it possible to hold them in advance of the actual discovery of ore. While the fundamental defect lies in the law, which at present requires a discovery before completing a location, and therefore before exclusive possession is acquired, still I believe that another fact detrimental to prospecting is found in the creation of so-called 'development companies.' As a rule, these companies are not 'development' companies in any sense, but more properly 'retardation' companies. Before their organization there were numerous individuals of means who were open to propositions from prospectors and the owners of mining properties and who would investigate, through the agency of some mining engineer, propositions which appealed to them individually. There was thus a rather widespread and numerous clientele or purchasing power scattered throughout the land. Each 'development company' gathered a group of these individuals into its fold and made one purchasing entity instead of many. Each 'development company' further employs a consulting engineer or manager to decide upon the purchase or rejection of properties offered to it. These supervising officials feel it necessary to be doubly cautious in accepting properties, and, acting in responsible capacities, will actually not take the chances on behalf of their employers which they would be perfectly willing to take as individuals. They are constantly looking for bargains, and no proposition ever comes to them in an entirely satisfactory form. In order to earn their salaries they must make better terms upon every property brought to their attention. They even go further and actually, although quite probably without realizing it, constitute a little monopoly upon the purchasing side—so much so that if one of these companies learns that another has examined a certain property and failed to purchase the same, the other almost invariably promptly rejects it without any consideration.

Gold in the Canal Zone

A number of placer claims located along the Gatun river and its tributaries, some of them within and some of them without the Zone, have been examined by D. F. MacDonald, the official geologist. The following is a summary of the investigation, as published in *The Canal Record* of November 26:

Location.	Number of pans washed.	Gold per cu. yd., cents.	Cost of working gravel, per cu. yd.
Gulneal creek	17	trace	\$1.00+
Palenque creek	30	2.1	1.00+
Cuatro Calles creek	20	0.7	1.00+
Quebrada Pato	22	0.6	1.00+
Quebrada Mollejones.....	12	2.0	0.12+
Agua Clara	52	2.0	0.12+
Main Gatun river	46	1.0	0.12+
Bar near mouth of Agua Sucia creek	6	7.5	0.12+
Another part of same bar.....	6	1.2	0.12+
Agua Sucia creek	47	0.0	0.60+
Main Gatun, below mouth of Agua Sucia	28	1.3	0.12+
Quebrada Lopez	14	2.7	0.60+

Mr. MacDonald is of the opinion that the territory has practically no value for mining purposes.

Electric Furnaces for Steel Production

A Pennsylvania concern has recently ordered from Siemens & Halske, of Berlin, two 20-ton induction furnaces of an improved type that has been developed from the combined patents of Kjellin, Rochling-Rodenhäuser, and Frick. These furnaces, which are now in course of construction, will be of the double-ring form and will be supplied with power from separate single-phase alternators. The generators will supply a current of 5000 volts. The normal power consumption of the furnaces will be 1800 kw. each, and they will be employed for the refining of molten open-hearth steel, which will be used chiefly for the production of rail material. The output of each furnace will be about 160 tons per day of 24 hours, depending upon the grade of steel produced. The importance of this order will be more thoroughly understood when it is considered that up to this time the largest furnace of this type had a capacity of only 12 tons per day. The confidence of the builders is such that they are now offering furnaces of 40 tons capacity, built upon the same lines.—*Daily Consular Report*.

Working with one furnace for 298, and a second furnace for 90 days of the first 11 months of 1913, there was smelted at Katanga, Africa, 48,500 tons of ore averaging 15 to 16% copper and yielding 14,124,000 lb. of copper, at a cost of 9.7c. per pound.

Two reservoirs are being constructed in the state of Hyderabad, India, which will have a total capacity of 13,739,000,000 cubic feet.

Recent Advances in the Study of Sulphide Enrichment

By C. F. TOLMAN, Jr.

Almost simultaneously, Van Hise, Weed, and S. F. Emmons¹ announced the theory of 'secondary sulphide enrichment,' and explained the processes and described the details so accurately and fully, both Weed and Emmons giving illuminating examples from mines with which they were familiar, that the active study of the succeeding twelve years proved to be largely confirmatory and added but little to the deductions of these men. The principle was so clearly announced, easily understood, and well fortified by indisputable examples, and fitted in so well with Van Hise's ideas of the predominant rôle played by the ordinary meteoric circulation in the formation of ores, that it came to be given recklessly as the explanation of all rich sulphide ores found near the surface.

Studies by Spurr at Tonopah, of Lindgren and Ransome at Cripple Creek, and others, proved that bonanza silver ore in combination with sulphur, arsenic, and antimony, and rich telluride ores, often show no notable downward enrichment, and emphasized the fact that field and mineralogical studies were necessary in order to determine the importance of this process. This need induced Ransome to summarize the criteria available for the recognition of 'downward sulphide enrichment', and while the paper, and the discussion which followed, were disappointing in that they did not result in important contributions to our knowledge of the subject, they were of great value in summarizing and coördinating the data at hand. A summary of the process written at the close of 1912, would have read about as follows:

The descending solutions are strongly acid from the oxidation of the pyrite. They contain the sulphates of those metals that appear in the original ore, those of silver and copper producing the most important enrichments. When these solutions reach the water-level they deposit simple and nearly pure sulphides in the reverse order of their solubilities, silver sulphide first, copper sulphide, chalcocite, next, with subordinate amounts of bornite and chalcopyrite in some few cases. Covellite is considered as an oxidation product of chalcocite, or possibly, in a few cases, precipitates directly as a secondary sulphide, at the top of the enriched zone. It is recognized that complex sulphy-salts of silver are often secondary, but the reactions by which they are formed are not understood, and no microscopical study of the opaque sulphides has been made, and therefore the criteria for distinguishing primary from secondary ores are not developed.

At the time the above summary is supposed to have

been written, most investigators thought chalcocite to be formed only by secondary enrichment processes. For example, Ransome stated in his article on the criteria of downward sulphide enrichment: "I believe that we are justified in regarding chalcocite very rarely, if ever, formed except under conditions of downward sulphide enrichment or by vadose sulphate solutions." Although Tolman, in 1907, had explained that there was a rapid neutralization of the acid solutions, and suggested neutral or even alkaline solutions as agents causing the secondary transport of copper, the possibilities along these lines were not recognized. Bard, for example, suggested that calcite gangue tended strongly to inhibit enrichment by the neutralization of the acid and precipitation of the metals as carbonates.

Chemical Research

Although much valuable chemical research was undertaken previous to 1913, about all that was established was that secondary sulphides had been produced by several methods in the laboratory. It could not be said which of these methods, if any, represented the reactions in nature, and the equations governing them were guessed at, rather than known. In fact, the experiments, as reported, were distinctly misleading in suggesting that we had to do with the precipitation of a single stable sulphide, and not, as will be indicated later, a mixture of unstable compounds, changing from one mineral to another, the intermediate and final products being determined, probably, by the composition, and the concentration of the solution, and the temperature and pressure under which the reactions took place.

Before considering the advances in our knowledge of this subject during the past year, it seems advisable to call attention to two things that have proved to be a distinct hindrance to the study of the subject. The first is in regard to nomenclature. It would be difficult to invent a more inappropriate and inaccurate name for the process than 'secondary sulphide enrichment.' Sulphide enrichment alone is probably too narrow a term, for recent experiments and observations show that native silver and possibly native copper may be precipitated in the sulphide zone, and therefore are not merely products formed from the direct oxidation of the sulphides. There are two processes that are contrasted and which need separate terms: (1) downward enrichment caused by descending surface waters; (2) upward enrichment caused by a renewal of the ascending thermal solutions. Secondary is a term used by mineralogists to designate a mineral or minerals formed by the breaking down, replacement, or substitution of an earlier formed mineral. Downward en-

¹For literature on sulphide enrichment, see Tolman, C. F., *Mining and Scientific Press*, Vol. 106, pp. 179-180 (1913); Emmons, W. H., *Bull.* 529, U. S. Geol. Survey, 1913.

richment is by no means always secondary, for chalcocite has been described as filling veinlets in the original ore, and in the country rock. Ascending enrichment is not necessarily primary. A. F. Rogers will describe a well established case of ascending secondary enrichment, in a forthcoming number of *Economic Geology*, and the microscopic study of polished sections of many varieties of ores leads me to believe that there is a break-down in certain primary ores, not caused by descending solutions.

That ascending solutions may react on earlier formed sulphides to form secondary sulphides is not recognized by Gratton,² who states: "In this paper, minerals called primary are regarded as products of original deposition from solutions probably ascending, heated, and of alkaline character; secondary sulphide minerals are those produced from other sulphides by the action of descending, cold, acid (or possibly neutral) solutions." This has led him to postulate as a general occurrence a single period of formation of primary ores, and to attribute all secondary changes in these ores to the results of descending vadose solutions: a conclusion which I suspect will be modified by his further studies.

'Upward' and 'Downward' Enrichment

The terms 'upward' and 'downward' enrichment may be applied, then, whenever the origin of the solutions is in mind, and the adjective primary or secondary can be added to either of these terms only when it is wished to emphasize the mode of precipitation, that is, whether the minerals are deposited as a filling of a fissure, or as a replacement of the older sulphides. The terms hypogene and supergene would be satisfactory to the scientist, but these derivatives of a dead language are hardly virile enough to stand rough usage in mining camps.

A. F. Rogers will discuss this matter in a forthcoming number of *Economic Geology*. He will suggest the terms 'upward secondary sulphide enrichment,' 'upward primary sulphide enrichment,' and 'downward secondary enrichment'. These terms may seem cumbersome, but it seems to me that if we use the terms 'upward sulphide' and 'downward sulphide' enrichment to designate the source of the solutions, this will help to divorce the genetical meaning from the term 'secondary sulphide enrichment' and we will gradually come to use this expression in its mineralogical sense. It would probably not often be necessary to use the complete term 'downward secondary sulphide enrichment.'

The second point that seems to me to deserve criticism is the assumption that has been adopted in much of the recent experimental work, that the composition of the ore-forming solutions, both ascending and descending, can be approximated from the analyses of mine waters.

Any extensive set of mine workings opens up large

masses of sulphide ore to the direct attack of moisture plus oxygen. This attack is so intense that mine fires are developed at times. Stopes filled with broken low-grade ore expose immense areas of ore to this attack. On the other hand, the underground circulation, given constant head by pumping or tunnel drainage, is made many thousand times more active. The first effect is to manufacture acid, and much later to take the metallic salts in solution. It seems probable, therefore, that the descending solutions that caused enrichment are, in general, much less acid than the present mine waters. The fact that great volumes of water are developed by pumping does not prove that a rapid or copious downward circulation existed before the workings were driven. These earlier downward-creeping solutions, although less acid than those of the mine, may have had a much higher metallic content.

If caution must be used in making our deductions as to the composition of the descending ore solutions from analyses of mine waters, much greater difficulties are encountered in attempting to determine the nature of ascending ore solutions from such analyses. The original ores are probably formed in a brief period of intense mineral activity, and later ascending waters may not give an idea of the composition of the ore-forming waters. Again, most ores are deposited from solutions at considerable depth, and the latter must be different in composition and concentration from the later superficial spring water. This cannot be discussed in detail here, but it may be noted that extensive sets of analyses of mine and spring waters are being collected "with a view of ascertaining the general nature and composition of the waters that have been assumed to be agents in the deposition of lode ores, in order that chemical experiments designed to illustrate the natural processes might be accomplished, as far as practical, under natural conditions."³

The development of the extensive disseminated chalcocite deposits of the Southwest, the evident relation of enrichment to permeability of rock, to fracturing, to present and past topographies, to the rate of erosion, etc., and the fact that specks of iron oxides on the surface may indicate disseminated sulphides at depth, encouraged the application of geological field and microscopical methods of examination to these deposits. One of the advances that may be credited to 1913 is the recognition of the paramount importance of these relations. Early in 1913 I published a brief summary of secondary enrichment,⁴ emphasizing these relations, and giving examples of practical problems that had been encountered in this work. Shortly afterward, W. H. Emmons' comprehensive treatment of the subject appeared, in which these relations were considered, but the emphasis was

³Emmons and Harrington, 'A Comparison of Waters of Mines and of Hot Springs,' *Econ. Geol.*, Vol. VIII, p. 653 (1913.)

⁴Bibliography and summaries of the papers mentioned will be found at the end of this paper.

placed upon the mineralogical composition of the original ores, and its effect upon enrichment.

Important advances were made in the knowledge of the chemistry of downward enrichment in 1913. Palmer and Bastin determined quantitatively the reaction between silver sulphate solutions and niccolite, throwing much light on the formation of native silver by descending solutions. Palmer and Bastin, and also Cooke and Grout, showed that native silver, and possibly native copper, are precipitated by descending solutions, especially in presence of ferrous sulphate, and we may conclude that the native copper, so often formed toward the top of the sulphide zone, may be deposited directly from descending solutions.

Up to 1913 it was assumed rather generally that the descending solutions causing enrichment were acid, and that the secondary sulphides therefore were precipitated in an acid environment. Grout, however, found difficulty in precipitating sulphides on other sulphides in acid solutions, but obtained rapid precipitation when he mixed solutions containing metallic salts with solutions of alkaline carbonates and hydroxide, that had been in contact with pyrite. He concluded that secondary sulphides are formed by descending acid solutions meeting alkaline solutions. This generalization is, however, somewhat doubtful. It seems probable that in fractured lodes, where a relatively strong descending circulation is developed, an acid condition will obtain. The development of alunite and kaolin by the action of the descending solutions that precipitate the secondary sulphides is evidence to this effect. Moreover, the sulphides generally develop at the underground water-level, and an immediate neutralization at that point does not seem probable. In experiments now being carried on in the chemical laboratories of Leland Stanford Junior University, Mr. Clark has succeeded in obtaining relatively rapid sulphide precipitation when the sulphides are ground fine. However, the neutralization of the solutions is probably an important factor in the precipitation of the later sulphides, and there is a possibility of a rather deep downward migration of the metals in alkaline solutions. We need further experimental work on these problems.

The suggestion of Bard⁵ that calcite gangue tends to inhibit downward enrichment does not find confirmation in the experimental work of Bastin and Palmer. Moreover, many cases of sulphide enrichment of copper ores in limestone are known. On the other hand, lenses of rich oxidized copper ores in limestone occur, which show no leaching of the copper. The reasons for these differences have not received full explanation.

The discovery of the occurrence of important bodies of 'primary' (formed by ascending solutions) chalcocite did not occur in 1913, but the completed proof from structural and field relations was made avail-

able in this year in the valuable contribution of Sales.

The most important development of the study of sulphide enrichment of last year was the demonstration of the value of microscopic study of polished opaque sections of the ores. This study has been carried on for some time at several American universities, but Graton and Murdock have been the first to make public their results in regard to sulphide enrichment.⁶ They show that any of the copper sulphides may be primary or secondary (in the mineralogical meaning), and that secondary changes show a tendency to transform the iron-rich copper sulphides through the intermediate sulphides into the copper-rich sulphide chalcocite. This break-down has been proved experimentally in the valuable contribution of Spencer. As criteria for primary chalcocite, Murdock and Graton suggest cleavage, and graphic intergrowth of bornite and chalcocite. I believe, however, that the criteria in regard to cleavage need verification; that the so-called graphic intergrowth of chalcocite and bornite is certainly in some cases a break-down of some copper sulphide mineral into chalcocite and bornite, and in other cases a replacement of bornite by chalcocite according to a regular pattern.

In the experiments mentioned above, Mr. Clark has been able to prove that the copper sulphides formed in a number of his experiments consisted of a mixture of cuprous sulphide, cupric sulphide, and sulphur. Mixtures of the two sulphides occur in nature, and have been described under the names diginite, carmenite, and harrisite. It seems probable that not only the composition of the original precipitates, but also of the sets of minerals that are developed by the crystallization of this product, are determined by the composition of the solutions and precipitates, and the conditions of temperature and pressure under which they are formed. It is likely, therefore, that the final solution of many of these problems will be accomplished by physical chemistry. We may hope for valuable information shortly from the physical chemists now investigating these subjects.

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A summary of the results of the study of polished sections of secondary silver ores. Polybasite, proustite, and stephanite are commonly developed by the processes of secondary enrichment. Drawings are given illustrating the

⁶This study is in its infancy, but we may now expect its rapid development. It starts where the examination by transmitted light stops, and shows, in a beautiful way, the relations of intergrowth, replacement, and order of formation of the opaque ores. More attention has not been given this work, perhaps, because of the general idea that the process of polishing is a delicate and tedious one. We have found in our laboratories at Stanford University that the polished surface can be prepared rapidly and easily. A little care will prevent scratching of the surface by coarse powder or fragments of the ores, and a brilliant burnish is quickly obtained by polishing with tin oxide on felt. A section can be prepared in about 15 minutes.

⁵Bard, D. C., *Econ. Geol.*, Vol. V, pp. 59-61 (1910); Welsh and Stewart, *Econ. Geol.*, Vol. VII, pp. 785-788 (1912).

development of these sulphides by replacement of the original sulphide minerals, and also deposited as fillings of later fissures.

BROOKAW, A. D. 'The Precipitation of Gold by Manganous Salts,' *Jour. Ind. & Eng. Chem.*, July 1913. 'The Secondary Precipitation of Gold in Orebodies,' *Jour. Geol.*, Vol. XXI, pp. 251-268 (1913).

Reports of the results of further suggestive experiments on this important subject.

CLIFFORD, JAMES O. 'Formation and Growth of Disseminated Copper Deposits,' *Mines and Methods*, June 1913.

COOKE, H. C. 'The Secondary Enrichment of Silver Ores,' *Jour. Geol.*, Vol. XXI, pp. 1-29 (1913).

Cooke oxidizes, dissolves, and precipitates silver minerals in an instructive series of experiments. He concludes that ferric sulphate is the agent that oxidizes and dissolves the silver, and by reversible reaction ferrous sulphate reprecipitates the native silver. When hydrogen sulphide is present (from the action of sulphuric acid on primary sulphides) this is acted upon by the ferrous sulphate, and sulphur is produced, which unites with the silver to form sulphides. Although not mentioned by Cooke, it is probable that the sulphur necessary for the formation of silver sulphides is also furnished when the solutions attack the disulphide of iron, pyrite. Cooke concludes that only in pyritic lodes will enrichment of silver be important. Bastin, however, believes that scarcity of pyrite and abundance of calcite are factors favoring the development of secondary silver sulphide. Cooke also investigates the solubility of silver chloride in salt solutions. The solubility is small in dilute salt solutions, but increases rapidly in concentrated solutions, from which the silver chloride (cerargyrite) precipitates on dilution. This explains the erratic occurrence of bunches of superficial silver chloride in arid regions, for very concentrated salt solutions may develop at or near the surface in desert regions.

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The most important and only exhaustive treatment of the subject that has as yet appeared. The treatment of the relation of enrichment to erosion, physiography, and climate, is less complete than could be desired, when one remembers the control these factors exercise over the processes of downward enrichment. The chemistry of the process is well summarized, and the composition of mine waters is elaborately discussed. One of the most important contributions appearing in this volume is the proof that the vertical range of the secondary sulphide zone shows a relation to the mineral composition of the ore. He states "that ores containing abundant pyrrhotite are not enriched to depths so great as those containing pyrite and chalcopyrite." The author discusses in some detail the mineralogy and paragenesis of the oxidized ore minerals and the secondary sulphides. Unfortunately, he did not have at hand the recent data obtained from the study of polished ores. He gives short descriptions of a number of copper, silver, and gold deposits, and summarizes the conclusions that may be drawn from them in 48 paragraphs. These conclusions constitute an important contribution to the science of ore deposits.

FABLES, J. C. 'The Precipitation of Copper from the Mine

Waters of the Butte District,' *Bull. Amer. Inst. Min. Eng.*, 79, pp. 1267-1285 (1913).

It is stated that the waters pumped from the mines in the early years of the district contained little copper, and that the metal appeared in the mine waters after the deeper workings were filled with copper-bearing waste.

GRATON, L. C. 'Investigation of Copper Enrichment,' *Eng. & Min. Jour.*, Vol. 96, pp. 886-887.

Scope of the investigations of the 'Secondary Sulphide Commission.'

GRATON and MUMFORD. 'The Sulphide Ores of Copper, Some Results of Microscopic Study,' *Bull. Amer. Inst. Min. Eng.*, 77, pp. 741-786 (1913).

The most important paper that has as yet appeared on the microscopic study of polished sections of copper ores. Photomicrographs show the complex development of successive copper sulphides, and rarely a simple precipitation of chalcocite. The following order is recognized in a number of ores: (1) Secondary chalcopyrite into (2) bornite, into (3) covellite, into (4) chalcocite. Pyrrhotite, however, goes directly into chalcocite without intermediate products. All the copper sulphides observed, occur both as primary and secondary minerals. Criteria suggested (in part provisional) as indicating a primary origin for chalcocite are: (a) primary "intergrowth" of chalcocite and bornite; (b) cleavage. "Sooty chalcocite" is not necessarily secondary, but is the result of the disintegration of the ores near the top of the sulphide zone.

GROUT, F. F. 'On the Behavior of Cold Acid Sulphate Solutions of Copper, Silver, and Gold, with Alkaline Extracts of Metallic Sulphides,' *Econ. Geol.*, Vol. VIII, pp. 407-433 (1913).

Mr. Grout was rather unsuccessful in his attempts to form secondary sulphides from acid solution, of a strength corresponding to analyses of mine waters, and acting on sulphides from which the fine material was sifted out by means of a 200-mesh sieve. When the finest material was used he was more successful, although the action is slow. Whenever much precipitation occurred, the free metals were prominent. He doubts, therefore, if secondary sulphides are formed by the reaction of acid solutions on primary sulphides. He investigated the question whether or not the precipitation is caused by H_2S formed by the attack of H_2SO_4 on pyrrhotite and alabandite, the two minerals that have been proved to develop this gas copiously, under the attack of dilute H_2SO_4 . He showed that pyrrhotite does not evolve H_2S when copper sulphate is added to the solution containing H_2SO_4 , and that the relatively rare alabandite is the only sulphide that precipitates copper "notably" as a sulphide, from an acid solution. Upon treating pyrite with a solution of alkaline carbonates or hydrates, and adding the extract to the acid sulphate solution of copper, he obtained prompt and complete precipitation of the metallic sulphides, and suggests, therefore, the secondary sulphides are formed in nature at a point where the descending acid solutions mingle with deeper alkaline solutions.

GUILLEMAIN, C. 'Zur Kenntnis der Lagerstätten in der Provinz Katanga,' etc. *Zeit. für Prak. Geol.*, XXI, 320-338 (1913).

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LINDGREN, WALDEMAR. 'Mineral Deposits,' chapter XXIX, pp. 780-844 (1913).

PALMER and BASTIN. 'Metallic Minerals as Precipitants of Silver and Gold.' *Econ. Geol.*, Vol. VIII, pp. 140-171 (1913).

The majority of the common sulphide minerals are shown to precipitate native silver or a mixture of silver and silver sulphides from neutral and acid solutions of silver sulphate. The chemical equation is established, governing the precipitation of native silver by the mineral niccolite. This throws light on the formation of the rich secondary native silver deposits of Cobalt, Ontario. Other examples showing secondary enrichment by the deposition of native silver are given. For example, in the Up-to-date mine, near Caribou, Boulder county, Colorado, Bastin found secondary chalcocite, bornite, silver, and covellite in a calcite gangue. Pyrite galena and sphalerite are the least active of the common sulphides in precipitating native silver. All the sulphides precipitate native gold.

RANSOME, F. L. 'Note on Nomenclature of Secondary Ores.' *Econ. Geol.*, Vol. VIII, p. 721 (1913).

SALES, RENO. 'Ore Deposits at Butte, Montana.' *Bull. Amer. Inst. Min. Eng.*, 80, pp. 1523-1627. Review, *Mining and Scientific Press*, Vol. 107, pp. 453-459 (1913).

A splendid structural study of the Butte copper deposits. The geological evidence presented to show that the deeper chalcocite was formed by ascending 'primary' solutions seems conclusive. The conclusions as to genesis also seem well founded. The suggestion is an interesting one that there was but one period of mineralization, and that the difference in the mineralogy of the ore deposits in "the central, intermediate, and peripheral zones" are due to changes in the character of the solutions, resulting from the action of these upon the country rock. We need more mineralogical and experimental data on this subject. A satisfactory microscopical and chemical study of the Butte ores and accompanying rock alterations will furnish us the data yet lacking for the understanding of these complex deposits.

SHANNON, EARL V. 'Secondary Enrichment in the Caledonia Mine, Coeur d'Alene, Idaho.' *Econ. Geol.*, Vol. VIII, pp. 565-571 (1913).

Rich cabinet specimens, from this locality, of native silver and tetrahedrite and covellite, are known to mineral collectors. The author discusses these, and shows that they are products of secondary enrichment. He suggests that enrichment has taken place in this mine, and not in most of the other mines of the district, because of the smaller amount of siderite present in the primary ore of the Caledonia mine.

SPENCER, A. C. 'Chalcocite Enrichment.' *Econ. Geol.*, Vol. VIII, pp. 621-652 (1913).

This is one of the most suggestive papers that has appeared on the subject. The chemistry is treated more fully and logically than elsewhere. The author emphasizes for the first time in print, that the formation of the secondary copper sulphides is not simply a precipitate of chalcocite on pyrite or other sulphides, but that the formation runs through a series of products which he suggests is pyrite into chalcopyrite into bornite into covellite into chalcocite. These changes are suggested by changes in colors in his artificial precipitates. In regard to the moot question of the effect of calcite gangue, he shows that secondary copper sulphides are formed in calcite gangue when cupric and ferrous sulphates are present.

THOMPSON, A. P., 'The Relations of Pyrrhotite to Chalcopyrite and Other Sulphides.' *School of Mines Quarterly*, Vol. XXXIV, pp. 385-395 (1913).

From the study of polished sections of pyrrhotitic copper ores, Mr. Thompson finds that the primary sulphides from

the various mines studied show the same order of development, which is: (1) pyrite, (2) blend, (3) pyrrhotite, (4) chalcopyrite. The later sulphides replace both the earlier sulphides and the gangue as well.

TOLMAN, C. F. 'Secondary Sulphide Enrichment.' *Mining and Scientific Press*, Vol. 106, pp. 38-43, 141-145, 178-181.

A general review of the subject. Emphasis is laid on the field study of the subject, and the author discusses the problems presented during the study of the disseminated copper deposits of the southwestern United States.

WELLS, R. G. 'Electro-Chemical Activity Between the Solutions and Ores.' *Econ. Geol.*, Vol. VIII, pp. 571-578 (1913).

Mr. Wells gives a simple method for measuring the current and electromotive force developed by the action of various solutions on sulphides. He concludes that "electrochemical action is an almost necessary accompaniment of chemical action in the alterations going on in ore deposits," and suggests that there may be natural circuits, formed between different sulphides of the ores and the ore solutions, reduction taking place at one place (the cathode) and oxidation at another place (the anode of the circuit).

WHITMAN, A. R. 'Vadose Synthesis of Pyrite.' *Econ. Geol.*, Vol. VIII, pp. 455-467 (1913). *Mining and Scientific Press*, Vol. 107, p. 928 (1913).

The author designed apparatus to test the successive processes of oxidation, solution, and re-precipitation of pyrite. He succeeded in forming crystalline secondary pyrite, and discovered the importance of kaolin in assisting precipitation. He also proved that the descending acid products of oxidation of pyrite are neutralized, and by further percolation become alkaline.

WINSHELL, H. V. 'Persistence of Ore in Depth.' *Mining and Scientific Press*, Vol. 107, pp. 332-334 (1913).

Discusses the effect of depth especially on secondary processes of ore formation.

Metal Production of Washington in 1913

The total value of the metal mine output of Washington in 1913 was slightly more than \$1,000,000, a decrease of 6% from the value of 1912, according to preliminary estimates of C. N. Gerry, of the U. S. Geological Survey. This was due in part to decreases in silver and copper production and in part to somewhat lower metal prices. An increase of 2% gave a gold output valued at \$694,000. About 78% of the gold output came from crude ore and concentrate shipped, largely the former, and about 22% from cyanide and amalgamation bullion.

There was a decrease in silver yield of about 21% from 413,538 oz. in 1912 to about 326,000 oz. in 1913. The silver output was evenly divided between the silicious ores of Republic and the copper ore of Chewelah. The silver content of the latter decreased.

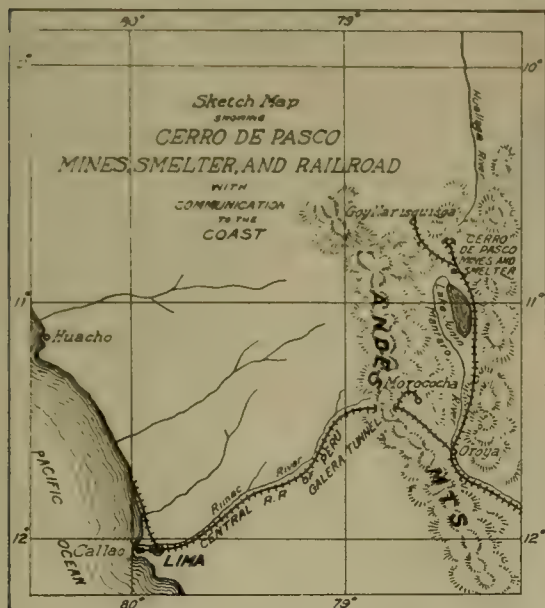
The copper output decreased about 9%, from 1,086,010 lb. in 1912 to about 986,000 lb. in 1913 as a result of curtailed production from Chewelah district. No zinc ore was shipped from the state, but shipments of lead ore were made from Stevens county, giving an output of nearly 300,000 lb., as against 127,387 lb. in 1912.

The San Francisco mint in 1913 received a total of 2,375,651.75 oz. of gold, valued at \$49,109,079.18, as against 2,522,544.75 oz., worth \$52,145,627.10, in 1912.

The Cerro de Pasco Smelting Plant

By SPENCER BISHOP

The smelter of the Cerro de Pasco company is situated at La Fundicion, Peru, a town having an elevation of 14,000 ft. Because of the altitude, the Company has a great many difficulties to fight against



which are not seen or thought of by those who have not been there. There is snow, hail, or rain almost every day of the year. The average temperature is 44°F. The great majority of people going to that altitude are afflicted with *soroche* (mountain sickness), and the few who escape it have a great deal to be thankful for. The sickness is like a severe case of sea-sickness accompanied by sharp pains at the base of the brain and in the chest, lasting from two days to two weeks. The attack may occur each time one goes from a low to a high altitude. The fear of pneumonia is always present, as in any high altitude, but nature favors mankind, for germ diseases are not contracted as easily as in lower altitudes.

Callao is the port of entry, and also the terminus of the Peruvian Central railroad. Eight miles inland is Lima, the largest city in Peru. From here the ascent of the mountains commences. Leaving Lima at 7 a.m., the very gradual climb is begun. For an hour the roadbed is on one side of a valley which soon contracts to a ravine, just wide enough for the Rimac river; and the roadbed. Now and again it widens so that small towns can find room for their mud huts. At 3 p.m., after winding up the narrow

and deep cañon for 98 miles, Tielio is reached, which is the highest station on the road, being 15,665 ft. above sea-level. A few hundred feet beyond the station the last tunnel is entered, where the elevation is 50 ft. higher than at Tielio. Half way through the tunnel the grade starts down-hill to Oroya, elevation 12,000 ft. above sea-level, which is reached at 5 p.m. and is 130 miles from Lima.

There are three long switch-backs, seventeen bridges, and sixteen tunnels on the road. At Oroya a change of cars is made for the smelter. This new line is owned by the Cerro de Pasco Mining Co., and runs from Oroya to the coal mines at Goyelarisquisga. There are two branches on the road, one of about six miles which runs to Cerro de Pasco, and the other about eleven miles long which runs to the other coal mine at Quishuarecaucha. The smelter at La Fundicion, 75 miles from Oroya, is reached about 9 p.m.; and eight miles beyond the smelter, Cerro de Pasco, where most of the copper mines are situated, is reached by 9:45 o'clock.

Cerro de Pasco boasts of 25,000 inhabitants. It lies at an elevation of 14,600 ft., in a saddle of a mountain range, through which runs an old trail to Lima. The town is over a hundred years old. Various interpretations have been given to the name. At a glance, 'A Pass in the Mountain' appears correct, but inasmuch as *pasco* in the Indian dialect means 'a night's camping place,' more guessing is required for the true meaning. The Indians in the neighborhood seem



CONVERTER ROOM.

to be ignorant of the origin of the name.

Great changes have taken place since the smelter was started, and problems have been solved that were at first thought to be impossible. From three 56 by

180-in. blast-furnaces and six 7-ft. Parrot-type converters, the plant has grown until it now consists of five blast-furnaces, two 10 ft. by 25 ft. 10 in. Pierce-Smith basic-lined converters, two 11-ft. spherical con-

verted, with the result that the present battery comprises two 10-ft. by 25 ft. 10-in. Pierce-Smith, two 11-ft. spherical, and two 7-ft. Parrot converters, the last two being used only occasionally. At present a battery of ten Dwight-Lloyd sintering machines is being erected, the trial some months ago of one of these machines having proved their worth. With the large amount of fine ore the Company must handle, they will make a large saving.

At the power-house most of the engines are to be electrically driven by the English system of rope-drive. One blowing engine for the converters, one blast-furnace engine, and one air-compressor will remain on steam. These are to take care of the sudden extra loading that may occur. This will practically do away with the boiler-house, as the waste-heat boilers should deliver enough steam for this load. The electricity for this change and for similar work at the mines is to be obtained by water-power at Oroya, where 10,000 hp. will be

verters, and two of the old 7-ft. Parrot-type converters, five 19 by 60-ft. coal-fired reverberatory furnaces, fourteen 18-ft. six-hearth McDougall roasters, and ten Dwight-Lloyd sintering machines.

The blast-furnaces, converters, and new dust chamber have been remodeled. The lower parts of three furnaces have been left unaltered, the old brick tops were replaced by steel similar to those on the two completed furnaces, with the addition of a 9-ft. gooseneck instead of one of 6-ft. diameter. This larger flue proved to be exceptionally satisfactory. From constant use, these furnaces had opened out to 72 in. at the tuyeres, making the furnaces 72 by 180 in., although the two new ones are 48 by 177 in. With a blast of from 32 to 36 oz., these furnaces are smelting about double what they originally did.

The McDougall roasters have been installed as they were needed, there being now fourteen of them. A new flue is being built to increase the draft, so that the capacity will be greater than at present. Two of these furnaces are used to dry silica for the basic converters. The others roast ore for the reverberatories.

Only three of the five reverberatory furnaces are in constant use. Each furnace smelts 60 tons of charge with 45 tons of coal. One of these furnaces has waste-heat boilers attached, and with the three 300-hp. boilers, 400 boiler horse-power is obtained. The steam is piped to the power-house. With the remodeling of the furnaces, more converters were necessary, and the original six Parrot-type were to be replaced by five 11-ft. spherical acid-lined converters. Before these had been installed, a Pierce-Smith basic converter was

generated by means of three Allis-Chalmers units which are being installed. The electricity will be sent to the smelter, 75 miles away, at 50,000 volts. There it will be reduced to 10,000 volts for the mines and 2200 volts for smelter use. At the mines 250 volts will be used for the motors. The system of rope-drive connecting the air-compressors which is



EXTERIOR OF SMELTER.



SMELTING PLANT AND STACK.

used in the smelter power-house will also be used at the mines. The steam hoists will remain, but will be operated by air in place of steam.

Quite a few foreigners are to be found among the employees, but the lower class of labor is picked from the natives. Unfortunately, these are very ignorant, small in stature, slow of action, superstitious, and not muscular. It takes several of them to do the work that the average white man can do. Most of the natives come from the agricultural districts and

have no idea of mechanical work. Any excuse to lay off from work is welcomed, and the many religious holidays, together with 'pay-day,' afford the opportunity.

At La Fundicion the Company has a coal-washery, and seventy 12-ft. beehive coke ovens in which they make most of their own coke. In addition to the group of mines at Cerro de Paseo, the Company is operating mines at Morocochoa, from which large quantities of high-grade ore is mined. Morocochoa is a few miles from Tielio among very high mountains, and here the most interesting and wonderful geological formations can be seen.

The Company employs about 5000 men. Of this number, 3000 are at the smelter and the other 2000 in the different mines. At each camp a hospital for emergencies is maintained, and there is also a large, well equipped general hospital at Cerro de Paseo. A small fee is charged each employee toward the maintenance of the hospital.

Developments in the Shushana Goldfields

By E. F. WANN

The recent discovery of placer gold on tributaries of the Chisana river, which with the Nebesna river forms the headwaters of the Tanana, has drawn all of the old-time prospectors toward that district. The existence of gold in the country between the White river on the south and east and the headwaters of the Tanana river on the north has been known for several years, but the cost of getting supplies in from the nearest towns has been such as to bar prospecting except in the most desultory manner. However, with the advent of a sufficient number of prospectors to make the matter of supplies an object to the transportation companies and merchants, conditions will be much more satisfactory.

The rocks in the locality of the find are mainly slate and shales, with intrusions of quartz-porphyry. A curious feature of the gravel deposits is the occurrence of a great amount of slate and sandstone in alternate layers, varying from one-sixteenth to three or four inches in thickness. In other places, through what appears to be the old glacial channel bearing the auriferous gravel, can be found granite, andesite, and other rocks that are foreign to this immediate locality. The course of the old glacial bed seems to be in an east-west direction, and its width in the vicinity of the discovery from three to four miles.

The discovery party took out close to \$30,000 from the claim known as No. 1 on Little Eldorado creek, where the wash was about three to four feet deep, and the gravel contained as much as \$27 per pan, \$5 to \$10 worth of gold per pan being common. The bed-rock at this place was overlain in places with a yellowish clayey deposit, evidently formed from the decomposed porphyry, which made the saving of the fine gold, if any were present, impracticable with the means

at hand this season. The scarcity of wood and timber for lumber in the immediate vicinity and the shortness of the season hastened the work so that instead of using a man in the dump-box for puddling the clayey matter, it was rushed through, with only two lengths of boxes below the dump-box, presumably with the intention of reworking the tailing later.

From claim No. 2, on Little Eldorado creek, I understand there was produced about \$30 per day for each man shoveling in. No sluicing was done on this creek except on claims No. 1 and 2. The gravel on fraction 3A, on Bonanza creek, from which claim about \$10,000 worth of gold was taken, was found to contain coarse gold. The gravel is shallow, and as this part of the creek is in the cañon, all of the gold there will probably be found to be fairly coarse. Two silver nuggets, one weighing about 4 oz. and the other 1½ oz., were found in the clean-up, together with galena. Pay-gravel has been found up to No. 13 on Bonanza creek. No other sluicing was done on this creek, and the gold was found to be coarse.

Pay-gravel has also been found on the benches to the right and left of the Little Eldorado, and on the benches of Gold Run creek, a tributary of Glacier creek. The following creeks are also known to contain pay-gravel: Glacier, Gold Run, Big Eldorado, Wilson, Johnson, and Alder Gulch. The total area of the gravel deposits along all of these creeks combined is equal to about fifty or sixty square miles. The appearance of the gravel on the benches and the fact that gold can be panned out of the surface leads one to believe that there will be bench-diggings. These diggings lie in the centre of a region of extensive gravel deposits, evidently of glacial origin. The country rock, where it can be seen in place, looks as if it might contain metalliferous veins. In fact, two or three veins containing gold and copper ore have already been found.

The urgent need of a railroad to open up the rich mineral belt extending from Haines Mission to the lower Tanana is every year becoming more apparent.

Ore reserves in the mines operated by the Kyshtim Corporation, controlling the Russian company, the Kyshtim Mining Works Co., are estimated by R. Gilman Brown as follows, in long tons:

Mine.	Assured ore.	Probable ore	Total.
Koniukhoff	517,000	.....	517,000
Smlrnof	482,000	163,000	645,000
Tissoff	444,000	160,000	604,000
Amerikansky	611,000	74,000	685,000
Total	2,054,000	397,000	2,451,000

Large tonnages, proved by drilling, show from 2 to 3.6% copper. If the reverberatory furnace is completed next summer, the output of copper in 1914 should be between 9000 and 10,000 tons.

During November the Elmore vacuum plant at the mines of the Sulitjelma company, Norway, produced 1075 tons of copper concentrate.

Long Lake Power Development

By E. P. KENNEDY

*Long lake, which lies about 2 miles from the beach at an elevation of 727 ft., has an area of 3.1 square miles. It is situated near Speel river, between Ketchikan and Skagway, 35 miles southeast of Juneau, Alaska. Water measurements for eight months and an estimate for the remaining four give a yearly run-off of 21,757 million cubic feet, and as the drainage area is taken at 32.4 square miles, the above run-off amounts to 24 ft., or an equalized yearly flow of 689 cu. ft. per second. The initial plant will use 300 sec.-ft., which is equivalent to a run-off of 10.4 ft. over an area of 32.4 square miles.

The power-plant is to be situated near Second lake, 2000 ft. from and 535 ft. below Long lake, and about 1½ miles from the beach. This plant will consist of two units, each of 5000-kw. capacity and each to be direct connected to a water turbine utilizing 300 second-feet.

To be assured of a continuous flow of 300 sec.-ft. the lake will be drawn on by tapping with a tunnel or by a siphon to a depth of 12 ft., and the two spillways from the lake closed, thus raising the lake level 25 ft., giving an available storage of 37 ft. The cost of this power installation would be:

Power-house with two 5000-kw. units complete.....	\$250,000
Pipe-lines, two 60-inch with head-gates	93,594
Closing spillways from lake	10,000
Tapping lake	5,000
Contingencies and incidentals	3,000
Plant for construction	13,882

Total\$375,476
Or a capital cost of \$37.54 per kilowatt or \$27.95 per horsepower.

The cost of operating the above plant would be, per year:

General expense	\$ 6,000
Operating labor	6,000
Supplies, etc.	4,000

Total	\$16,000
Operating cost per year per kilowatt.....	\$1.60
Interest and depreciation, 8% on capital cost	3.00
Cost of kilowatt-year	4.60
Cost of horsepower-year	3.43

To be assured of a yearly average of 10,000 kw., the generators should be run at 25% above normal capacity for 6 months of the year while there is a large excess of water, and thus provide for unforeseen shut-downs.

The lake area is 3.1 square miles, or 86,423.040 sq. ft., requiring 20 ft. in depth at this area to provide for the required storage.

This storage is obtained by raising the lake level 25 ft. and drawing on the lake 12 ft. The increased area obtained by raising the lake will make up for the decreased area by drawing the lake and also provide suf-

ficient storage below the 2 ft. of ice.

From flow measurements the following figures are obtained:

	Measured flow.	Required flow for 300 sec.-ft.	From storage.
January	324,187,200	803,520,000	479,332,800
February	283,046,400	725,760,000	442,713,600
March	374,976,000	803,520,000	424,544,000
April	352,512,000	777,600,000	425,088,000
May	1,154,390,400	803,520,000	.....
June	2,947,104,000	777,600,000	.....
July	5,340,729,600	803,520,000	.....
August	4,860,492,480	803,520,000	.....
September	4,473,792,000	777,600,000	.....
October	803,520,000	803,520,000	.....
November	518,400,000	777,600,000	259,200,000
December	324,187,200	803,520,000	479,331,800
	21,757,337,280	9,460,800,000	2,510,210,200

DETAIL OF CONSTRUCTION PLANT

Horse tram from beach, 11,000 ft., 30-in gage,
20-lb. T-rail, 76 tons at \$40 per ton.....\$3,040
7335 ties, 6 by 8 by 48 in., equivalent to 117,328
ft. B.M., at \$14 per M.....1,642
Labor and tools 3,000

Gasoline tow-boat	\$ 7,682
2 barges at \$3000	2,000
1 donkey engine	6,000
1 donkey engine	1,400
2 horses	600
1 air-hoist	200
1 compressor with water-wheel and pipe for riveting	2,000
Riveting hammers, etc.....	1,000
Camp	2,000
Three cottages	3,000
Sawmill \$600, cost absorbed in tram ties and cottages.	

Total cost of plant	\$25,882
Allowance for plant after 6 months.....	12,000
Charged to power installation	13,882

DETAIL OF PIPE-LINE FOR LONG LAKE 60-IN. I.D.

Feet.	U. S. gauge.	Thickness, inches.	Safe lead.	Safe pressure, per ft.	Weight per ft.	Total weight.
500.....	3/16	0.187	139	60	150.25	75,125
166.....	1/4	0.250	185	80	197.50	32,785
166.....	5/16	0.312	231	100	244.00	40,504
166.....	3/8	0.375	277	120	291.25	48,347
166.....	7/16	0.437	323	140	337.75	56,066
170.....	1/2	0.500	370	160	385.00	65,450
331.....	5/8	0.625	462	200	478.75	158,466
355.....	3/4	0.750	555	240	572.50	191,787
Total						666,530

Velocity when carrying 300 sec.-ft., 8 ft. per second; loss per 100 ft., 0.225. Weight of two lines, 1,337,060 lb.; and estimated cost erected is 7c. per pound.

The steel of which the above pipe is made will have an ultimate tensile strength of 60,000 lb. per square inch. Thickness of pipe is figured from the formula:

$$\text{Diam. in inches} \times \text{pounds pressure}$$

$$2 \times 10,000$$

which takes care of the efficiency of joints and allows a sufficient factor of safety. The weight of above pipe is obtained from the formula: weight in pounds per foot (12.5 times diameter in inches times thickness in inches) plus 10 lb. This weight takes care of laps, rivets, asphaltum, and paint.

*From Western Engineering.

The Slater Leaching Process for Copper Ores

By H. W. MONSE

Among the new processes for the extraction of copper from its ores in the wet way, there is one of much interest, chemically as well as technically. This is the cyclic hypochlorous acid process of H. B. Slater, of Riverside, California. The chemical reactions involved are simple enough fundamentally, but they are sufficiently unusual to be worth careful consideration and some study. Inasmuch as the process is a cyclic one, it will perhaps be best to describe the operations and reactions in a series of steps. The completeness of the cycle can then be checked from point to point of the process.

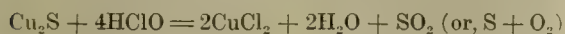
The Leaching Liquor

The leaching liquor comes from the anode compartment of an electrolytic cell of ordinary type. A 15% solution of common salt is used here, and in it there is suspended ferric hydroxide (produced at the third step), the quantity used depending on the copper content of the ore to be treated. Electrolyzing, the reaction is:

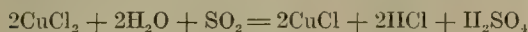


half of the chlorine going to form ferric chloride and half to form hypochlorous acid. Electrolysis is continued until only a small amount of suspended hydroxide is left. This means that there is but very little free chlorine in the solution; and it means, in practice, that very little chlorine escapes into the air. For an ore containing 2 to 2.5% copper, the lixiviant will contain 5 to 7 gm. per litre of iron as ferric chloride, and a corresponding amount of hypochlorous acid. In the cathode compartment there is formed during electrolysis sodium hydroxide, in amount equivalent to the quantity of chlorine produced. This is used at a later stage of the process.

Ore ground to 40 mesh is easily treated. If chalcocite be assumed to be the chief copper mineral present, the leaching reaction, as far as the hypochlorous acid is concerned, is:



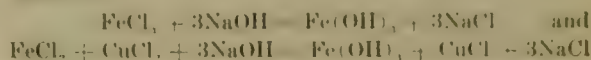
as a part of the sulphur is freed in elementary form. The SO_2 produced in this reaction reduces part of the cupric chloride to cuprous chloride:



so that even at this point in the process a considerable portion of the extracted copper is present as cuprous chloride, held in solution in the sodium chloride solution.

At this point the leaching liquor contains ferric chloride, ferrous chloride, cupric chloride, and cuprous chloride, all in salt solution. To it there is added sufficient of the sodium hydroxide solution, from the

cathode compartment of the cell, to completely precipitate all of the iron as hydroxide, according to the reactions:



This last reaction is an interesting one chemically, especially because cupric chloride acts here as an oxidizing agent, raising ferrous to ferre iron. This reversal of the usual order of things takes place because of the complete and immediate removal of the ferric iron as hydroxide as fast as oxidation takes place. A slight excess of the sodium hydroxide causes no precipitation of copper as hydroxide, for the copper is all locked up in the complex (perfectly colorless) form with the sodium chloride, and the concentration of ferrous iron is so slight that a considerable excess of hydroxide is required to produce a precipitate.

The combined reduction effect of the ferrous chloride at this stage and the sulphur dioxide in the previous one results in the complete reduction of all the copper to the cuprous form. This is of practical importance, since it is only necessary to supply a single equivalent of chlorine for each copper molecule instead of two equivalents, which would be needed if the copper were to be extracted as cupric chloride. As a matter of fact, it is in practice only necessary to supply a very slight excess of chlorine in the leach over that calculated for the cuprous chloride equivalent.

Recovery of Copper

The copper can, of course, be recovered by the usual methods, or it can be precipitated with the aid of the sodium hydroxide as cuprous hydroxide. If this precipitation is made with hot sodium hydroxide solution, air oxidation is rapid and the ordinary black oxide of copper is formed. Probably the reaction: $2\text{CuOH} + \text{O} = 2\text{CuO} + \text{H}_2\text{O}$ will express this step. The black oxide so formed might well be cast into blocks and used as cathodes in the electrolytic cell giving metallic copper, and resulting in a noticeable decrease in the working voltage of the cell.

It is evident that the process is completely cyclic chemically. No chemicals are brought in from outside except the salt, which may be lost in the final wash waters, and this can be reduced to as low a point as may be desirable in practical operation.

The following points are worthy of special consideration: (1) Ores of low total sulphur content can be treated. (2) The ore need not be roasted. The only reason for roasting any part of the ore treated would be to bring up the iron content of the leach in order to produce sufficient ferric hydroxide to restore the original concentration for the next leach.

This might be necessary in the case of an ore containing much lime. (3) If the ore is not roasted, practically none of its iron is leached out with the copper. (4) The separation of the iron from the copper is easy and complete. (5) All materials used are produced in a single operation in a single electrolytic cell, except the salt lost in the final wash waters. (6) The sodium hydroxide produced in the cathode compartment is completely utilized in separating the iron from the copper and in the subsequent precipitation of the copper. (7) The precipitated ferric hydroxide separated in (6) is used in the preparation of the succeeding lixiviant. (8) Extraction is very rapid and complete. With agitation, using a 40-mesh ore, 95% extraction can be had in four to six hours. (9) Copper produced by this process is extremely pure. None of the other metals can follow it into its complex salt with sodium chloride, and they are almost completely removed with the iron by precipitation as hydroxides. For the 'porphyry ores', so called, and for non-roasting ores in general, the Slater process appears to combine nearly the maximum number of advantageous features with but very few objectionable ones.

The Ethics of Mine Promotion

By J. PARKE CHANNING

"I presume that a great deal of misconception regarding mines is a relic of forty or fifty years ago, when mining was not an industry, but was an adventure. The West was unprospected, and when rich ore was discovered, the cost of converting it into cash was relatively low as compared with the product, or, in fact, was negligible. A mining scheme was something like the quest for buried treasure, where success depended not upon the cost of the adventure, but upon the luck which one had. The successful ventures were dangled in front of the eyes of business and professional men by those unscrupulous individuals who cared nothing for the investor.

In the meantime, mining has become a recognized industry in which the highest technical skill is employed in prospecting for orebodies, in developing them, and in finally equipping and operating them. But the memory of the unscrupulous promoter still lingers in the mind of the investor, and he therefore confounds their operations with those of people who make mining a business.

Probably few people realize today that the United States Steel Corporation is primarily a mining company, its main assets being its holdings of favorably situated iron ore and coking coal lands. The same thing applies to the larger copper-mining companies, and to many of the gold properties, such, for example, as those on the Rand, or in southern Alaska.

In modern mining the first and primary desideratum

is to get a large body of ore. The question of grade and the cost of working it determines its ultimate value. As I have frequently pointed out, there are really only two primary sources of wealth in the world, mining and agriculture, and mining is just as important as agriculture. While the same methods of analysis may be applied in determining the value of a mining company as in arriving at the value of a railroad, still there is one factor in mining which gives an added value, and that is, the continued chance of finding either new or richer ore upon a property which is being exploited. This chance is one which induces the shrewd investor to go in for mining. Care should be taken, however, by the investor to discriminate between the searching for and developing of new properties, and the exploitation of those which have been found and are already worked or about to be worked. The searching for new mines is a more or less hazardous business. One may take ten different prospects, spend money in developing them, and be extremely fortunate if one of them turns out to be a mine. To do this kind of work requires a large capital so that the risk may be reduced, and in America we have such companies as the Guggenheim Exploration, the General Development Co., and the United States Smelting, Refining & Mining Co., that do this kind of work. If they take up a property which turns out badly, the expense is charged to profit and loss, and they trust that later on some successful development may recoup them for the loss sustained in the nine, nineteen, or ninety-nine failures.

It is said that the success of a few St. Louis business men in unexpectedly developing a large mine in Montana a number of years ago has induced so many people from that city to go into the development of prospects that the sum total of expenditures for this class of work has been far greater than the dividends poured into that city from the original successful mine. On the other hand, those investors who have gone into the porphyry copper mines, either in their early days or when the price of copper was low, have reaped a most satisfactory reward. The tendency nowadays is for good mining companies to give annually not only figures of cost and production, but estimates of actual ore developed, and also the opinion of its managers as to its future prospects. With all these data available, the investor has an opportunity of making up his own mind as to the risks of profit or loss which he takes by buying any mining stock. For many years the principal transactions on the Boston Stock Exchange have been in mining shares, and within the last few years the shares of the better copper companies are dealt in upon the New York Stock Exchange. The investor should be careful to invest in shares which are dealt in either on some well known exchange or on the Curb. Unfortunately, there are many so-called mining stocks which are very easy to buy, but extremely difficult to sell at any price.

*Abstract from *The Annalist*.

Gold Dredging Abroad in 1913

By CHARLES JANIN

Yukon Territory

During the year interesting details regarding the operations of the Yukon Gold Co. at Dawson and Iditarod, the latter being in Alaska, were made public. They were printed in the report by O. B. Perry which

for the first few weeks after the dredge reached the tested area were in excess of the average value of the whole area shown from prospecting results. Information given to shareholders shows the total from the 'tested area' to date as follows:



DREDGING GROUND ON THE PARACALE RIVER.

appeared in the *Mining and Scientific Press* on June 28 and need not be repeated. The following summary will serve to indicate the extent and cost of the work:

	Production cu. yd.	Production c. per yd.	Costs c. per yd.	Operating gain.
Dawson dredges ...	5,157,280	64.88	38.64	\$1,765,736.97
Iditarod dredges ..	172,333	2.34	45.91	324,926.09
Hydraulicking	2,967,750	21.22	9.37	351,090.53
Miscellaneous				279,665.56
				\$2,721,419.15

From the operating profit as shown was deducted: royalties \$692,995.43; amortization and deferred charges, \$577,146.27; interest, general expense, and examinations, \$378,685.88; making a total of \$1,648,827.58.

Colombia

Considerable interest has been manifested in the dredging operations of the Pato dredge, and a boom in the shares followed the announcement that recoveries

	Cu. yd.	Estimated recovery.
To Oct. 21	239,492	\$140,617.02
To Oct. 28	24,100	15,900.00
To Nov. 4	26,370	17,500.00
To Nov. 11	25,250	31,250.00
	315,212	\$205,267.02

These values represent an average of 65c. per cu. yd., and for the last week \$1.23 per cu. yd., which are certainly most encouraging. Previous to reaching the tested area the dredge dug approximately 473,500 cu. yd. with a recovery of \$80,380, and the recovery for the week ending July 15 was only 35c. per cu. yd. The low values caused disappointment and scepticism among the shareholders, who began to weary of the stereotyped phrase "when the dredge reaches the tested area." When, however, the high weekly returns from the dredge were announced, a reaction took place, and some little trading was done in shares. The estimated profits

from the Pato are shown from the following extract from the report by Theodore Hoover: "The Pato has not been operating for a sufficient length of time to enable us to make any alteration or correction in the engineer's original estimates. We can, therefore, only introduce into our calculations the estimates which we made some years ago, and hope that these will be borne out in actual results. These estimates were to the effect that the Company had 310 acres of available dredging ground at Pato which would yield a net profit of £350,000. They estimated that this would be returned at the rate of £50,000 per annum, which indicates a life of seven years."

An investigation is being made at the present time of other parts of the Pato property, including ground on California Hill, which it is expected can be profitably worked by hydraulicking.

The Certigue Dredging Co. operated a dredge on the Certigue river for a short time during 1912, but the dredge sank in December. The operations were in the nature of a test during an examination of the property. The dredge which had been built some time required considerable work to put in order and many delays were caused by repeated repairs to the dredge and over fuel and boiler troubles. The dredge worked intermittently from August 17 to November 11, but was operated at full capacity for 239 hours only. During the test the dredge handled 22,700 cu. yd. of gravel. The total recovery of gold and platinum was a little over \$7000, and it was assumed under proper conditions the operating costs should not exceed 10c. per cu. yd. It was expected that a new dredge would be put on this property. Below the Pato ground is the Pochet property on which a 5-ft. Werf Conrad steam dredge has been working some years. The dredge is open-connected type, has a steel hull, and digs to a depth of 26 ft. below water level and during high water cannot reach bedrock. While the yardage handled is small and the dredge works only one shift, the amount recovered per yard is good, and the dredge has been a profitable venture to the owner. His familiarity and consequent success with native labor permits a lower operating cost than if it was necessary to have an expensive European crew which, under the same conditions, would require closing the dredge down. A new dredge to be built in 1914 is that of the American Goldfields Development Co., which has been doing considerable prospecting to the south of the San Juan river, and will build a dredge to recover the platinum found in some of the ground prospected. Several prospecting parties have been sent to Colombia by different concerns during the year, and now that the success of the Pato dredge is assured, no doubt other investigations will follow. South America is one of the few fields for dredging possibilities that has not yet been exhaustively investigated.

British Guiana

The Guiana Gold Dredging Co. operates four dredges on the Potaro river. It is one of the most profitable

mining enterprises in Guiana. The production from the dredges has shown a steady increase yearly since the Company began operations in 1907. The following table showing production by years and dividends paid is of interest:

Year.	Crude oz. of gold recovered.	Dividend paid.
1907-8	2955	12½
1908-9	3737	10
1909-10	4455	10
1910-11	5885	10
1911-12	7511	10
1912-13	9160	10

The gold recovered for the year ending March 31, 1913, was \$174,570.40. Expenses were:

Management and operation	\$88,535.16
Prospecting	4,085.00
Royalty on gold shipped	6,889.10
	<hr/>
	\$ 99,509.26
London and agency expenses depreciation of dredges written off on claims, etc.	33,050.58
Total	<hr/>
	\$132,559.84

Yardage figures are not given and are probably not kept as the operation of the dredges extends over about twenty miles of river and any figures of yardage would only be an approximation at best. With the exception of an accident which stopped the work of one dredge for two months, the four dredges of the Company worked steadily throughout the year.

The Minnehaha Dredging Co. operating on the same river produced 2472 oz. of gold. The Company prospected some new areas and expects to build a new dredge in 1914.

Philippine Islands

In the Paracale district, Ambos Camarines, according to the Manila correspondent of the *Press*, there are five dredges at work as follows: (1) the old Risdon dredge on the Malaguit river; (2) the old Stanley, or Maximilo, dredge on the headwaters of the Paracale river; (3) two dredges belonging to the Paracale Bucket Proprietary in the lower part of the river; and (4) the New York Engineering Co. dredge on the Gumaos river. One of the new dredges intended for operation on the Paracale river sank last May. The machinery is being recovered, but it will have to have a new pontoon. The steel hull and machinery for the new dredge on the Umirai river has arrived in sections from Australia and is being set up.

The Yuba Construction Co. has been building a dredge on the Malaguit river which was to be completed in November. This boat is equipped with 5-ft. buckets and will have a modern hull.

Considerable interest has been manifested in the work of the Gumaos dredge, which was built in 1912 and which is the first American dredge of modern type to be put in operation in the Islands. The running time has not been so high as expected, but is fair, considering the sunken timber encountered, and that the boat is operated with a Philippine crew. In February,

1913, the dredge dug 57,000 cu. yd. in 436 hours running time, and recovery averaged 31.7c. per yard. The time lost during the month was due to the necessity for turning the dredge at the end of a narrow gorge. During March 42,000 cu. yd. averaging 64c. was handled in 320 hours, the dredge being shut down for 12 days waiting for a new stacker belt. In April 130,000 cu. yd. was handled averaging 15c., and for May 105,000 yd. in about 500 hours running time. This would total 304,000 yd. in four months. While the actual operating expenses are not available at this writing, and over such a short period would virtually be nothing more than an indication for future estimations, it may be of some interest to mention the fuel and labor costs. Fuel runs about \$2000 per month; native labor \$1700, and white labor, including dredge-master \$1750; so, for labor and fuel, the total is \$5450 or \$2725 per month. The dredge is a 5½-cu. ft. steam dredge, with a wooden hull and was built at a cost of \$150,000. The life of the property was estimated at five years. The dredge was built by the New York Engineering Co., and it was designed to dig 38 ft. only, but has repeatedly dug to a depth of 45 ft., and a 25-ft. extension has been put on the ladder to dig deeper ground during 1914. This extension is necessary to reach the deeper pay ground as recoveries have fallen from 2000 oz. to 220 per month.

Mining Costs in the Coeur d'Alene District

Detailed mining costs at the Snow-Storm mine are presented in the following table. The ore is mined, through adits, from a vein dipping at an angle of 65°. The method employed is a combination square-set and fill.

	48,897 tons shipping ore.	50,648 tons milling ore.
Foremen, bosses, machinists, nippers, and supply men.....	\$0.151	\$0.160
Timbermen and carpenters.....	0.216	0.199
Miners	0.192	0.221
Carmen	0.130	0.132
Shovelers and laborers.....	0.340	0.348
Power labor	0.025	0.023
Hoist engineers	0.017	0.017
Total pay-roll expense	\$1.071	\$1.100
Explosives	0.070	0.067
Illuminants	0.015	0.015
Iron and steel	0.010	0.011
Miscellaneous supplies	0.046	0.047
Timber and lagging	0.199	0.179
Power supplies	0.002	0.002
Electric power	0.022	0.044
Wood and coal	0.002	0.003
Stable and stock	0.007	0.006
Total supplies	\$0.373	\$0.374
Total cost per ton	\$1.444	\$1.474

Cloths on an Oliver filter at the Black Oak mine, Soulsbyville, California, were recently removed after 17 months' work.

Gravel Mining in Alaska and Siberia

The following is from the report of the annual meeting of the Lena Goldfields, Ltd., held in London on December 16, 1913. This Company controls the Lenskoie properties, and C. W. Purington has recently examined them. In his preliminary observations, Mr. Purington refers to one important item, namely, the actual costs which he can certify on the west coast of America in relation to the actual conditions which prevail on the Lenskoie. He points out that on the permanently frozen benches at Bonanza creek, in the Klondike, about 3,000,000 cu. yd. of gravel that was thawed was handled at a working cost of 9.37c. per cubic yard, and he estimated that the future operations of that Company will not exceed 10c. per cubic yard. He states that he does not see any reason why Lenskoie operations on a large scale should cost any more, and with the exception of the more rounded character of the gravel, the Klondike conditions are more difficult than the conditions on the Lenskoie for the following reasons: (1) the water-supply is not so abundant; (2) the price of labor and supplies is higher; (3) the expense of building ditches is greater than in the Lena, and the conditions for obtaining the necessary head are not so good; and (4) the permanent frost is not of so continuous or widely distributed a character in the Lena district as it is at Nome or in the Klondike. On the other hand, the season would probably be shorter, not exceeding 120 days. Therefore, on the tested Lenskoie ground there is from five to seven years' life, there are economies which can be and ought to be introduced, there is still, according to the Lenskoie report, a great length of the Bodaibo stream to be tested, there are hydraulicking possibilities, and there are legitimate profits to be made from the trade which the very considerable population on the mines stimulates.

The dewatering problem at the Washoe plant, Anaconda, consists of reducing 20,000,000 gal. of pulp with 2% down to about 12% solids. This is finer than 200 mesh and nearly all colloidal. Tests showed that a Dorr continuous thickener 28 ft. diameter and 3 ft. deep has approximately 85% of the capacity of a tank 28 ft. diameter and 10 ft. deep, so a series of Dorr thickeners is being installed. The overflow from them will pass to 20-deck buddles. The concentrate from the latter goes to five 50-ft. diameter by 12-ft. deep Dorr continuous thickeners, where it is distributed, and then to Oliver filters for final removal of moisture.

The development of the mining industry in Colombia is indicated by the increase in the exports of gold, which have been as follows in recent years: 1905, \$1,616,936; 1906, \$2,705,465; 1907, \$2,877,742; 1908, \$3,836,875; 1909, \$2,988,711; 1910, \$3,369,954; 1911, \$3,751,833; and 1912, \$6,634,914.—*Daily Consular Report.*

Discussion

Readers of the MINING AND SCIENTIFIC PRESS are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment. Insertion of any contribution is determined by its probable interest to the readers of this journal.

Ore in Sight

The Editor:

Sir—Is the old reliable standard of 'ore in sight' when three sides are accessible really trustworthy? In the Harqua Hala mine in Arizona one block had the three visible faces in rich ore and a 'horse,' entirely concealed, occupied everything but the faces. I ran across another case recently in Mexico. Two eminent American mining engineers made a most careful survey of 26 'visible' blocks of ore and practically certified that there was a profit in sight of over \$1,300,000 U. S. currency. The metal content of over half of it has been extracted at less than the estimated cost per ton, with an extraction higher than the estimate, yet the net profit to date has been little less than \$55,000, or a little over 8% of the certified profits. Are mine buyers justified in paying big fees for such guesses, and can't we devise some better way to guess?

CASSIUS E. GILLETTE.

Washington, December 16, 1913.

The Use of Powder Underground

The Editor:

Sir—While so much is being published about 'Safety First,' would it not be well to take some notice of the dangerous and wasteful use of powder in mines? My own experience has taught me that this is a source of danger that is not always properly considered. I will cite one instance that, while it may seem extreme to most of those who may read this, is not so unusual or extreme as it may appear at first reading. The instance referred to was the use of 165 sticks of 40% powder in a 70-ft. drill-hole. One hundred and sixty-five sticks of powder 8 in. long, placed end to end, will make a total length of 111 ft. Now when 111 feet of 1½-in. powder is compressed into 70 linear feet the diameter will be 1.414 in. Some of the holes were loaded to the collar, and the primers were placed at about the centre of the load. The fuses were cut to have the holes go in the proper order. Now suppose hole No. 6 goes at the proper time and is duly counted, but, unknown to the miner who is counting the shots, it blows two feet of the collar from No. 8, without disturbing the primer. Although there may be no missed shots, yet we have more or less powder that has not been exploded scattered through the rock pile. If this is hard rock, which in this particular case it was, this powder is very dangerous to the shovelers.

In my own experience I have found at least three-fourths of the holes are overloaded, and this applies to soft as well as hard rock. A hole in ordinary rock should not be loaded over half full of powder. In very hard rock the load may be increased to fill two-thirds of the hole, but never more. If this load will not give good results, then increase the strength of the powder, or do better drilling. Miners are apt to increase the load of powder if they have a round of holes that fails to break as they think it should. It is seldom that the miner cuts down the load unless he is compelled to do so by the management or is paying for the powder himself.

R. NOBLETT.

Ray, Arizona, December 16, 1913.

Ore

The Editor:

Sir—I notice with pleasure that Mr. Herzig, in your issue of September 13, 1913, elects to break a lance with T. A. Rickard in regard to the latter's definition of 'ore,' and, if I may be allowed to comment on the engagement, I shall say that the honors are easily with Mr. Herzig. I have always found much that was admirable in the writings of Mr. Rickard, and I have a great respect for his command of the English language, but I submit that his definition of 'ore,' and his defence of it as set out in his answer of the date just quoted, are distinctly lame. It seems to me that Mr. Rickard, in a matter like this, pays the penalty of his undoubtedly high qualifications as a writer of English, in that any lapse is likely to be immediately evident to his readers, and I feel sure he will understand the spirit that prompts me to supplement Mr. Herzig's criticism.

I am, let us suppose, an artist in oils. I paint a picture, putting into it my best endeavors; the result, I know, is not perfect, but it is a sincere attempt at perfection. An art critic appears, and while admitting my recognized ability and talent, proceeds to point out various defects in my work. Now, if I reply, I may do so in several ways. Let us take two of them. Meeting criticism half-way, I may admit my mistakes, and determine to avoid them in the future. Or, I may arise in my wrath and say, "Go and paint a better picture yourself, and then hear my candid opinion of it."

I think it is obvious that the latter is an answer that will satisfy no one, but it is precisely such an answer that Mr. Rickard gives Mr. Herzig. "I challenge Mr. Herzig to proffer a definition of 'ore'; if he will, I can promise to make it look sheepish."

I can almost hear a murmur:

"I am monarch of all I define,

My rights there are few to gainsay:

Ex cathedra I claim that a mine

Is a hole yielding ore that will pay."

As to the promise, I can well admit the possibility of its fulfilment, after examining Mr. Rickard's defini-

tions, and noting how ridiculous he himself makes them appear. Referring to his lecture, 'The Valuation of Mines,' published in the *Mining and Scientific Press*, May 24, 1913, page 766, I should like to quote verbatim two or three sentences, in order to explain my point. The italics are mine.

"Ore is rock containing sufficient metal to be exploited at a profit. When rock cannot be profitably mined, it is waste."

Referring to the cost of mining, "10-dwt. gold ore in one locality means loss; in another, 5-dwt. ore ensures a handsome profit. Therefore a definition is required. Ore is metal-bearing rock, which, at a given time and place, can be mined at a profit. Ore that is unprofitable today may yield dividends at a later period * * * ore previously profitable becoming unprofitable * * *"

Any attempt to insert here the defined equivalent of ore will result, not only in redundancy, but in contradiction of terms.

Mr. Rickard says it is permissible to be redundant in the effort to be explicit. He will hardly go as far as to claim that it is necessary to be contradictory also. In any case, there is surely a weak spot in a definition that requires redundant explanations.

Again, Mr. Rickard trips similarly over his definition of a mine. If a mine is a certain type of hole or excavation, namely, one that yields profitable ore, an 'unprofitable mine' is a contradiction of terms; it is difficult to see what purpose is served by making a definition that involves redundant and contradictory qualifications.

A point to which Mr. Herzig does not refer, is the use of 'which' in the definition of 'ore' quoted above. As the sentence stands, with the comma after rock, 'which' is used in a relative, not a defining, sense, so that we could recast the line thus, "Ore is metal-bearing rock, and, at a given time and place, it can be mined at a profit." This is obviously not the meaning originally intended by the author, and his definition therefore should be written, "Ore is metal-bearing rock that can, at a given time and place, be mined at a profit."

The defining relative 'that' is of such assistance in just such sentences as this, that it should not be ousted by an ambiguous 'which.'

Even were 'which' retained, the comma after 'rock' is an error. In the following, " * * * to distinguish a mine from a hole in the ground which is fit for * * *" (Mr. Rickard's reply to Mr. Herzig), I think the defining 'that' would have been preferable to 'which.' And I wonder why Mr. Rickard spells 'to-day' without a hyphen.

Finally, shall I submit my definition of 'ore'? And be butchered to make a Roman holiday?

No, sir, it's far easier to be a spectator, though not a silent one, and—it's certainly safer!

G. AUBREY GOW.

Lebong Soelit, Benkoelen, Sumatra, Nov. 13, 1913.

Professional Ethics

The Editor:

Sir—In your issue of December 20, Mr. Hills comes at the 'professional ethics' question from one of its many angles, and his query as to "the right to sell information to another where the first employer has hopelessly failed to pay his bill" certainly raises a point, the fineness of which depends upon the conditions associated with each particular case; this consideration remains unchanged even where an advance payment has been made.

Considering Mr. Hills' experience as a fair example one might presume that, in the vernacular, he got 'stung.' Many reports have been rendered by a large number of engineers for which no compensation was ever received. In this particular case the examination was made at the request of a client existing as a partnership of three men, all interested in the purpose of the examination and equally involved in paying the engineer. The fact that one-third of the fee was paid and the balance not only not guaranteed but even refused, certainly does not justify one of the three partners in withholding permission to the engineer to use the information. Obviously if the partners fulfilled their obligation the information becomes their property, but when they refuse to do this it is reasonable to assume that they should forfeit their rights to the exclusive use of the report. It is also possible that one-third of the fee did not cover expenses; wherein might arise a point for the consideration of equity versus ethics. It appears to me that the logical conclusion in this case, and in others of a similar nature, should be determined by a sense of what is just to client and engineer, and under the circumstances Mr. Hills would be justified in giving his information to the second party.

Ethics always has been and probably will continue to be a mooted question. No set rules can be laid down to govern fine points except that of applying good old common sense. A professional man is usually endowed with ordinary intelligence, and his conception of what is just and right will govern his actions to accord with the dictates of his conscience. If all doubtful questions were looked at from an unbiased viewpoint and judged according to common sense ideas there would be less need for rules on ethics.

J. M. LILLIGREN.

Buckhorn, Nevada, December 30, 1913.

In Venezuela an extensive oilfield is being proved by the Shell and Standard Oil companies, which have acquired extensive interests on the Sea of Maracaibo. The Guggenheims have a large staff of engineers examining the district, and Mr. Reynolds, late of the Anglo-Persian Oil Co., is drilling on behalf of an English and Venezuelan oil company with, it is reported, excellent results. The field is considered of great importance for European markets, as it will have no need of the Panama canal.

Concentrates

Most of these are in reply to questions received by mail. Our readers are invited to ask questions and give information dealing with the practice of mining, milling and smelting.

Blasting ore by electricity has given results at least equal to those obtained with ordinary safety fuse, according to W. Cullen, I. Donaldson, and W. Waters, whose experience covers over four years on the Rand.

Rolling and otherwise working aluminum reduces its density, this being due to a transformation from a crystalline to amorphous state, according to F. J. Brislee in a paper presented to the Faraday Society. The worked metal was more prone to corrosion because it was amorphous.

A furnace lining of a refractory nature may be made from asbestos and water-glass, according to a writer in the *Brass World*. It is useful for patching or plugging cracks, as it does not crumble as readily as other similar composition made from clay. The materials used are fine asbestos, 40 lb., and water-glass, 60 lb. The water-glass is the sodium silicate of commerce, which is soluble in water. The asbestos and water-glass are mixed to a paste with water so that it can be worked.

At the present time there are 53 alloys of aluminum and copper manufactured. The most important contains about 92% aluminum and 8% copper. This particular alloy has a tensile strength of 20,000 lb. per square inch, but shrinks badly in casting. It has been found that the addition of 8 to 10% of cobalt and 1% of tungsten or molybdenum to pure aluminum or copper-aluminum alloys, yields a metal which casts better and is more readily worked and finished and more non-corrosive than the alloys formerly used.

The corrosion of the iron retorts used in distilling crude petroleum is found to be due to the presence of free hydrochloric acid in the aqueous portion of the distillate, according to E. Pyhälä. The quantity of the acid was 0.107, 0.043, and 0.026% in samples of oil containing 29, 12, and 7% of water, respectively. Water, separated from the crude oil, and having a specific gravity of 1.1426 at 20°C., yielded 0.33% of hydrochloric acid when distilled. The acid was not formed until 86% of the water was distilled over, the temperature then being 125 to 130°C. The acid is probably formed by the decomposition of the chlorides held in solution in the water.

The difficulties in the treatment of the manganiferous ores of El Favor mines of Jalisco, Mexico, while not yet entirely overcome, have been greatly improved, and definite progress has been made whereby a process has been devised which yields 75% of the

silver as against 50% by cyanidation. Definite improvement on the 75% extraction is now practically assured, and as soon as political conditions will permit, steps will be taken to make these changes, as El Favor now has the complete use of its entire milling equipment. There is over a year's supply of ore broken down in the stopes, ready for milling, and all costs of this mining are paid for.

Costs at the Kalgurli mine, Kalgoorlie, during the past fiscal year, when 128,415 tons of ore was treated, were as follows:

Mining:	Cost per ton.	Milling:	Cost per ton.
Superintendence	\$0.04	Superintendence	\$0.07
Breaking ore	0.56	Rock-crusher	0.07
Timbering stopes.....	0.06	Aerial tramway	0.07
Tramming	0.36	Ball-mills and conveyor	0.46
Filling stopes	0.15	Roasting	0.70
Tools repaired	0.03	Separating and settling	0.05
Tool renewals	0.03	Grinding	0.28
Candles	0.02	Agitating and filter-	
Explosives	0.15	pressing	0.48
Timber	0.03	Disposal of residue....	0.12
Assays	0.01	Water	0.12
Hoisting and com-		Oil and grease	0.02
pressed air	0.23	Precipitation and clean-	
Management and gen-		up	0.11
eral	0.15	Assaying and general..	0.05
Sundries	0.03	Management and gen-	
		eral	0.22
Total mining	\$1.85	Total milling	\$2.82

Dredges, as a rule, float in a pond surrounded on three sides by high gravel banks, and on the fourth or back side by irregular tailing piles. It is, therefore, difficult to get the heavy spares on the boats. This is done in some cases by bringing the boats close to the banks, or by lowering the parts needed on to



GEAR FOR LIFTING SPARES ON DREDGES.

a punt or flat-bottom barge floating in the pond. The accompanying illustration shows a device used on the Ophir dredge at Oroville. It simply consists of an I-beam suspended from the bow gantry, and well over the ground being attacked. A crawl works on the beam, and buckets or other spares required are easily placed on the dredge.

Special Correspondence

PORCUPINE, ONTARIO

MILL WORK AT THE DOME.—DOME LAKE, PORCUPINE CROWN, PEARL LAKE.—NORTHERN ONTARIO AND CALIFORNIA EXPLORATION COMPANIES.—KIRKLAND LAKE 'PROPRIETARY.'

Milling results at the Dome mine continue to be satisfactory, and the monthly production has shown a steady increase. The production for November, which was the highest monthly tonnage yet attained in the Porcupine district, totaled 13,820 tons, an increase of 3957 tons in six months. An additional 40 stamps are being installed, and when this is completed the treatment process, which at the present time is an all-slime treatment, will be somewhat changed. The product of the tube-mills will be classified into sand and slime, the former being leached, and a part of the slime will be treated with the present equipment. Eventually the slime may be cyanided direct in filter-presses. It is expected that the addition to the mill will be in operation next May. This plant has been designed and erected by the Merrill Metallurgical Company.

The Dome Lake property is now being operated under the control of the Hudson Bay Mines Co., of Cobalt. It has been decided to sink the shaft to a depth of 400 ft., where it is hoped that the ore-shoots will be longer and more persistent.

The annual meeting of the shareholders of the Porcupine Crown will be held in Montreal on January 28. It is stated that the engineers report will show approximately 50,000 tons of proved ore which averages \$40 per ton. The mill, which has a capacity of 180 tons per day, is operating on the Dorr continuous cyanide system. This is something new for Porcupine, and the management states that excellent results are being obtained. It is expected that at this meeting the directors will commence dividend payments by the declaration of a 3% quarterly dividend.

A special shareholders' meeting of the Pearl Lake Mining Co. will be called in the near future, in order that the report of the general manager, Mr. Fisher, may be presented, and plans for the reorganization of the Company submitted. It is understood that Mr. Fisher's report will be discouraging and will come as a shock to a great many shareholders who have built their hopes on the extravagant statements made by the previous management. Mr. Fisher, while pessimistic regarding the ore in the present workings, states that the situation is not hopeless and that there are indications of a large body of ore on the 600-ft. level. It will be necessary, however, to raise more money for development.

A meeting of the shareholders of the Northern Ontario Exploration Co. has been called for the purpose of considering proposals for the absorption of this Company by the California Exploration Co. The former company was originally organized by Bewick, Moreing & Co. to develop a number of claims in the Porcupine district, which were purchased from the Timmins-McMartin syndicate. Considerable money was spent in the development of these properties, but the results were disappointing and all work in Ontario was stopped. Subsequently, Bewick, Moreing & Co. became active in California and took over the old Plymouth mine, the development of which has been satisfactory. The Northern Ontario Exploration Co. has a considerable interest in this property, and it is now proposed to absorb the Company, giving the shareholders stock in the California Exploration Co. for their interest. The capital of the California company will be increased to £120,000, and the shares will be split to have a par value of 10s. each, shareholders of the Northern Ontario company receiving a total of 179,137 shares.

The prospectus of the Kirkland Lake Proprietary, Ltd., which was recently floated in London, is an exceedingly interesting document, and shows that even in these days of 'tight' money it is still possible to sell 'hot air' at a good margin of profit. This new Company is capitalized at £200,000 in £1 shares, and the subscription offer was 75,000 shares at par. It is stated that this amount was largely over-subscribed, and that the shares are now selling at a premium on the London market. It is understood that this Company will operate at Kirkland Lake, the new gold-mining camp of northern Ontario, and that it expects to take over the Tough-Oakes, Burnside, Wright, and Robbins properties.



MAP OF PRINCIPAL MINING DISTRICTS OF ONTARIO.

in all of which C. A. Foster is interested. The first is partly developed and seems to have excellent possibilities, while the others are prospects of uncertain value. The Company has acquired under a contract the benefit of all the arrangements now in course of negotiation or which may be hereafter entered into by Mr. Foster for properties in the Kirkland Lake district, including the right to take over the same at cost price and free of any commission or profit to Mr. Foster. For this understanding, Mr. Foster receives the sum of £25,000, and for every two shares over and above the present issue up to a further 50,000 shares, which may hereafter be allotted, an additional £1 in cash or one fully paid-up share at the vendor's option. The £25,000 will presumably be paid out of the proceeds of the issue of 75,000 shares, leaving approximately £50,000 as working capital. The directors are R. P. Cobbold and H. G. Latilla of London, and C. A. Foster of Haileybury. So far as can be learned, the idea is that the Kirkland Lake Proprietary will develop these

properties and such others as may be acquired, up to a certain stage, and then float them individually. It would appear that the £25,000 which Mr. Foster receives will be only the beginning, this sum being paid for what might be termed Mr. Foster's good will. Of the four properties mentioned, the Tough-Oakes is easily the most promising, and development to date has succeeded in opening a considerable amount of rich ore. The Company is capitalized at 600,000 shares, par value \$5, of which Mr. Foster and his associates hold 450,000 shares. A short time ago, the Company endeavored to sell 50,000 treasury shares at \$4, but the flotation was a failure. It can be seen, however, that this is placing an exceedingly high value on this property, which is not warranted by the limited amount of development. No information has as yet been given regarding the ultimate disposition of the properties which will come under the control of the new Company, but for the sake of the English investor, it is to be hoped that the different companies will be floated at a capital that is commensurate with the requirements, and that the investor may at least 'get a run for his money.' The possibility is, however, that the promoters will get their share whether or not anybody else does.

DULUTH, MINNESOTA

WORK ON THE MESABI RANGE.—STATE LEASES.—WASHING ORE.—TENDENCIES IN EQUIPMENT.—WEATHER.—CANTON AND ALBERTA MINES.—IRON ORE SITUATION.

The past year has been a prosperous one for the Mesabi range in general, and the current year promises to be nearly as good. Indications point to a prosperous season for the Virginia district in particular. Jones and Loughlin are preparing to strip the Columbia forty. The Oliver Iron Mining Co. is drilling the Mesabi Mountain ground and it is figured that this will be stripped. The advantage of opening this is that it will give the Company a much better chance to get at the ore at lower levels in the Lone Jack and Ohio forties. The Mesabi Mountain property is a state lease, as is also the Minnewas, which is being opened as a shaft property. On this property, a concrete shaft is being sunk, and a temporary head-frame and hoisting plant has been erected. Work on the permanent plant is under way, which includes a steel shaft-house. The Company is also drilling the Rouchleau property, and it is expected that this will also be opened as well as some other ground north of the city.

A. B. Coates has given up his lease on the Madrid property in the city limits, but it is reported that the fee owners will operate the mine. About 100,000 tons has been shipped so far. A washing plant of small capacity was erected over the shaft to treat the lower-grade ore. This is said to have given successful results. The Oliver Iron Co. is also opening several properties at Virginia and other places on the range. This policy is said to be due to the fact that the Company will relinquish the Hill ore lands and will have other property opened to keep up reserves. The policy seems to be to open all property that is leased, as much as possible, to avoid paying royalties on idle mines, and this has resulted in a practical cessation of work at several places where the Company owns the fee. This has given a temporary set-back to the towns in the vicinity depending on the mines for sustenance. The state leases are being operated more vigorously, with the result that the revenues of the state will be materially increased from royalties. One mine, the Hill Annex, is on a school property, and it is said that the school fund will receive over \$12,000,000 from this one mine. The Jones & Loughlin Co. has started operations on a large orebody near Grand Rapids, and has installed a hydraulic dredge. This is said to have demonstrated its practicability for removing the overburden in the short time it operated this fall. The orebody at this property is large and a part of

it will require washing. A large concentrating plant will be built to handle this ore. Several companies have been conducting experiments along this line, so that the near future will see several more washing plants at work. The drier operated by M. A. Hanna & Co. at the Brunt mine, at Mountain Iron, is said to have been successful in reducing the moisture content from about 18% to about 3%, although the question of what effect this drying has upon the formation of fine material and the behavior of the ore in the furnaces is not mentioned.

The general trend of new construction work is toward permanency. Wooden head-frames are practically a thing of the past. Concrete is taking a prominent part in all new construction both at the surface and underground. Mechanical power is being used to a greater extent, but power-plants are hardly keeping pace with developments in other localities, due probably to the comparatively shorter life of the underground mines. For the open-pit mines, no extensive plant is required outside of the steam-shovel equipment. Experiments are being conducted along various lines to improve methods, and safety and public welfare are given more consideration than they have received in the past. The use of electric power is becoming more general, and new sources are being developed. It is thought that the pumping of the majority of the mines will in course of time be done with electric power.

The Hull-Rust mine shipped last season 3,457,608 tons of ore, which is a record for a season's shipment from one mine.

The weather this winter has been remarkably warm, and the first permanent snowfall occurred after the first of the year. This is not enough as yet to help loggers to any extent, and it is feared that mining-timber contractors will have trouble in getting out their supply in time to fill their contracts. This has not affected the price as yet, which is ranging around 4.5c. per lineal foot for 16-ft. timber from 7 to 9 in. at the small end.

The Pitt Iron Mining Co. has leased the Canton forty, adjoining the Miller mine at Aurora, which it is operating, and has started sinking a shaft on the property. The Canton forty is owned by the Oliver Iron Mining Co. The orebody at the Canton is contiguous to that on the Miller, and can be most advantageously worked in conjunction with that of the Miller. The Alberta mine, which has been operated by the Minnesota Mining & Development Co., has been shut down, and the lease reverts to the state, which owns the fee. The Lily Iron Mining Co., from which the Minnesota company sub-leased the property, is suing for an injunction to prevent the Minnesota company from removing the machinery until liens against the latter have been satisfied. The Alberta mine is in the Virginia district.

The iron-ore situation at the present time is in a rather uncertain state, practically no sales for 1914 delivery having been made as yet; so whether the prices will be lower the coming season is a matter that is causing considerable speculation. The recent placing of orders for large tonnage of rails is conducive to a more optimistic feeling. The Cuyuna range continues very active. Considerable exploration work is under way, and the area of ore-bearing formation is constantly increasing. The city of Brainerd opened bids on January 5 for exploring and mining the property bequeathed to it by the late Judge G. W. Holland. The county commissioners of Crow Wing county accepted the bid of the Long-year Exploration Co. to explore the county poor farm. The Company pays \$100 as rent and agrees to drill nine holes per year. It gets a 50-year lease at 30c. per ton, and a minimum tonnage of 10,000 tons the first year, 20,000 tons the second, 30,000 tons the third, and 40,000 tons each succeeding year during the life of the lease.

The output of iron for the month of December is reported at 1,983,607 tons, or 63,987 tons per day, which is a decrease from the November production of 2,233,603 tons.

NEW YORK

PROFIT-SHARING BY EMPLOYEES. YUKON GOLD, NEW YORK & HONDURAS AND GERMAN POTASH SYNDICATE. ALASKAN COPPER. MEXICAN AFFAIRS. ARMOR PLATE MANUFACTURE. INSPIRATION COMPANY. COPPER SITUATION.

The International Nickel Co. is following the example set by the United States Steel Corporation, to which it is distantly related, in offering to allow its employees to purchase a limited number of shares at \$110, paying for it in installments from their salaries. Dividends will begin as soon as the first instalment is paid, and the employees will receive extra compensation amounting to 5% of the stock subscribed for, so long as they retain their stock and remain in the employ of the Company. As International Nickel common stock is paying 10% per year, the employees will get what amounts to 15% a year on their holdings. The permissible number of shares varies according to length of employment and salary received, amounting to 10 shares in the case of those receiving over \$4000 per year, who have been in the Company's service 10 years or more.

At the annual meeting of the Yukon Gold Co., all the re-

the United States was going to do about it. Naturally the answer has not been made public but it might have been an inquiry as to what the European powers did when the Balkan states embarked on two wars in the face of their prohibition. We are now paying pensions amounting to \$175,000,000 per year on account of previous wars, and the American public is not likely to see in the losses of foreign investors any compelling reason for intervention, no matter how awkward our diplomatic position may be, the more especially since the interest is merely suspended, not repudiated. If the warring factions in Mexico would only carry on their fighting without ripping up the railroads, the mining companies—most of them, at least—would be able to get along fairly well.

Some time since I wrote of the possibility of the United States Government embarking in the armor-plate business, and a bill appropriating \$8,000,000 for the purpose will soon be introduced in the House. Sir Robert Hadfield has been in this country for some time, presumably on account of the possibility of securing the use of Hadfield steel, which is much cheaper than that now used in the manufacture of projectiles. In this he has been unsuccessful, since it was deter-



COPPER CLIFF SMELTER, OF THE CANADIAN COPPER CO., OF THE INTERNATIONAL NICKEL COMPANY.

tiring directors were reelected. The New York & Honduras Rosario Mining Co. has declared a dividend of 2% payable January 24, following its dividend of 3% paid December 30, 1913. The New York representative of the German Potash Syndicate has announced that, at the general meeting in Berlin, all the members waived their right to terminate the agreement at the end of 1915, and it is therefore extended to 1925. (A cable to San Francisco on January 21 stated that the German Government had appropriated \$125,000 for an exhibit of potash minerals at the Panama-Pacific Exposition in 1915.)

The Kennecott Mines Co. has paid a dividend of \$1,000,000, bringing its total distribution to \$5,000,000. The Tacoma plant of the American Smelting & Refining Co., where the Alaska copper ores are treated, was reported to have been shut down on account of a strike, but as a matter of fact nothing more serious occurred than a little inconvenience, and the plant is running. The total copper now coming from Alaska amounts to a respectable quantity, and when the affairs of that 'distressful country' are finally adjusted, it is likely to increase considerably.

Mexico has been so much discussed that only strong provocation will lead one to reopen such a sore subject. The needed stimulus has been supplied by the announcement by President Huerta that payment of interest on all domestic and foreign indebtedness will be suspended for six months. As something over \$300,000,000 worth of bonds is largely held in Europe and America, this is touching the pocket nerve with a vengeance. European governments lost no time in asking what

mined a short while ago to continue the use of the more expensive forged projectiles. It will be interesting, therefore, to see whether the Hadfield steel will be adopted for armor plate in the government plant. It may be said that Sir Robert's wife is American, since he married the sister of George W. Wickersham, attorney general under ex-President Taft. Well informed persons are of the opinion that the Hadfield steel is much cheaper and just as good, since it has been adopted by the British admiralty.

The Inspiration Consolidated Copper Co., in its report to the New York Stock Exchange for November 30, 1913, shows cash on hand amounting to over \$2,000,000. In spite of this, it is reported that the Company will have to do some new financing in order to complete its scheme of new construction, which has been considerably extended as compared with its original plans. The 4-mile branch, to connect the plant with the Arizona Eastern railway, will be built by the Company instead of by the railroad people as at first planned; and additional lands will be bought for the storage of tailing and to increase its water-supply. The surface plant and work underground will be on a more extended scale, and it is said that plant will be provided for the recovery of the oxidized copper minerals, which cannot be caught in the flotation plant. The Company has \$6,000,000 in bonds outstanding, but it has over 500,000 shares which are available for the raising of new funds.

Two seats on the New York Stock Exchange were sold for \$50,000 each on January 19. Sales on the Exchange on January 22 totaled 783,300 shares.

BRITISH COLUMBIA

THE SEYMOUR RIVER MINING DISTRICT.—DISPUTED PLACER CLAIMS IN THE CARIBOO DISTRICT.

The mineral resources of that portion of the province of British Columbia, situated to the north from the head of the Seymour arm of Shuswap lake, have been receiving more serious attention from prospectors during the past season than formerly. Although handicapped to such an extent that the transportation of supplies by pack horse has been costing \$6. per pound from the village of Seymour arm to McLeod's camp, a distance of about 22 miles by trail, development work has been carried on all last summer on the Camp McLeod group of claims, and assessment work has been done on the Copper King and Bass groups. The camp is locally known as the Cotton-belt, because the first discovery of mineral, in the form of a heavy gossan outcrop, was made by a negro prospector about 20 years ago, at the time when he and other stampeders to the big bend of the Columbia river were traveling to the placer diggings on creeks emptying into that river, following an Indian trail that crossed the summit between Seymour and Columbia rivers near the scene of present activity. The discovery resulted in the staking of the Cotton-belt group of claims, and the performance of sufficient assessment work to obtain crown grants or patents to the ground. Later, the attention of some trappers, who hunted and trapped every autumn and winter in the neighborhood of the Cotton-belt camp, was attracted by other gossan outcrops on the mountain side, which were found to overlay copper ore as well as galena. Several claims were staked and assessment work was done; but at that time smelting ores were useless as there were no smelters nearer than Trail, on the lower Columbia river, and want of transportation facilities to the Canadian Pacific railway. The progressive policy adopted by the provincial government in encouraging and aiding the construction of new railways and good wagon-roads, is responsible for the renewed activity in the development of the claims last summer. The miners argued that, if a fair tonnage of ore of commercial grade was exposed, the construction of a wagon road could be secured, followed later by railroad to the head of Seymour arm, where water transportation could be used to the Canadian Pacific railway at Sicamous, and the ore shipped to the Trail smelter.

The rock formations of the range of mountains in which the occurrence of galena, copper, zinc, and magnetite ores are found, are mica, schist, and crystalline limestone. The orebodies occur both as contact deposits between these rocks and as veins in the mica schist, their lines of strike and dip being conformable to the bedding planes of the country rock. They strike nearly true northwest and southeast, and dip at an angle of 45° toward the northeast. So far, work has shown that there are at least three distinct parallel orebodies in the Cotton-belt mountain, one of the earliest discovered, on the summit at an elevation of about 6000 ft. above sea-level; another at about 1700 ft. lower elevation, and the third about 300 ft. still lower. All are on the southwest slope of the mountain, looking toward the north fork of the Seymour river and Deep creek, one of its tributaries. The persistence and length along the lines of strike of each of these orebodies are quite unusual. For example: the outcrop of the Cotton-belt orebody is exposed by cross-cut trenches on the plateau, along the summit of the mountain, for a distance of nearly two miles; the outcrop of the second or Copper King orebody can be traced across five claims or about 7500 ft.; and that of the third or Camp McLeod orebody has been exposed in open-cuts made about 100 ft. apart for a distance of 3000 feet. The Cotton-belt orebody is composed of some galena and zinblende in a matrix of magnetite; the Copper King orebody is composed of iron pyrite and chalcopyrite in a quartz matrix; and the Camp McLeod orebody is similar in composition to the Cotton-belt,

only the amount of galena is greater.

Considered from a commercial standpoint, the ore in the Copper King orebody apparently has an advantage over the others because it could be easily concentrated, while the other ores containing galena, zinblende, and magnetite would present a more complex problem. The tonnage of ore in the Copper King should be considerable judging from the width of the outcrops, which at several points exceeds 12 ft. The Camp McLeod orebody varies in width from about 3 to 10 ft., and the Cotton-belt averages about 3 feet. In addition to the extensive surface work that has been done, underground work on the Camp McLeod group in 1913 included an adit driven along the strike of the lode, a distance of 65 ft.; on the Bass group the incline shaft has been extended to a depth



MAP OF BRITISH COLUMBIA.

of 50 ft.; and on the Copper King group a short adit has been driven to cross-cut the orebody at depth.

The supply of timber for mining and domestic purposes is abundant on all the properties except at the Cotton-belt group, situated on the extreme summit, and about 500 ft. above timber line. Deep creek, a tributary of the Seymour river, will afford practically an unlimited supply of power, as it is quite a large stream having a fall of several hundred feet in about a mile, and as it flows through Camp McLeod property, is easily accessible for use.

The hydraulic plant formerly operated at Bullion, in the Cariboo district by H. B. Hobson, for a company composed of Canadian Pacific people, was purchased several years ago by the Guggenheims. A new ditch was partly made, but work was stopped at the property in 1907 or 1908. From 1894, a total of over \$2,000,000 was recovered from the gravels. The water supply was always insufficient to work over 50 or 60 days per year. The following season, after suspension of work, it was alleged that the Guggenheims had not complied with the provincial mining regulations. Mr. Hobson then resumed work, but was soon mixed up with litigation which was settled before his death. In 1913, John Hopp assumed that the Guggenheims had not fulfilled the hydraulic regulations, and re-located the claims. Then E. T. Ward claimed to have bought them from the Guggenheims, and is soon to appear before the authorities to endeavor to oust Mr. Hopp. Such complications are almost unknown in British Columbia, and it is hoped that work will soon be resumed.

General Mining News

ALASKA

Cordova

The Mother Lode Mines Co., with property adjoining the Bonanza, has started to sled some high-grade ore to the railroad for shipment to the Tacoma smelter. The Golden Eagle claim at Golden, in the Port Wells district, has been leased on option to Edwin Griset, of Cordova. The lease is for four years, with a royalty of 10%, and a purchase price of \$30,000. The mine is at tidewater and can be worked by adits. About \$15,000 of ore has been opened.

Fairbanks

Winter dumps are being taken out on Fairbanks creek, and several outfits are doing well. Work on the lower end of Goldstream is as active as in former years. After many hardships during a 21-day trip, P. Breen and A. Allendale, of Council, Seward Peninsula, reached Fairbanks on December 17 with their dog-team. They averaged 50 miles per day. Their destination is Shushana.

The geology and mineral resources of a part of the Yukon-Tanana region, including the gold placers of Rampart and Hot Springs, are described in a report just issued by the U. S. Geological Survey as *Bulletin 535*, by Henry M. Eakin. Placer gold was discovered in the Rampart district probably

Mines property continues without interruption. No. 1 shaft is completed from the Sheep Creek adit to the surface. A hoist has been installed at No. 10 level, enabling men and supplies to be handled coming through the Sheep Creek adit and up the shaft to the Perseverance mine. This adit was driven 600 ft. in December, and connection should be made with the vertical shaft early in April. All levels from No. 5 to 10 inclusive are being driven east and west. By May all the main drifts will be driven west to the surface. No. 2 power-plant on Salmon creek is now at work, and No. 1, near the beach, has the first unit completed. Work on the dam was stopped in November, but will be resumed in April. Removal of rock for the crushing and mill foundations will be finished in about three weeks. Bunk, boarding, and club houses for the employees have been fully equipped with all necessities.

SHUSHANA

There is a difference of opinion between those who have been over it, concerning the McCarthy-Shushana route. Some say that it is a failure, while others declare it is all right. A number of men are leaving the district.

VALDEZ

The 1913 season in the country tributary to Cook's Inlet and to Seward on the Kenai peninsula, at the head of Resurrection bay, was marked by steady progress in the mining industry. This portion of Alaska is notable for free-milling high-grade gold quartz veins, hydraulic and dredge mining, as well as for the Matanuska coalfields. In the first mentioned class of mining the following properties were producers, the Gold Bullion, Gold Quartz, and the Milo Kelly, situated in the Susitna district, tributary to Cook's Inlet, also the Kenai Alaska Gold, Skene Lechner, and the Primrose properties tributary to Seward. Hydraulic mining was conducted successfully on Cache creek, a tributary of the Big Susitna river, but dredge mining on the Kenai river was suspended pending examinations being supervised by Mr. Tripp, of Juneau. Prospecting on Grant lake, near the 25-mile post on the Alaska Northern railway, resulted in exposing some high-grade gold quartz, of which a shipment of about 4 tons was sent to the Tacoma smelter by James R. Hayden in November last, the returns from which are reported as being quite satisfactory.

ARIZONA

The state mine inspector, G. H. Bolin, has issued his annual report at Phoenix. He and his deputies, William Farrell, John Harper, and J. C. Wilson, made 266 inspections of 84 mines during the past year. The total number of men employed in those mines was 13,933, of which 2664 were above ground and 11,269 below. They are divided among the counties as follows: Cochise, 4448; Gila, 2458; Graham, 35; Greenlee, 3133; Maricopa, 159; Mohave, 426; Pima, 177; Pinal, 1786; Santa Cruz, 188; Yavapai, 907; and Yuma, 189. During the year, 66 men were killed in Arizona mines, and there were 70 accidents classed as serious. The Copper Queen heads the list of employing companies, with 346 men above ground and 2006 below. Other large employers are: Arizona Copper Co., Ltd., 169 above and 792 below; Calumet & Arizona, 160 and 1387; Ray Consolidated, 228 and 1357; Inspiration, 162 and 458; Miami, 81 and 783; Old Dominion, 125 and 409; Arizona Copper, 140 and 501; Detroit Copper, 133 and 926; Shannon, 170 and 275; and United Verde, 34 above and 555 below.

The inspector summarizes the industry as follows: "Mining in Arizona was never more active than at present. The principal porphyry companies that are operating actively are the Miami, Inspiration, and Ray. These mines produce low-grade ore and are mined by the caving and shrinkage system. On April 17 five men were killed by an air-blast in the Miami mines. After investigating this disaster, Mr. Harper and I came to the conclusion that the stopes were drawn



ELLAMAR MINE, ELLAMAR, ALASKA.

as early as 1893, and since 1896 systematic mining has been carried on, the first claim worked being on Little Minook creek. Later, as the area being prospected increased, placers were located and mines developed on the tributaries of Baker creek, and still later on Sullivan creek and neighboring streams tributary to Patterson creek. The stream gravels have furnished the greater part of the gold output of the Rampart and Hot Springs districts. Smoothly rounded pebbles of cassiterite, the oxide of tin, are found with the gold in the Sullivan creek placers near Rampart. The area in which the cassiterite occurs is small, being less than a mile in its longest direction. The tinstone or stream tin, as it is commonly called, varies in amount with the gold, the placers commonly being rich or lean in both minerals. In the richest spots as much as half a pound of tin to the pan is reported, which at the present price of the ore would give the gravels a value, not allowing for costs of mining or transportation, of \$18 to \$20 per yard, according to assay. Gravels that contain as little as 9 lb. of cassiterite per yard are being mined profitably in the York region. A copy of *Bulletin 535* may be obtained free on application to the director of the Geological Survey, Washington, D. C.

JUNEAU

The work of developing and equipping the Alaska Gold

too much, thereby leaving too much open space between the back of the stope and the loose ore in the stope. Instructions were given not to allow more than 10 ft. of space between loose rock and the back of stope in future. The number of fatalities in the Ray mine has decreased 200% or more. The narrowing of the stopes, which was ordered by this department, is responsible in a great measure for the decrease. Considerable improvement has been made in the ventilation of the mines in the past year. The managers of the larger mines, by installing large electrically driven fans which force pure air into parts of the mine where it was impossible for a miner to do a shift's work, have found that such parts can be cooled to such an extent that a miner can do much more work without impairing his health to a marked degree. Waste and timber in parts of mines that have been exhausted, or where the ores have been extracted, are responsible for a great amount of heat encountered in mining. More attention is given to the safety of employees at present than before. 'Safety-first' departments have been organized by all the large operating companies. Regular meetings are held, and the men in charge of operations exchange ideas in order to install devices which will prevent accidents."

GILA COUNTY

(Special Correspondence.)—Recent assays of tailing from the Inspiration flotation plant show as low as 0.64 and 0.13% copper. The towers of the Roosevelt power-line are near the mill. During the past week two men were killed by falling from one of them. The American Bridge Co. expects to receive 600 tons of structural steel per week for the new mill. There is nothing special to report on underground work in the mine.

Miami, January 16.

MOHAVE COUNTY

During December the Tom Reed mine produced gold worth \$109,000, and in 1913 a total of \$1,300,000. About \$800,000 was paid in dividends. The claims in Copper cañon, Cedar Valley district, known as the Molybdenite group, have been optioned to J. H. Conway, of St. Paul, Minnesota.

SANTA CRUZ COUNTY

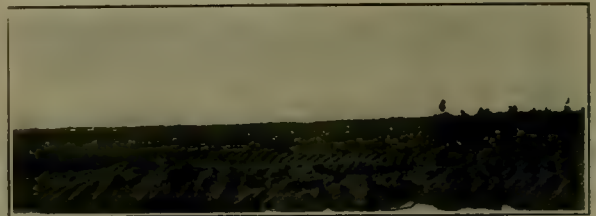
According to *The Oasis*, of Nogales, the present situation of mining in the county is as follows: Ore shipments have been made from the Three R mine in the Patagonia mountains; in the Chief, near the Three R, a promising orebody has been developed; in the district are a number of good properties, among which is the Buena Vista group, operated by the Arizona-European Mining Co.; just across the mountains is the well known World's Fair mine; at Mowry, the Red Mountain Mining Co. is busy developing its claims, and a concentrating plant will probably be erected; the Duquesne mines, near Washington camp, 20 miles from Nogales, are shipping ore regularly; in the Santo Niño, near Duquesne, the Havalena Mining Co. has had good results, but litigation has stopped work temporarily; a group of claims in the Patagonia mountains is being actively prospected by J. F. Campbell, A. S. Henderson, and L. Koeller; other good claims in these mountains are the Volcano, Sunshine, Morning Glory, Bluenose, Cunningham, Buffalo, Skibo, Hardshell, and Flux; there are also several interesting properties in the Santa Rita mountains, among which is the Elephant Head, employing 125 men, and shipping ore, while a reduction plant is contemplated; rich silver-lead-zinc ore has been opened in the Mark & Louis Lulley mine; the Wandering Jew mine, worked many years ago by the old monks, is in this district; litigation has suspended work at the Alto; ore is being shipped from the Royal Blue; on the south side of the mountains are the Trenton, Santa Rosalia, Ivanhoe, Mammoth, and Blue Lead claims, which are opening well; on the east side the Mansfield Mining Co. has cut a large shoot of copper-gold ore at 400 ft.; the American Boy, August, Hosey, Happy Jack, Gringo, and Victor are near by; near the Pima county line, on the north side of the

mountains, the old placer deposits are being worked by a few men; southwest of Greaterville the Onyx King Mining Co. has developed a large deposit of chalcedony; the Oro Blanco district, in the west of the county, is gold bearing, and there are the Austerlitz, Montana, Warsaw, Oro, Oro Blanco, Grubstake, Tres Amigos, Oro Fino, and Progressive mines; the first named has a mill working; the Montana and Progressive have opened large tonnages of ore; and near the Mexican boundary the Gold Cañon Placer Mining Co. has been hydraulicking, but a cloudburst put the plant out of commission temporarily.

CALIFORNIA

BUTTE COUNTY

Dredging companies know the value of the ground on which Oroville is built, and Lawrence Gardella, a dredge operator, and the North California Mining Co. are trying to have an existing ordinance repealed, whereby they can dredge



DREDGE TAILING AT OROVILLE.

a 40-acre tract within the town limits. They propose to give the town an 8-acre park in return for the privilege of recovering the gold contained in the area; but the park committee argues that it will have only a rock pile on its hands if this is done.

CALAVERAS COUNTY

It is stated that negotiations are pending for the sale of the Keystone Union, and other claims by the Calaveras Copper Co. at Copperopolis.

LASSEN COUNTY

Mining at Hayden Hill has been quiet for some time; but the Lassen Mining Co. is to resume work in the spring, while others are preparing for operation.

NEVADA COUNTY

Development in the Champion mine, owned by the North Star company, is said to be very satisfactory. The Black Bear stamp-mill in the Rough and Ready district is working again, this time on ore from the Forlorn Hope vein, which junctions with the Black Bear.

PLACER COUNTY

Work is to be started soon at the Spring Garden and Packham Hill claims near Forest Hill. An active season is anticipated for the district.

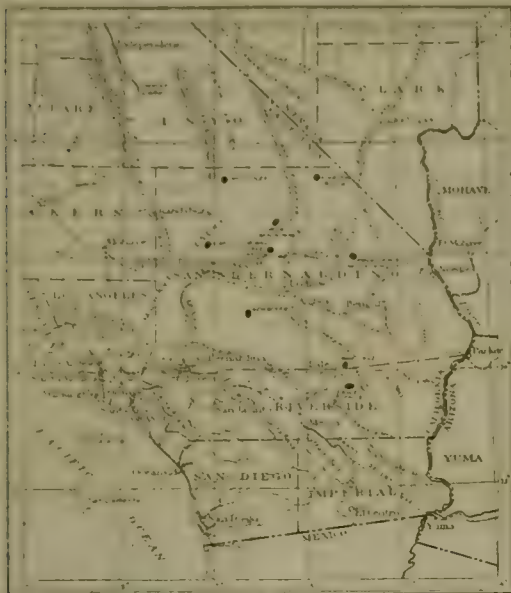
It is probable that Eastern capital will be secured to reopen the Southern Cross mine, near Humbug cañon. The mill and other buildings were burned last summer. So far this winter, no mines near Alta have been worked.

PLUMAS COUNTY

At Johnsville, the Jamison mill is to restart crushing, there being ample water in the reservoir. An air-compressor is being installed by lessees at the Tefft mine, near Claremont peak. The machine will be driven by water-power. Twenty-seven copper claims in Lights cañon have been filed for record at Quincy for the Nevada-Douglas Copper Company. The Mohawk copper mine in Last Chance cañon, near Vinton, has been sold to Salt Lake people for \$125,000. The mine was opened by M. J. Daly, who has shipped ore worth \$55 per ton. E. A. Ludwick is manager.

SAN BERNARDINO COUNTY

The Atolla district was the second largest producer of tungsten ores in 1913, and still makes a larger production of scheelite than any other district in the world. Nearly all the output was produced by the Atolla Mining Co., but small



MAP OF SOUTHERN CALIFORNIA.

quantities were also produced from several mines at Atolia and the Stringer and Randsburg districts on the north.

SHASTA COUNTY

The Friday-Lowden group of copper claims has been bonded by an English Columbia company, called the Silver Tip Mining Company. The property adjoins the Mammoth holdings. The deal was made through S. E. Bretherton. Twelve men are working at the Mount Bailey company's West End mine, and 10 tons of rich ore is sent daily to the Gambrinus mill. A compressor is being installed at the Shasta Monarch mine. Cross-cutting is to be done at 140 ft. The Whiskeytown district is hoping for an active season. At 500 ft. in the Esperanza mine, a seam of good coal has been opened. A. J. Oswald is superintendent.

SISKIYOU COUNTY

All the hydraulic mines are working full time, and there is plenty of water. The 'dry gulch' miners are making good clean-ups, the first time for six years, owing to shortage of water.

TRINITY COUNTY

The Globe 20-stamp mill, at Dedrick, is treating 100 tons of ore per day, with high recoveries. Fifty men are employed at the property. Wallace McGregor is manager. D. W. Shanks has taken charge of the Trinity Consolidated Mines Co.'s Union Hill and Hupp placer properties. The plate for the Lagrange Syphon at Stuart's Fork was landed on January 16, and the break will soon be repaired.

TUOLUMNE COUNTY

At the Hazel Dell mine, near Columbia, a 500-ft. cross-cut has been driven, from which drifts are cut 310 and 120 ft. east and west. In the latter drift the ore-shoot is 32 in. wide, worth \$55 per ton. The ore contains a high percentage of galena. The Jamestown Exploration Co. has an option on the Carlin mine, and further development is proposed. The Columbus, near Tuolumne, will probably be reopened. The 2200-ft. adit at the Shawmut, used for conveying ore to the

mill is being enlarged preparatory to using electric locomotives instead of horses. Work at the Hope is satisfactory, and a Huntington mill will be erected. G. W. Weston is manager.

YUBA COUNTY

(Special Correspondence.)—The report published in this journal of January 10, relative to the loss of two drills operated by the Guggenheim interests, is not quite correct. One machine of the Keystone type was wrecked, but not lost. It was washed down the river about 1200 ft. and has since been refitted.

Smartsville, January 15.

COLORADO

CLEAR CREEK COUNTY

(Special Correspondence.)—The electric trolley system at the Capital mine was brought into commission on January 12. Considerable development work is planned. The Onondago Mining Co. will operate the Ruler property through the Capital adit, a perpetual right of way having been secured. E. C. Bauman is manager. Two well known miners fell about 600 ft. in the Capital mine on January 15 and were killed. The machinery at the Rosebud mine on Democrat mountain was started this week. Cross-cutting is under way 800 ft. from the portal of the adit, to cut the east extension of the Astor vein. G. W. Teagarden is manager. The Butler property is the scene of a promising find. The ore-shoot is 5 in. wide and assays return 290 oz. silver per ton. H. W. Kirby is owner. Hanson & Co., leasing on the Anamosa mine on Columbian mountain, have uncovered a 20-in. ore-shoot and a test shipment returned 150 oz. silver per ton. A carload shipment will be sent to the Argo smelter next week. It is stated by J. B. Ballantine, in charge of installing machinery at the Pelican mill, which is being provided with the Edison method of ore dressing, that ore treatment will be started within two weeks. The Mendota mill at Silver Plume, which has been in almost continuous operation for 12 years, has been closed down temporarily. Pending the starting of the same, Stephens Bros., the operators, will carry on development on the Frostburg vein, work to be done above the Victoria adit level. Work has been resumed on the Gold King property situated on Saxon mountain. B. O. Bonham is in charge.

Georgetown, January 13.

OURAY COUNTY

Development in the Mountain Top is very satisfactory. No. 2 shoot has been opened for 300 ft. and is from 2 to 3 ft. wide, averaging from \$30 to \$40 per ton. Metal contents are: gold, \$1; silver, 35 oz.; and lead, 12 per cent.

TELLER COUNTY (CRIPPLE CREEK)

Sinking is under way in No. 1 and 2 shafts of the Portland mine, from 1600 to 1750 ft. Two shifts are employed. Lessees at the C. K. & N. mine are making a large output of \$30 ore. Control of the Jo Dandy Mining Co. was sold on January 16 to William MacDonald, of Albany, New York, and H. C. Gilderhouse, of St. Louis, Missouri, for \$100,000. This was paid to Allen L. Burris, of the El Paso Consolidated company, representing a large number of shareholders. Two cars of ore from the South Burns mine returned \$20 and \$19.70 per ton, respectively. Two shifts of miners are working in a drift from the Fuller cross-cut in the Roosevelt drainage tunnel, to develop the C. K. & N. vein. Results are promising so far, but the flow of water is 800 gal. per minute. From the drainage tunnel the flow is now 7300 gal. per minute.

IDAHO

BLAINE COUNTY

The Wilbert mill, 40 miles from Arco, has been shut down owing to the low price of lead ore. Development is to be continued.

BOISE COUNTY

The Liberty Mining Co. has been organized at Boise to work placer ground in the Boise basin, about 30 miles north-east of that city. The officers of the Company are A. E. Small, president; James Cathcart, vice-president; M. A. Small, secretary and treasurer; E. W. Barry, H. L. Fisher, Charles F. Baxter, and J. C. Buckholz, directors. The company has a large tract of virgin placer ground on Moore's creek, two miles below Idaho City and adjoining the Boston-Idaho Gold Dredging Co.'s ground. The property consists of 402 acres of bar and bench ground and is situated well above the bed of Moore's creek, affording an excellent dump for the ground, which will be worked by the hydraulic method. Two electric pumps of 500-hp. capacity will be installed, capable of delivering water at 60-lb. pressure. The plans include the construction of a large storage reservoir, which will have a capacity of 13,500,000 gal. Frank E. Johnnes, a Boise mining expert, has made a thorough examination of the property and reports an average of 24.7c. gold per cubic yard. Operations will commence in May or June. The working season here is from March to November, inclusive.

CUSTER COUNTY

The Lucky Boy Gold Mining Co.'s properties at Custer have been bonded and leased, with a purchase option, to Colorado Springs men. The various claims have been opened by 25,000 ft. of development, and the mine, stamp-mill, and cyanide plant have been fully equipped. Previous to the shut-down the mines produced \$7,000,000 in gold and silver.

LEMMI COUNTY

Great activity is reported from the lower Salmon mining districts. One lessee on Shoup is extracting ore from an 8-in. vein which will yield over \$250 per ton in gold. This ore will be treated at the new mill and cyanide plant at Pine creek. Mr. Gonder, who owns property on Sheep creek, in the Gibbonsville district, is in Nevada on a trip for new machinery. The A. D. M. people at Gibbonsville will probably install a new compressor in the spring. The ore opened would pay for the installation of a mill. On the Kitty Burton, at Ulysses, other lessees are equally active. Though the ore is not high grade, it is reported that they are making money.

SHOSHONE COUNTY

The Clearwater Gold & Copper Mining Co. has developed a large tonnage of ore in its mine on the upper Clearwater, and transport is difficult. According to Sam Seidenfeld, a large stockholder, it is proposed to construct an aerial tramway 12 miles long to cross the Bitter Root divide between Montana and Idaho. The tramway would have a capacity of 24 tons per hour. About 4000 ft. of work has been done in the mine at a cost of \$80,000. The Stewart Mining Co.'s earnings in December were \$65,000, making a total of \$226,000 for the last quarter of 1913. The last half-year's profits were \$435,000, from which \$277,000 has been paid in dividends.

The National Copper Co. at Mullen, is erecting a 500-ton plant, the ore being crushed with rock breakers, rolls, and Hardinge mills to 30 mesh. This is then concentrated. The sand product is reground in other Hardinge mills and then the whole product passed to Dorr thickeners to be dewatered as low as possible. The underflow goes to a flotation plant, the overflow being returned to the head of the mill. The tailing passes to other Dorr thickeners, the overflow from which is mixed with the underflow from the first series of thickeners which goes to the flotation boxes. The underflow from the second series of thickeners goes to the tailing dump. All of the concentrate from the tables and Minerals Separation plant passes to a Kelly filter to be dewatered.

MICHIGAN

HOUGHTON COUNTY

(Special Correspondence.)—Organized labor throughout the United States has sent at least \$750,000 into the Michigan

strike district since the inception of the labor difficulty here last July. How much of it ever reached the men who went on strike is a question which is agitating the minds of officials who are investigating the trouble. The largest contributions to the maintenance of the strike came from the Butte branch of the Western Federation of Miners. A similar contribution had just been made to the strikers in the Bingham district, Utah, in 1912. The Western Federation of Miners has not received any contributions from Bingham, or the Homestake, where there was a strike some years ago. Further trouble has arisen with the Western Federation, and it appears that Walker of the Illinois Federation of Labor and the American Federation of Labor, is trying to consolidate the Western Federation and the United Mine Workers of America.

At 18 of the copper mines there is a total of 8724 men employed, against 13,514 before the strike, which started on July 23. 'Moyerism' seems to be the only issue at stake now, and the mining companies will not recognize the Western Federation of Miners. Charles H. Moyer and others have been indicted on the charge of conspiracy.

Houghton, January 15.

MONTANA

LEWIS AND CLARK COUNTY

Ten to fourteen inches of high-grade galena has been opened at the bottom of the incline shaft of the Franklin mine, at a depth of 280 ft. From 15 to 20 men are employed.

MADISON COUNTY

The Big vein has been cut 225 ft. north on the 500-ft. level of the Corbin Copper Co.'s Blowout property at Rochester. A large flow of water was also cut, and additional pumps will be installed to handle the 800 gal. per minute flow. The Company is developing its Gambrinus mine at Butte with satisfactory results.

SILVERBOW COUNTY

The North Butte company has acquired 900 additional acres of Butte territory for which it has paid \$1,000,000 in cash and 20,000 shares of stock. This property has been in process of acquirement for nearly two years, and the \$1,000,000 of cash has come out of earnings, and at the same time the Company has added to working capital a total of about \$1,000,000.

During 1913 the Butte & Superior Mining Co. treated 307,957 dry tons of ore, which yielded 104,214 tons of concentrate, containing 102,002,039 lb. of zinc. The recovery averaged 83.08 per cent.

NEVADA

The new mining law regarding the employment of men about mines who cannot speak or understand English, referred to in the last issue of this journal, is to be tested in the courts. The Tonopah Mining Co., W. H. Blackburn, manager, is representing the other mining companies at Tonopah in this argument.

ESMERALDA COUNTY

During the past week the shaft of the Darms Coal Mining Co., at Coaldale, passed through 14 in. of good coal at 300 ft. The shaft will be sunk deeper.

HUMBOLDT COUNTY

At the Broughton-Newman lease on the Original Rochester estate, controlled by W. C. Pitt, C. H. McIntosh, and others, the lessees have shipped ore worth \$124 per ton in silver and gold. A 140-ft. adit has cut the ore-shoot, which is from 4 to 8 ft. wide. There is estimated to be a total value of \$70,000 in sight. The Octopus claims have been bonded to Oakland and Spokane people for \$50,000, with a cash payment of \$2500. Ore opened is 9 ft. wide, 3 ft. being worth \$40 and the balance \$12 per ton.

LINCOLN COUNTY

The Day-Bristol Consolidated Mining Co., of Pioche, is in

the hands of a receiver, H. E. Freudenthal. The Consolidated Nevada Utah Corporation complains that the Day-Bristol company's properties have been mismanaged during the past two years and money has been spent extravagantly.

LYON COUNTY

The Mason Valley smelter, at Thompson, received 4075 tons of ore during the second week of January, and shipped 240,000 lb. of blister copper. A 60-hp. gasoline engine and air-compressor is being installed at the Smith Valley mine. Rich gold ore has been opened by Bovard and Knight on their Pumpkin Hollow ground. Development at the Burlington-Nevada mine is satisfactory.

NYE COUNTY

The mines at Tonopah, during December, produced 46,115 tons of ore worth \$937,480. The total for 1913 was \$10,016,968, and \$63,602,133 to date. At the Belmont, 14,603 tons was treated, yielding 4019 oz. gold and 370,354 oz. silver, with \$171,866 profit. The Tonopah company's output was 11,890 tons, yielding 227,523 oz. bullion and 135 tons of concentrate worth \$46,250. The profit was \$133,125. The West End mill treated 4869 tons at a profit of \$42,211. From the Jim Butler

mill is treating 170 tons per day. Placer mining at Round Mountain yielded \$100,000 last season. D. Jewell and associates recovered most of this.

STOREY COUNTY

The water in the Con. Virginia winze was down 180 ft. below the 2500-ft. level on January 21.

NEW MEXICO

SOCORRO COUNTY

(Special Correspondence.)—A gasoline hoist, air-compressor, and machine-drills are being assembled at the Lincoln property. The Maud shaft is being sunk a further 160 ft., making 700 ft. in all. Development at the Pacific property is to be extended. The Deadwood plant is working full time. Work is going on steadily in the main drainage and transportation tunnel of the Oaks Co. which will eventually be under the large mines of the district at depths of from 1400 to 1800 ft. During 1913 the Socorro mine produced about 25 tons of gold and silver bullion, and a good tonnage of high-grade concentrate.

Mogollon, January 12.



TONOPAH, NEVADA.

mine 1971 tons was shipped at a profit of \$13,451. Other contributors to the December total were the Extension, with 4958 tons; Montana-Tonopah, 4581; North Star, 398; MacNamara, 2110; Merger, 585; and Midway, 150 tons. During the week ended January 17, 10 mines produced 10,297 tons of ore worth \$252,450. In the Extension mine the west shoot of the Murray vein at 950 ft. is 9 ft. wide, containing good ore. At 700 ft. in the Tonopah company's property, the Last Chance vein has widened from 2 to 3 ft. Three feet of good ore has been cut on the 665-ft. level of the Montana-Tonopah, this being the downward extension of the A. B. K. vein below the fault, which came in below 615 ft. On the 1100-ft. level of the Halifax, two veins are being developed, and the raise at 1000 ft. shows 10 ft. of ore. Three feet of ore is being driven on in the Midway at 635 ft. Cross-cutting north at 1166 ft. in the Mizpah Extension is still in favorable trachyte formation. The Buckeye-Belmont shaft is now in good condition to the 1000-ft. level. Pump stations will be cut at this and the 865-ft. level. A No. 5 Cameron pump is to be used in shaft-sinking. The shaft is in trachyte.

The Round Mountain company's superintendent, R. H. Ernest, states that the mine is improving. New ore-shoots have been cut at 450 ft. depth, 600 ft. southwest of the main workings on that level, and 100 ft. beyond this shoot the southwest cross-cut intersected another mineral zone. The first shoot is from 12 in. to 3 ft. wide over 250 ft., worth \$20 per ton, and the second is worth from \$3 to \$15 per ton. The

OREGON

JACKSON COUNTY

(Special Correspondence.)—M. Blanchin, president and general manager of the Bill Nye Corporation, a French company, but with American headquarters at San Francisco, arrived this week to make an inspection of the Bill Nye mine, near Gold Hill. M. Blanchin was pleased with the mine. It is now worked by one shift, but has been unwatered and overhauled, and the superintendent, Mr. Bellamy, states that an additional shift will soon be added. The new 75-ton mill at the Nellie Wright mine is nearly completed. It will be driven by electric power. The mine contains a large tonnage of ore. Gold Hill, January 15.

A. E. Smith, of San Francisco, has been visiting the hydraulic mines at Gold Hill, and has interested the miners in saving black sand, which contains platinum. Tacoma and Sutherlin, Oregon, people have purchased placer ground near Dowden Falls, three miles from Gold Hill. Active prospecting is under way. While there is plenty of water for large hydraulic mines, the smaller properties are short, the former depending on snow and the latter on local rainfall.

JOSEPHINE COUNTY

(Special Correspondence.)—A great amount of development is being done at the mines of Illinois valley, surrounding the pioneer camps of Kerby and Waldo. The hydraulic placers are making a fine showing, as the season is an excellent

one for surface mining. New workings have been opened on the Simmons-Cameron-Logan placers. A double-lift Hندی elevator has been installed on this line to take care of the tailing. John Logan, owner of the mine, is also operating the Osgood, nearby, with excellent results. The Wimer mine, known as the Deep Gravel, is operating this year under the management of Morrison brothers. A tubular elevator is also in operation on the Wimer, there not being sufficient natural dump to take care of the debris. The local manager, Mr. Wimer, reports that an exceptionally rich bank of pay-gravel is being worked this year. George W. Otterson, a prominent mining man of Ottawa, Canada, after making a thorough investigation of the mines of southern Oregon, took an option on a Grants Pass placer. He has begun work and will more extensively develop the mine, operating the present equipment during the remainder of the season.

Grant's Pass, January 15.

UTAH

CARBON COUNTY

About four miles from Helper is the Spring Cañon coal mine, which has a daily output of 1100 tons. The property has been producing only since March 1913, and the equipment is sufficient for a 2000-ton output. The mine is operated by electric power throughout. Two coal seams are being worked, 8 and 9 ft. thick, respectively. The town of Storrs is quite a model in every respect, and has a population of 500 to 600 people. Coal is shipped to California, Nevada, Idaho, Washington, Oregon, and Montana.

JUAB COUNTY

The Iron Blossom company has paid another dividend of \$100,000. The mine is in fine condition. The annual report of the Company shows net earnings of \$595,744 in 1913. The ore production was 39,526 tons, worth nearly \$20 per ton net. Ore reserves are 200,000 tons averaging \$20 per ton net. Ground north of No. 1 shaft of the Colorado mine has been leased. There is considerable activity in the north Tintic district. Ore shipments from 16 properties during the past week totaled 153 cars.

SALT LAKE COUNTY

The Utah Metal Mining Co. has issued a report covering the following work: On December 4, 1913, the Utah Copper Co. completed its pipe-line, and the water being supplied amounts to 440,000 gal. per day. Early in 1914 the flow from the springs on Middle cañon will be increased for the Utah company. The Bingham-New Haven Mining Co. is also supplied, and further water contracts are expected with other companies and the town of Bingham. Negotiations are under way for hauling waste and mill tailing through the tunnel to dump in Middle cañon. A drift is being driven west from the 9100-ft. point in the tunnel, toward the Bingham-New Haven property, the vein being 3 ft. wide in limestone. At 8600 ft. in the tunnel, 244 ft. of work has been done in favorable mineralized ground. It is hoped that the Company's finances will soon be on a sound basis.

WASHINGTON

FERRY COUNTY

J. L. Harper has forfeited his bond on the Surprise and adjoining mines, which includes the ground in dispute between the Republic Mines Corporation and the Quilp Gold Mining Co., and conceded to the latter under a written agreement by which the litigation was settled and the Quilp company came into unquestioned possession of the ground in dispute. The annual meeting of the Knob Hill Mining Co. was held at Spokane on January 14. During 1913 ore valued at \$140,000 was shipped from the mine, and \$25,000 was paid in dividends, the only Company in the state to pay any. Development at the mine is promising.

KING COUNTY

Gold receipts during 1913 at the United States Assay Office at Seattle showed a large increase over the previous year, being \$8,205,000, as against \$4,490,900 in 1912. The receipts from Alaska amounted to \$6,600,000. With the close of business January 1, 1914, the Seattle office had handled a total of 435 tons of gold valued at \$218,612,600 since its establishment in July 1898.

STEVENS COUNTY

The Silver Queen mine, two miles from Turk, which has been idle for 10 years, is to be unwatered and further development done. Rich silver ore was formerly mined. From the Providence, near the Silver Queen, ore was sent out last summer. It costs \$21 per ton to deliver ore to the Tacoma smelter from this district. Rich copper-silver ore has been opened in an abandoned adit of the Copper Queen claims, 9 miles from Chewelah. E. E. Thomason is the owner. No. 2 adit at the United Copper mine has been driven 3700 ft., leaving 500 ft. to reach the two-compartment winze sunk below the 600-ft. level. This should be through by April 1. The adit is 6 by 7½ ft., with a 0.5% grade, and a 30-in. gage track. Electric haulage will be used later on. The adit will have cost \$50,000 on completion. The mill has been increased by another unit of 12 stamps, the daily capacity being from 125 to 150 tons per day. From 80 to 100 men are steadily employed.

SPOKANE COUNTY

The following dividends have been paid by mining companies in the adjacent areas of British Columbia, Washington, and Idaho:

Company.	1913.	1912.	Total to date.
B. C. Copper	\$ 88,756	\$ 177,512	\$ 704,155
Bunker Hill	817,500	752,100	14,729,250
Can. Con.	464,352	232,176	1,480,245
Federal	720,000	720,000	10,788,750
Granby	899,911	.....	4,752,043
Hecla	320,000	300,000	2,970,000
Hedley	360,000	360,000	1,224,000
*Hercules	1,500,000	600,000	5,500,000
Int. C. & C.	120,000	.....	941,000
Knob Hill	25,000	5,000	70,000
Le Roi No. 2	43,200	60,000	1,567,620
Snowstorm	45,000	75,000	1,124,640
Standard	650,000	425,000	1,075,000
Stewart	402,435	.....	402,435
Success	90,000	180,000	930,000
Totals	\$6,456,154	\$3,886,788	\$48,259,138

*Estimated.

CANADA

BRITISH COLUMBIA

The Portland Canal company's adit is now in 2870 ft. At 2300 ft. No. 1 vein was cut, and is over 100 ft. wide, while at 2800 ft. No. 2 was cut, it being 40 ft. wide, mostly quartz. Neither vein was well mineralized where cut, but contained a little galena and pyrite. Drifts have been started north and south respectively on the two veins. The adit is being driven 60 ft. per week at a cost of \$20 per foot. W. J. Elmen-dorf is manager. Work has been resumed at the Glacier Creek mine, adjoining the Portland Canal property, on No. 1 vein cut in the latter. A shipment of ore from the Lake View mine, on Glacier creek, to the Tacoma smelter, yielded an average of gold, \$9.80; silver, 570.7 oz.; and lead 22.1%. A good tonnage has been opened in the mine. Complete returns for 1913 from the Grand Forks smelter of the Granby company are as follows: ore smelted, 1,246,013 tons, and blister copper, 21,960,997 lb. There was 17,434 tons of foreign ore treated. There is 16 in. of snow at the Hidden Creek property of the Granby company. A winze is being sunk from the 300 to 400-ft. level of the Jewel mine. C. A. Banks is manager.

The following table shows the estimated production of the principal properties in the Cobalt district in 1913 compared with 1912. The total for 1913 is estimated for the last month of the year, and in one or two instances for the last two and three months.

Mine	Gross ounces	
	1913	1912
Nipissing	4,600,000	4,719,578
Coniagas	3,550,247	3,703,942
La Rose	2,623,000	2,920,344
McKinley-Darragh	2,250,000	2,704,868
Buffalo	2,000,000	1,890,150
Kerr Lake	2,109,975	1,895,309
Crown Reserve	1,833,333	2,714,766
Cobalt Townsite	1,783,554	1,505,596
Cobalt Lake	1,200,000	1,123,146
O'Brien	1,200,000	1,091,631
Sen. Superior	1,150,000	.....
Beaver	750,142	689,921
Temiskaming	735,000	1,242,243
Temiskaming & Hudson Bay	659,872	957,055
Trethewey	610,139	620,923
Penn. Canadian	365,000	.....

Dividends paid by Cobalt mines in 1913 were as follows, according to *The Daily Nugget*:

Company.	1913.	To date.
Beaver	\$ 60,000	\$ 410,000
Buffalo	890,000	2,527,000
Caribou-Cobalt	25,000	25,000
City of Cobalt	.....	139,321
Cobalt Central	.....	192,845
Cobalt Lake	240,000	240,000
Cobalt Silver Queen	.....	315,000
Cobalt Townsite	500,000	900,000
Coniagas	1,640,000	5,720,000
Crown Reserve	795,966	5,483,315
Foster	.....	45,774
*Hollinger	1,170,000	1,440,000
Kerr Lake	600,000	4,920,000
La Rose Consolidated	937,500	4,079,185
McKinley-Darragh	1,033,938	3,865,262
Nipissing	1,800,000	10,890,000
Right of Way	.....	526,903
Seneca-Superior	309,649	309,649
Temiskaming & Hudson Bay	162,981	1,870,341
Temiskaming	150,000	1,384,156
Trethewey	150,000	1,012,598
Wettlaufer	141,659	637,465

Total	\$10,196,694	\$46,935,718
La Rose (shared privately previous to May 1908) ..	1,204,862	
Private corporations (estimated).....	3,500,000	

Total\$51,638,681

*The Hollinger is at Porcupine.

Ore from the Crown Reserve and Dominion Reduction companies, at Cobalt, was sent to Germany during the first week of January. During December the Dome mill at Porcupine treated 13,470 tons of ore yielding gold valued at \$106,904. This makes the total, since operations began in April 1913, 104,330 tons and \$936,106 in gold. The last ore shipment from the Tough Oakes at Kirkland Lake was 28 tons containing 23.59 oz. gold and 67.50 oz. silver per ton. Six shipments have made a total worth \$63,285.

YUKON

All dredges of the Canadian Klondyke Mining Co. are shut down for the winter. During the past season 6,363,515 cu. yd. of gravel was dredged, yielding 85,899 oz. gold worth \$1,331,000. Working expenses totaled \$480,000. Three boats with 16, and one with 7½-cu. ft. buckets, were in operation. No. 2

dredge worked 268 days, a record for the district. They are all driven by electric power, generated by water power from the Klondike river. J. W. Boyle, general manager, may probably install another boat at the upper end of the property in 1915. The hydraulic plants of the Yukon Gold Co. moved 2,875,000 cu. yd. of gravel during the season of 1913. Water for this purpose comes 75 miles, and was described in the *Mining and Scientific Press* of January 16 and 23, 1909, by T. A. Rickard. No. 6 dredge is to be re-erected in the spring on Gold Run creek, 50 miles from Dawson. No. 7 is to be transferred to 41 Hunker. Since starting dredging, the Company has completely worked out 108 full claims and several fractions. All boats are driven by electric power. During the season November 30, 1912, to December 1, 1913, the Klondike produced gold worth \$5,327,310, according to the report of George Black, territorial commissioner, published in the *Dawson Daily News*. The total for 1913 is estimated at \$5,500,000, an increase of \$500,000 over 1912. The gold output to date is \$174,652,411.

COLOMBIA

The Pato dredge recovered \$12,600 from 18,900 cu. yd. of gravel during the last week in December. November returns from the Colombian Mining & Exploration mine totaled \$22,000. Ten stamps are being erected in the new mill, and should be crushing soon.

KOREA

The Seoul Mining Co., operating the Suan concession, in Whang Hai province, Korea, reports the following results for December 1913.

Stamps working	40
Time, days	29.83
Ore crushed, tons	6350
Total recovery	\$61,499
Operating expenses	27,500
Net earnings	33,999

The Oriental Consolidated Co.'s December clean-up yielded \$143,000.

MEXICO

CHIHUAHUA

On January 15, 15,000 oz. of silver bullion from the Batopilas Mining Co. crossed the border at Nogales, Arizona, on its way to New York. Supplies are being sent to the mine for more active work.

JALISCO

On December 10, the Mololoa 20-stamp mill of the El Favor Mining Co. started ore treatment, the entire plant from that date being available for El Favor ores. E. E. Bugbee, professor at the Massachusetts Institute of Technology, Boston, states that a preliminary roast following magnetic separators, and the present cyanide process in use at El Favor, shows over 90% extraction from the manganese-silver ores of the Company's mines. There is on hand at the property 60 days supply of dynamite, 90 of cyanide, and large stocks of other supplies. There have been no rebel disturbances in the district. On January 30 a dividend of 1c. per share on 3,500,000 shares will be paid. At the beginning of 1914 the Company had \$54,195 credit in United States banks. Other receipts remitted since December 12 will add to this amount.

SONORA

About 75 men are working at La Cobriza mine, 100 miles south of Nogales, Arizona, on the border. The smelter is now in full blast. A 100-ton mill will be built to concentrate low-grade ores.

COSTA RICA

The Abangarez Gold Field Co. reports the following for November 1913: Ore treated, 7370 tons; total recovery by amalgamation and cyanidation, \$51,257; profit, \$2355; and improvements, \$1979.

Schools and Societies

COLUMBIA UNIVERSITY students numbering 502 earned a total of \$56,705 during their summer vacation last year.

The UNIVERSITY OF CALIFORNIA has started a course on oil production, including well drilling and handling of product.

The UNIVERSITY OF WASHINGTON, Seattle, opened a three months meeting for mining men on January 5. There were 44 registrations from 10 states, Alaska, and five foreign countries, to study quartz, placer, and coal mining.

The AMERICAN INSTITUTE OF MINING ENGINEERS will hold the 107th meeting in New York City on February 17 to 20. The committees on iron and steel, petroleum and gas, mining law, and mining geology have asked for a total of seven sessions for the reading and discussion of papers.

The New York section of the AMERICAN INSTITUTE OF MINING ENGINEERS held its last meeting on January 16. A paper on 'Mine Gases' was presented by N. H. Darton, of the U. S. Geological Survey. It covered the results of an exhaustive study made under the auspices of the U. S. Bureau of Mines.

The OLD FREIBERGERS society held their semi-annual dinner on December 4 at the Imperial restaurant, London, England. Sixteen members and one guest were present, and Edward Hooper, the president, occupied the chair. The evening was enlivened by the singing of old German Kommerslieder, and was thoroughly enjoyed by all those fortunate enough to be present.

The COLORADO SCIENTIFIC SOCIETY has elected the following members to serve during 1914: President, Richard A. Parker; first vice-president, E. N. Hawkins; second vice-president, Thomas B. Stearns; treasurer, J. W. Richards; secretary, H. C. Parmelee; executive committee, J. D. Skinner and Charles A. Chase, term expiring January 1, 1917; and Victor G. Hills to fill vacancy expiring January 1, 1916.

The OLD FREIBERGERS in America held their regular annual meeting at the Hofbräu Haus, New York City, on December 20. A pleasant evening was spent around the festive board. All the former officers were reelected, namely, Dr. R. W. Raymond, president; Gardner F. Williams, vice-president, and C. L. Bryden, secretary and treasurer. It was decided to hold a meeting in San Francisco in 1915 during the Panama-Pacific Exposition, and a number of the members are planning to go to Freiberg in 1916, to help celebrate the 150th anniversary of the founding of the old Bergakademie.

The annual meeting of the FARADAY SOCIETY was held on November 26, 1913, at the Institution of Electrical Engineers, London. The following officers and council were elected to serve for the year 1913-14: president, Sir Robert Hadfield; vice-presidents, G. T. Beilby, K. Birkeland, W. R. Bousfield, Bertram Hopkinson, A. K. Huntington, T. Martin Lowry, Alexander Siemens; treasurer, F. Mollwo Perkin; council, R. Beilfield, H. Borns, W. R. Cooper, F. G. Donnan, Emil Hatschek, R. S. Hutton, Alfred W. Porter, E. H. Rayner, R. Seligman, and Maurice Solomon. The seventieth ordinary meeting was held afterward. Ernest Vanstone submitted a paper on 'The Electrical Conductivities of Sodium Amalgamates.' This discussion is a preliminary to a more extensive investigation. A paper on 'The Influence of a Second Solute on the Solubility of Ortho-phthalic Acid,' was read by A. C. Rivett and E. I. Rosenblum. T. Martin Lowry showed a series of photographs illustrating the formation of an oxidizable variety of nitrogen, by the action of a spark discharge on air at atmospheric pressure. There was a discussion on the paper previously presented by F. J. Brisleon, 'The Density of Aluminum.' J. W. Richards, of Lehigh University, had also previously sent a note on 'Over-voltage,' which was discussed.

Personal

J. A. AGNEW sailed from Nicaragua Tuesday.

W. Y. WESTERVELT is at Redlands, California.

H. S. BRUCKNER is in San Francisco last week.

A. W. ALLEN expects to return to England in April.

J. W. FINCH has returned to Denver from California.

J. V. N. DORR has returned to New York from Cobalt, Canada.

GEORGE E. FARISH has returned to New York from Cobalt, Canada.

ROSS B. HOFFMANN and JACK HOFFMANN have gone to London.

C. E. BUNKER has gone to Nicaragua to become manager at La Leonesa gold mines.

RALPH ARNOLD will deliver a course of lectures at the University of Chicago this spring.

J. M. LOVEJOY is now superintendent of the Minas San Juan, Huantajaya (via Iquique), Chile.

J. H. COLLIER has returned from Nicaragua, where he has been investigating metallurgical problems.

W. S. HARRISON, general manager for the San Francisco Mines of Mexico, of Rugby, England, is at El Paso, Texas.

FRANK LANGFORD has left India for the Malay States and will return from there to the United States by way of the Philippine Islands.

HENRY H. ARMSTEAD sailed from Vera Cruz January 8 for New York, where he will remain until the last of March, at which time he will return to Mexico.

NORVAL J. E. WELSH has withdrawn from the management of the Otero Copper Co., at Orogrande, New Mexico, and is now at Organ, Dona Ana county, New Mexico.

GEORGE A. CAMPHUIS and GERALD RIVES have formed a partnership in mining engineering and mine management work, with headquarters in the Mills building, El Paso, Texas.

GODFREY E. MORGANS passed through New York on his return to London from Colombia, where he has been examining large coal and iron properties for Colombian investors.

S. WOLFF, formerly manager of the Cleveland office of the Allis-Chalmers Manufacturing Co., has been appointed Chicago manager for the De Laval Steam Turbine Co., with offices in the Peoples Gas building.

Among those present at the meeting of the Geological Society of America, at Princeton, December 30 to January 1, were C. D. WALCOTT, G. O. SMITH, J. F. KEMP, A. H. BROOKS, J. M. CLARKE, W. H. HOBBS, WILLET G. MILLER, A. P. COLEMAN, J. A. DRESSER, C. A. FISHER, N. H. WINCHELL, F. D. ADAMS, C. A. DAVIS, F. H. KNOWLTON, G. H. ASHLEY, A. W. GRABAU, MELVILLE E. STONE, T. W. VAUGHAN, I. C. WHITE, U. S. GRANT, ELLSWORTH HUNTINGTON, W. J. MILLER, S. W. BEYER, H. A. BUEHLER, E. O. HOVEY, HEINRICH RIES, FRED E. WRIGHT, E. H. KRAUS, GILBERT VAN INGEN, SIDNEY PAIGE, H. L. FAIRCHILD, J. VOLNEY LEWIS, THOS. C. BROWN, D. W. JOHNSON, J. W. SPENCER, A. L. DAY, LAWRENCE MARTIN, F. R. VAN HORN, R. VAN A. MILLS, A. C. BOYLE, T. T. READ, and G. P. MERRILL.

Obituary

Death of THEODOSIE TCHERNYCHEFF, director of the Geological Survey of Russia, is announced by cable. Tchernycheff was an able geologist and an experienced administrator well known to many Americans to whom he had extended courtesies in his own country. He was one of the leaders of the International Geological Congress and a man of first rank in his profession.

The Metal Markets

LOCAL METAL PRICES

San Francisco, January 22

Antimony	9 — 9½c
Electrolytic copper	15½—15¾c
Pig lead	4.35— 5.30
Quicksilver (flask)	\$39.00
Tin	41 — 42½c
Spelter	6½— 6¾c
Zinc dust, 100 kg. zinc-lined cases, 7½ to 8c. per pound.	

EASTERN METAL MARKET

(By wire from New York)

NEW YORK, January 21.—A change for the better is to be noted in the copper market, its position is at present strong and a good demand for export is being experienced. Standard spot to April is offered at 14.50 and electrolytic is quoted at from 14.50 to 14.62½. Lake copper is quoted at 15. Copper securities in general showed an advance during the day. The lead market is firm but quiet, with quotations at from 4.05 to 4.10. Spelter is also quiet. Gold bars to the value of \$2,000,000 have been engaged for shipment to Paris, making a total of \$4,000,000 for this present movement of bullion. The London market is cabled as firmer, with an upward tendency in mining shares.

SILVER

Below are given the average New York quotations in cents per ounce, of fine silver.

Date	Average week ending
Jan. 15	57.75
" 16	57.50
" 17	57.75
" 18 Sunday	57.75
" 19	57.62
" 20	57.50
" 21	57.37

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	56.25	63.01	July	60.67	58.70
Feb.	59.06	61.25	Aug.	61.32	59.32
Mch.	58.37	57.87	Sept.	62.95	60.53
Apr.	59.20	59.26	Oct.	63.16	60.83
May	60.88	60.21	Nov.	62.73	58.76
June	61.29	59.03	Dec.	63.38	57.73

To those who follow the course of the silver market there has been much of interest in the history of the past year. Among the most important events may be mentioned the successful issue of the \$25,000,000 loan to China; the suspension of the Indian Specie Bank, with the collapse of the native group of speculators, who have influenced the market for so long, and further important purchases of silver by the Indian Government. In addition, there has been political unrest both in Mexico, the largest producer of silver in the world after the United States, and also in China, the only important country which still maintains a silver currency, and which, in consequence, is one of the largest users of the metal. As a result the market has been an irregular one and difficult to forecast, according to Pixley and Abell's annual circular. India, with its immense population, has again been the dominating factor in the market. The Government has purchased during the year about \$5,500,000 of silver for coinage into rupees. A report on Indian finance is expected during the current month. China has been fairly quiet during 1913. Stocks of silver in Shanghai are \$5,785,000, as against \$3,347,000 in 1912. Imports of silver into England in 1913 were \$14,520,000, of which \$13,260,000 came from the United States, Mexico, and Canada. Shipments from San Francisco totaled \$2,348,000. Exports from England in 1913 were \$15,326,000 in silver bullion and coin, of which \$9,850,000 went to India. Stocks in London are \$1,900,000.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date	Average week ending
Jan. 15	4.10
" 16	4.10
" 17	4.10
" 18 Sunday	4.10
" 19	4.10
" 20	4.10
" 21	4.10

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	4.43	4.28	July	4.71	4.35
Feb.	4.03	4.23	Aug.	4.54	4.60
Mch.	4.07	4.32	Sept.	5.00	4.70
Apr.	4.20	4.36	Oct.	5.08	4.37
May	4.20	4.34	Nov.	4.91	4.16
June	4.40	4.33	Dec.	4.20	4.02

COPPER

Quotations on copper as published in this column represent average wholesale transactions on the New York market and refer to electrolytic copper. Lake copper commands normally 1-5 to 1-10c. per lb. more. Prices are in cents per pound.

Date	Average week ending
Jan. 15	13.80
" 16	13.90
" 17	14.00
" 18 Sunday	14.10
" 19	14.10
" 20	14.15
" 21	14.25

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	14.09	16.54	July	17.19	14.21
Feb.	14.08	14.93	Aug.	17.49	15.42
Mch.	14.68	14.72	Sept.	17.46	16.23
Apr.	15.74	15.22	Oct.	17.32	16.31
May	16.03	15.42	Nov.	17.31	15.04
June	17.23	14.71	Dec.	17.37	14.25

The New York copper market last week may perhaps be best described as hopeful, and a gradual improvement was evident. There was some quiet buying during the week at slightly improving prices, and the receipt of foreign statistics showed a big decrease in visible supplies in Europe during the first half of January, and will probably soon be reflected in better prices and increased buying on foreign account. The foreign visible supply in England, France, and afloat thereto, on January 15 had decreased 1892 tons in the fortnight to 19,142 tons. An increase of 240 tons, on the other hand, was shown at European warehouse points, including Hamburg, Rotterdam, and Bremen, the supplies there now being 8755 tons. Hamburg showed an increase of 302 tons, Bremen stocks dropped 62 tons, while those at Rotterdam were unchanged. This presumes, of course, that there is nothing in the allegation that large foreign shipments have been made on consignment. Exports from January 1 to 15 were 16,395 tons, as compared with 15,061 tons in the same period last year.

QUICKSILVER

The primary market for quicksilver is San Francisco, California, being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending	Jan. 8
Dec. 24	39.50
" 31	39.50

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	43.75	39.37	July	43.00	41.00
Feb.	46.00	41.00	Aug.	42.50	40.50
Mch.	46.00	40.20	Sept.	42.12	39.70
Apr.	42.25	41.00	Oct.	41.50	39.37
May	41.75	40.25	Nov.	41.50	39.40
June	41.30	41.00	Dec.	39.75	40.00

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date	Average week ending
Jan. 15	5.05
" 16	5.05
" 17	5.05
" 18 Sunday	5.05
" 19	5.05
" 20	5.05
" 21	5.05

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	6.42	6.88	July	7.12	5.11
Feb.	6.50	6.13	Aug.	6.96	5.51
Mch.	6.57	5.94	Sept.	7.45	5.55
Apr.	6.63	5.52	Oct.	7.36	5.22
May	6.68	5.23	Nov.	7.32	5.09
June	6.88	5.00	Dec.	7.09	5.07

TIN

New York prices control in the American market for tin, since the metal is almost entirely imported. San Francisco quotations average about 5c. per lb. higher. Below are given average monthly New York quotations, in cents per pound:

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	42.53	50.45	July	44.25	40.70
Feb.	42.96	49.07	Aug.	45.80	41.75
Mch.	42.58	46.95	Sept.	48.64	42.45
Apr.	43.92	49.00	Oct.	50.01	40.51
May	46.05	49.10	Nov.	49.92	39.77
June	45.76	45.10	Dec.	49.80	37.57

On January 22 the prices for tin were firm and quotations as follows: Spot for February, 38.75 to 39; March, 38.80 to 39.10; and April, 38.85 to 39.25c per pound.

The Stock Markets

SAN FRANCISCO STOCKS AND BONDS (San Francisco Stock and Bond Exchange.)

BONDS					
January 21.					
Listed.	Bid	Ask	Unlisted.	Bid	Ask
Associated Oil 5s.....	\$ 97	98½	General Petroleum 6s.....	—	50
E. I. du Pont pfd.....	84	—	Natomas Consol. 6s.....	—	24½
Unlisted.			Pac. Port. Cement 6s.....	—	100½
Ass. Oil 6s.....	78	—	Santa Cruz Cement 6s.....	84	—

STOCKS					
Listed.	Bid	Ask	Unlisted.	Bid	Ask
Amalgamated Oil.....	82½	84	Noble Electric Steel.....	—	8
Associated Oil.....	43	—	Natomas Consol.....	1½	—
Giant.....	81	—	Riverside Cement.....	60	—
Pac. Cst Borax, pfd.....	68½	—	Santa Cruz Cement.....	38	—
Pacific Crude Oil.....	—	35c	Stand. Port. Cement.....	19	—
Sterling O. & D.....	1	—			
Union Oil.....	56	—			

NEVADA STOCKS

(By courtesy of San Francisco Stock Exchange.)
January 22.

Atlanta.....	\$.19	Mizpah Extension.....	\$.35
Beicher.....	.35	Montana-Tonopah.....	1.10
Belmont.....	7.62	Nevada Hills.....	.56
Big Four.....	.13	North Star.....	.43
Con. Virginia.....	.19	Ophir.....	.17
Florence.....	.76	Pittsburg Silver Peak.....	.34
Goldfield Con.....	1.60	Round Mountain.....	.52
Goldfield Oro.....	.15	Sierra Nevada.....	.09
Halifax.....	1.25	Tonopah Extension.....	1.87
Jim Butler.....	.90	Tonopah Merger.....	.66
Jumbo Extension.....	.21	Tonopah of Nevada.....	6.50
MacNamara.....	.11	Victor.....	.31
Mexican.....	1.20	West End.....	1.37
Midway.....	.40	Yellow Jacket.....	.28

COPPER SHARES—BOSTON

(By courtesy of J. C. Wilson, Mills Building.)
January 22.

Bid	Ask	Bid	Ask
Allouez.....	\$ 38 38½	Mohawk.....	\$ 46 46
Ariz. Commercial.....	5 5½	Nevada Con.....	16½ 16½
Butte & Superior.....	3½ 3½	North Butte.....	29 29½
Calumet & Arizona.....	67½ 67½	Old Dominion.....	53 53½
Calumet & Hecla.....	432 435	Oscuela.....	79 80
Copper Range.....	39 39½	Quincy.....	64 65
Daly West.....	2½ 2½	Shannon.....	6½ 6½
East Butte.....	12½ 12½	Superior & Boston.....	2½ 2½
Franklin.....	3½ 4	Tamarack.....	3½ 3½
Granby.....	83 84	U. S. Smelting, com.....	42½ 42½
Greene Cananea.....	40½ 40½	Utah Con.....	10 10½
Imperial.....	22 22½	Winona.....	3½ 3½
Mass Copper.....	2½ 2½	Wolverine.....	46½ 47½

NEW YORK CURB QUOTATIONS

(By courtesy of E. F. Hutton & Co., Kohl Building.)
January 22.

Bid.	Ask.	Bid.	Ask.
Braden Copper.....	7½ 7½	Mason Valley.....	3½ 3½
Braden 6s.....	155 160	McKinley-Dar.....	1 1½
B. C. Copper.....	2½ 2½	Mines Co. Am.....	2 2½
Con. Cop. Mines.....	2½ 2½	Nipissing.....	7½ 8
Davis-Daly.....	1½ 1½	Ohio Copper.....	¾ ¾
Dolores.....	1 2	San Toy.....	17 20
El Rayo.....	2 4	Sioux Con.....	1 2
Ely Con.....	4 5	Stand. Oil of Cal.....	286 288
First Nat.....	2½ 3½	Tri Bullion.....	¼ ¼
Gibson.....	1 1½	Tuolumne.....	5½ 5½
Iron Blossom.....	1½ 1½	United Copper.....	¾ ¾
Kear Lake.....	4¾ 5	Wetlaufer.....	7 8
La Rose.....	1½ 1½	Yukon Gold.....	2 2½

NEW YORK STOCK EXCHANGE

(By courtesy of J. C. Wilson, Mills Building.)
January 22.

Bid	Ask	Bid	Ask
Amalgamated.....	\$ 77 77½	Miami.....	\$ 23½ 24
Anaconda.....	36½ 36½	Nevada Con.....	16½ 16½
A. S. & R.....	69 69½	Quicksilver, com.....	14 2
Calif. Pet.....	28½ 28½	Ray Con.....	19 19½
Chino.....	41½ 41½	Tenn. Copper.....	35 35½
Guggenheim Ex.....	48½ 49	U. S. Steel, pfd.....	112 112½
Inspiration.....	16½ 16½	U. S. Steel, com.....	85½ 85½
Mexican Pet.....	61½ 62	Utah Copper.....	54½ 54½

LONDON QUOTATIONS

(By cable, through the courtesy of Catlin & Powell Co.,

New York.)

January 23.

	£	s.	d.		£	s.	d.
Alaska Mexican.....	1	7	6	Kern River Oilfields.....	0	6	3
Alaska Treadwell.....	8	0	0	Mexico Mines.....	5	6	0
Alaska United.....	3	5	0	Messina.....	1	10	0
Arizona.....	2	0	0	Oroville.....	0	15	0
California Amalg.....	0	1	3	Pacific Oilfields.....	0	3	9
California Oilfields.....	6	0	0	Rio Tinto.....	69	6	0
Camp Bird.....	0	12	6	Santa Gertruds.....	0	17	6
El Oro.....	0	15	0	Stratton's.....	0	1	3
Esperanza.....	1	0	0	Tanganyika.....	1	18	9
Granville.....	0	10	0	Tomboy.....	1	7	6
AUSTRALASIAN							
January 22.							
	£	s.	d.		£	s.	d.
British Broken Hill.....	1	15	0	Mount Boppy.....	0	15	0
Broken Hill Prop.....	1	16	9	Mount Elliott.....	3	10	0
Golden Horse-Shoe.....	2	12	6	Mount Lyell.....	1	5	0
Great Boulder Prop.....	0	15	0	Mount Morgan.....	3	5	0
Ivanhoe.....	2	17	6	Walhi.....	2	15	0
Kaiguri.....	1	18	9	Walhi Grand Junc.....	1	18	9

AUSTRALASIAN

January 22.

	£	s.	d.		£	s.	d.
British Broken Hill.....	1	15	0	Mount Boppy.....	0	16	0
Broken Hill Prop.....	1	16	9	Mount Elliott.....	3	10	0
Golden Horse-Shoe.....	2	12	6	Mount Lyell.....	1	5	0
Great Boulder Prop.....	0	15	0	Mount Morgan.....	3	6	0
Ivanhoe.....	2	17	6	Waihi.....	2	15	0
Kalgurli.....	1	18	9	Waihi Grand Junc.....	1	18	9

Mineral Production of British Columbia

The following figures are from the preliminary review of the province in 1913 by the mineralogist, William Fleet

Robertson:			Increase or
Mineral.	Quantity.	Value.	decrease.
Gold, placer, ounces.....		\$540,000	— \$15,500
Gold, lode, ounces.....	266,547	5,509,526	+ 187,084
Silver, ounces.....	3,569,642	2,027,557	+ 217,512
Lead, pounds	54,205,594	2,130,280	+ 324,653
Copper, pounds	46,042,379	7,021,463	+ 1,387,050
Zinc, pounds	7,100,000	340,800	+ 24,661
Coal, long tons.....	2,136,694	7,478,429	+ 1,722,385
Coke, long tons.....	285,123	1,710,738	+ 124,740
Building materials, etc....		3,400,000	— 35,722
Total		\$30,158,793	— \$2,282,007

Practically all the placer gold is obtained in the Cariboo and Cassiar districts, the latter including Atlin. The lode-gold districts are Rossland, 135,300 oz.; Boundary, 103,300 oz., including Camp Hedley with 38,300 oz.; Nelson, 23,500 oz.; Coast, 3900 oz.; and Lillooet, 1300 oz. Silver was produced by the Slokan district, with 1,860,000 oz.; Ainsworth, 487,000 oz.; East Kootenay, 413,000 oz.; Boundary, 380,000 oz.; and Nelson, 160,000 oz. Slokan and Ainsworth were responsible for 31,000,000 lb. of lead; East Kootenay, 20,300,000 lb.; and Nelson, about 2,000,000 lb. A small bounty was paid to lead producers during part of the year. Copper amounting to 29,000,000 lb. came from the Boundary, chiefly Granby; 14,000,000 lb. from the Coast; and 2,200,000 lb. from Rossland. Slokan produced nearly all of the zinc. Laboratory experiments, in electric smelting lead-zinc ores, made by the Dominion Department of Mines, have reached an advanced stage, and an electric furnace has been constructed at Nelson, with G. C. Mackenzie in charge. Slokan ores are being experimented with for their commercial reduction. Labor troubles on Vancouver island caused a decrease in the coal output of the province. The Island mines produced 962,620 tons; Nicola, 262,768 tons; and Crowsnest, 1,351,498 tons.

Gold Movements in England in 1913

Imports were as follows, according to Pixley and Abell: Australia, £452,000; Brazil, £472,000; British India, £2,345,000; Java, £336,000; South Africa, £40,798,000; and West Africa, £1,596,000.

Exports were as follows: British India, £9,955,000; France, £1,831,000; Germany, £8,824,000; Holland, £96,000; Russia, £2,080,000; Switzerland, £442,000; Turkey, £401,000; and United States, £600,000.

Company Reports

TONGKAIH HARBOUR TIN DREDGING COMPANY

As its name implies, this Company operates dredges in a harbor in Siam. The report covers the seventh year of work, and shows the following:

Harbor gravels dredged, cubic yards.....	3,336,190
Yield of tin oxide, tons.....	1,339
Yield per cubic yard, pounds.....	0.90
Value per cubic yard, cents.....	23
Cost of dredging, cents.....	7.6
Other costs, cents.....	1.4
Value of output.....	\$758,000
Profit.....	385,000
Dividends paid.....	288,000
Surplus.....	337,000

No. 6 dredge is being built in Scotland by W. Simons & Co. It will have a digging capacity of 60 ft., and is to cost \$124,800. Only \$49,000 has now to be paid to the Government of Siam. Elliot T. Lewis is general manager.

CONIAGAS MINES, LIMITED

This Company operates at Cobalt, Ontario, and the report covers the year ended October 31, 1913. Development work during the year has been mostly on No. 9, 12, 18, and 28 veins, and cross-cutting to the southern boundary. There has also been considerable development done on small veins on No. 1 level. On account of recent discoveries in the claim adjoining the southern boundary, it is necessary to operate from No. 4 shaft, which was sunk in 1907-1908 near the southern boundary of the claim. A shaft-house will be erected and operations started within a few weeks. Broken ore in stopes has increased 14,000 tons. Ore reserves are as follows: 3870 tons containing 11,610,000 oz. silver, 132,525 tons with 2,650,000 oz., 52,130 tons with 2,085,200 oz., and 10,500 tons with 315,000 oz., a total of 16,660,700 oz. Allowing for contingencies, this should be reduced to 13,329,000 oz. New orebodies opened contain 2,950,000 oz. The mill operated 98% of the possible time, and treated 54,890 tons of ore. This, with concentrate shipments, yielded a total of 3,572,399 oz. Since 1905 the output has been 17,662,904 oz. of silver.

ST. JOHN DEL REY MINING CO., LTD.

The fifty-fifth half-yearly report of this Company, which operates a gold mine in Brazil, contains the following information from G. Chalmers, the superintendent: The ore reserves, down to and including horizon 18, a total depth of 983 ft. vertical, amounts to a total of 1,045,912 tons. This is equal to 5½ years supply at 192,000 tons per year. Development covered 1345 ft., and at horizon 18 the lode has been opened 259 and 222 ft. east and west, respectively. There was 70,070 tons of filling put into the mine. During the term the Sirocco fan ran with only two stoppages totaling 3 hours 50 minutes, consequently ventilation was good throughout the workings. The electric locomotives did excellent work. A total of 167 accidents occurred in the mine, of which 7 were fatal, 5 being due to carelessness of a hoisting engineer, 1 being probable suicide, and the last due to a man trying to get off a cage while in motion. The labor situation has been serious, but is improving by the importation of Japanese, 107 coming during the half-year. It is hoped that they will prove to be efficient. The various plants have worked well. Two new Chalmers & Williams tube-mills have been erected. Manganese steel linings are much preferable to the chilled iron make. From two quarries, 1391 tons of hard rock was excavated and sent to the mill for use in tube-mills. The sand-settling system has been al-

tered to cope with a larger tonnage, and the filter plant requires extending. The Edwards furnace treated 2619 tons of sand, yielding gold worth \$9600. The 120-stamp mill worked 138.3 days, and 82,500 tons of ore was treated yielding \$950,000. Extraction was 92.63%. The profit amounted to \$259,000. On December 19, 1913, dividends amounting to \$120,000 were paid on the 10% preference and ordinary shares. Mortgage bonds outstanding amount to \$134,000, and investments on the reserve fund are \$160,000. The rainfall was 11.97 in., or 4.05 in. less than during the previous period. The Morro Velho and Raposos tramway is of great service, and 14,588 passengers were carried. Health of the camp has been good, there being only four cases of typhus fever. The Hotel Retiro shows a loss on operation for the half-year. Brazilian exchange on the Company's drafts averaged 32.19 per milreis.

MEXICAN GOLD AND SILVER MINING COMPANY

The fiscal year of this Comstock company ended on October 31, 1913, and Whitman Symmes, the superintendent, gives the following information: At the date of the last report the stopes above the 2300-ft. level had been practically worked out, and extraction was continued from the 2400 and 2500-ft. level stopes. The last ore from the 2300-ft. stope was taken out on January 17. The 2400-ft. stope was worked by the shrinkage method, which avoided the use of any considerable amount of timber. When the work was completed, the ore was drawn from the stope, and it was allowed to cave, according to the usual practice in such methods. The last ore was taken out on February 28. In April the 2500-ft. stope was nearly exhausted, and ore was taken from beneath the sill floor of the stope on that level. By May 9 all the ore below the sill floor that appeared to be of value was taken out, and on May 16 all ore was removed from the main 2500-ft. stope. This stope was worked by the square-set system of timbering. The extraction of ore from the mine during the past year has been as follows:

Level, ft.	Tons.	Gross yield.
2300	202	\$ 3,139
2400	7,652	142,721
2500	6,318	260,163
Total	14,172	\$406,023

During the previous term an incline winze was being sunk below 2500 ft., and at February 14 it was down 147 ft. in practically barren rock. No arrangements being made with the Comstock Pumping Association, the work was abandoned. There being no further work that could be profitably done in the Mexican mine until the water-level had been lowered, all equipment was removed from below 2000 ft., and the drifts and air-ways securely timbered. Ore from the Mexican mine and surface dump milled during the past year, was 15,973 tons, yielding \$462,434. Mining and treatment, etc., for the Mexican totaled \$10.40 per ton.

An option on the Comstock Quartz Mining Co.'s property was allowed to expire, as prospecting did not open anything of value. The Mexican company has a 60% interest in the Monte Cristo lease, and the mill treated 13,274 tons, yielding \$109,071, also 118 tons of concentrate yielding \$5299. The cost of this treatment was \$2.83 per ton. In the Monte Cristo mine, work is under way on the 350-ft. level. When a satisfactory agreement has been made with the Pumping Association and adjoining mining companies, the lower levels of the Mexican mine will be explored.

The total value of the bullion from all sources was \$564,258, of which \$449,889 was from the Mexican and \$114,370 from the Monte Cristo. Operating expenses were \$177,570; construction, \$27,891; and miscellaneous, \$26,267. Value of supplies at the end of the year, October 31, 1913, was \$14,917; balance from Monte Cristo company, \$45,012, and cash at San Francisco and Virginia City, \$253,922. The Company has since decided to invest \$145,000 at Rochester, Nevada.

Horizontal Duplex Power Pumps for High Efficiency

A notable installation of pumps which was recently put into successful and continuous operation is that furnished to the Santa Gertrudis at Pachuca, Mexico, by the Fred M. Prescott Steam Pump Co., of Milwaukee. The original specifications issued by the purchaser called for vertical quintuplex plunger pumps, but after a full consideration of the accessibility and durability of the two designs, as well as the high economy of the horizontal duplex, the latter pattern was selected. The manufacturers have kindly furnished the following information regarding the plant.

There are three pumps of the same size in an underground station. Each has 4½-in. plunger diameter and 36-in. stroke, and a capacity of 500 gal. per minute against 1500-ft. head at 47 revolutions. The pumps handle mine water and are placed so as to permit putting in a fourth unit if the water increases beyond that which can be handled safely by two. The third pump is used as a spare. The electric motors driving the pumps are alternating-current induction motors of 500 r.p.m. synchronous speed, 3-phase, 50-cycle current.



HORIZONTAL DUPLEX PUMP.

The illustration, taken from a photograph of these pumps, will give a good idea of their general appearance, and especial attention is directed to the design of the water end. The variation in the water flow made it desirable that some means be provided for changing the capacity, and this is accomplished in this design by changing diameters of plungers, which is made possible by the use of a hollow steel cross-head admitting of plungers being removed and others substituted without dismantling or moving any of the permanent parts of the pump and within a very short space of time. Further, all dripping of water on the main slides is done away with, by having the stuffing-boxes centrally placed instead of at the ends. The water valves are of the double port design and faced with steel, and the valve pots are fitted with hinged covers to provide for quick inspection and repair. The water ends are furnished with both suction and discharge air-chambers of ample capacity, as well as an air-charging device which is operated in connection with the compressed air supply in the mine together with the pressure from the discharge column. Ample and removable stuffing-boxes and glands are provided at the inboard ends of the water barrels. The power end is of the heavy tandem type, the same as is used in connection with the Corliss fly-wheel pumping engines built by the Fred M. Prescott Steam Pump Co., and proportions are ample for any strain incident to mine work. The main bearings are of the quarter-box type, and all pins, rods, cranks, and shaft are of heavy design and section and the best construction. The gears employed on this work are of the cast steel 'herringbone' type in bolted halves, with pinions cut from solid blanks. The couplings joining the motor and pinion shafts are of special

design with leather links taking up any slight inaccuracies of alignment and operation. A mechanical efficiency of 85% was guaranteed on these pumps and their gears, which efficiency is reported to have been exceeded in actual work. These units are, for the horse-power developed, very compact, yet heavy, and sectionalized so as to go down any ordinary mine shaft.

Catalogues Received

T. H. PROSKE, Denver, Colorado. Booklet. 'The Imperial Drill Sharpening Machine.' 15 pages. 5 by 7 inches. Illustrated.

ELECTRIC WEIGHING Co., New York. Booklet. 'Electric Conveyor Scales.' Messiter patents. 8 pages. 6 by 9 inches. Illustrated.

RIX COMPRESSED AIR & DRILL Co., San Francisco. Leaflet. 'Portable Drilling Outfits. Self Rotating Air Hammer Drills.' 4 pages. 7¼ by 7¼ inches. Illustrated.

JUSTRITE MANUFACTURING Co., Chicago, Illinois. Booklets. 'The Justrite Carbon Lamps and Lantern,' and 'The Justrite Carbide Half-Shift-Lamp.' 10 pages. 3½ by 6¼ inches. Illustrated.

NATIONAL TUBE Co., Pittsburgh, Pennsylvania. Leaflet. 'Safety Calendar.' 8½ by 11 inches. Illustrated. Issued for the Company's employees, in connection with the 'safety first' trend in factories.

THE CYANIDE PLANT SUPPLY Co., 1 Broad Street Place, London, E. C. 'Tube-Mills.' Supplement No. 27. 48 pages. 6 by 8 inches. Illustrated. Descriptions are given of sectionalized mills, mills at various reduction plants, directions of driving pulleys, and standard specifications of tube-mills.

BUFF & BUFF MANUFACTURING Co., Boston, Massachusetts. Booklet. 'The Buff Transit.' 32 pages. 4 by 6 inches. Illustrated. Index. This surveying instrument is the result of 58 years of study. It has a 12-in. telescope with a power of 26.5 diameters. Full details are given as to its construction.

THE COMMONWEALTH GAS POWER Co., LTD., Hoskins Foundry, Perth, Western Australia. Booklet. 'The Commonwealth Down-Draught Generator.' 5½ by 8 inches. Illustrated. This apparatus is used in connection with suction-gas engines, and is a new system of generation where any kind of wood or refuse is consumed. In Australia, the generator and many makes of engines are working with great success. The cost of fuel being 0.32 cents per brake horse-power.

THE LUNKENHEIMER Co., Cincinnati, Ohio. Catalogue. 'An Improved Automatic Injector.' This injector is exceptionally durable, efficient, and economical. The tubes, which parts are

subjected to the greatest wear, are made of a special bronze composition of extreme hardness, and the injector can be subjected to long and severe usage before any sign of wear on the tubes appears. A feature of great importance is the scientific design of the tubes, which aids in prolonging their efficiency, even after considerable wear takes place within them. After the tubes are worn to such an extent that the efficiency of the injector is lost, new tubes can be quickly and easily inserted at small cost. The Lunkenheimer



AUTOMATIC INJECTOR.

injector is automatic at all times, and will restart at once after a temporary stoppage of steam or water supply.

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EDITORIAL

JAPANESE mineral production showed an increase in 1913, and final figures are expected to show a total value of over \$70,000,000 as compared with \$65,000,000 in 1912. The copper output amounted to 154,000,000 pounds.

THE review number of the *Bonanza* states that in the early days of Tonopah, the weekly supplies included four barrels of spirits frumentum; but even with such a bad beginning the camp has flourished like the green bay. Perhaps the 'spirits' was of the same brand as that which Lincoln once inquired for that he might send a barrel to each of the federal generals.

ANTHRACITE production of Pennsylvania for the year 1913, according to figures collected by the producers, amounted to 69,069,628 tons, which is an increase of 5,459,050 tons over that of the preceding year, but 884,669 tons less than the 1911 production. While the exhaustion of these fields is periodically predicted at a not far distant date, indications are that Pennsylvania will supply anthracite for many years to come.

THE mining department of the Auckland Exposition, which is now open and continues until the first of May, contains many interesting features. Mineral collections and working models, showing the ancient and modern methods of mining and ore treatment employed in New Zealand and which account for the production of £82,000,000 in gold from the native ores, are exhibited, and a comprehensive survey of the local mining industry is attractively presented.

LEACHING experiments on the Nevada-Douglas copper ores, which are being conducted at Denver, are reported as having demonstrated that copper can be produced by this method at the mine at a maximum cost of between 8 and 9 cents per pound, this charge including mining, crushing, sulphuric acid consumption, and all other charges incidental to the treatment of ores. Copper produced by this method, it is claimed, is as good as the best electrolytic copper. It is hoped that from the introduction of sulphur dioxide gas into the lixiviant for the purpose of reducing the ferric salts to the ferrous condition an improvement in efficiency will result, and experiments toward this end will be conducted.

CALIFORNIANS and others interested in recent changes of law as relates to the mining industry of the state will welcome Bulletin 66 of the State Mining Bureau, which is available for distribution free. In it will be found a summary of changes in the United States and California statutes in 1913, and of recent court decisions of local importance.

GOLD AND SILVER are articles of commerce as well as media of exchange, and the world movements of the surplus production of each year are matters of first moment to miners and merchants. We print elsewhere a long abstract of the annual bullion letter of Messrs. Samuel Montagu & Company which throws many sidelights upon the demand for the precious metals.

TEXAS has modified its mining law, a recent enactment of the legislature providing that the Land Commission may issue a permit for prospecting for mineral to any applicant upon the payment of 10 cents per acre for the land upon which he intends to prospect. When minerals in paying quantities are found, the applicant has the right to lease the land for a period of ten years. Each applicant is restricted to 1280 acres, but when such land is situated within 10 miles of any producing mine or a well of oil or gas, the number of acres that may be awarded is restricted to 200.

MINERAL exports for the month of September from Mexico, according to the recently published official statistics, have shown a decided decline from that of the same month of the previous year. The total gold exportation during the month amounted to \$2,692,132, which is a decline of \$703,948. The silver exports for the month totaled \$4,740,031, which is a decline of \$6,087,472 from that of the same month of the preceding year. Copper exported amounted to \$893,544, which is a decline of \$1,306,493 for the same period. Petroleum has shown a material increase in exports amounting to \$1,787,515, which is an increase of \$1,132,157.

EXTENSIVE deposits of platinum are reported as having been discovered at Wenden, in Westphalia, a district which has been the producer of iron, lead, copper, and zinc in the past. In that the platinum occurs as an alloy with silver, its presence had not been suspected as in this alloyed form it was soluble in nitric acid and being in solution as a nitrate it had not been previously tested for. The discovery in Westphalia is reported as the result of the chemical analysis of bore-hole samples. The platinum is contained in a rock formation overlying the common-metal orebodies. Assays from nine holes over an area of 500 acres show ore carrying from 0.9 to 1.9 ounces of platinum per cubic yard. These results are higher than obtained from the Ural deposits and preparations are being made for mining this orebody. In that the

production last year was only 1.304 tons, valued at \$1,732,200, and the visible sources are fast diminishing, this field, if it prove as good as anticipated, will be a welcome addition to the world's resources.

STRIKES seem still to occur, however much the laws be tinkered, and experience still holds first place as schoolmaster. The general strike in New Zealand, called three months ago, has now been declared off and the thousands of miners and union men who responded to the exhortations of the labor agitators have returned to work with nothing gained save an experience, which may or may not prove profitable in the future. It will be recalled that the New Zealand parliament has enacted a law for the compulsory arbitration of labor disputes, but this proved futile in the present instance, and settlement has only been brought about through pressure by law-abiding citizens who refused to allow the strikers to interfere with those who desired to work. The situation is similar to that in the Lake Superior copper region where present indications point to a like solution. The recent government investigation in the latter case seems to have resulted in nothing more tangible than a report that some of the smaller companies were operating at a loss, while the Calumet & Hecla company has made "extremely large profits." The conciliators' report has been rejected by the operators on the ground that they will have no dealings with the Western Federation of Miners, nor would they have any of its members in their employ.

IT is a pleasure to print, as we do this week, a clear and authoritative statement regarding the plans for a California mining exhibit at the Panama-Pacific Exposition. Mr. van Barneveld's argument for a consolidated exhibit centrally placed, is unanswerable. To hold an exposition in California without such an exhibit of the industry which made California famous, would be as disappointing as to open a mine that contained no ore—if Mr. Rickard will pardon the metaphor. The artist's sketch that has been prepared and copies of which are furnished with this issue, shows what a striking picture of California's great industry is possible, and anything less than the best would here be a failure. The state as such has appropriated no money for exhibits. This is a radical departure from previous custom. We believe it to be a mistaken policy that may lose to California much of the benefit that would otherwise flow from the exposition. No possible series of county exhibits can make up for the absence of suitable collections representing, not the resources, but the industries of the state. If this mistake is to be rectified it must be through the overruling good sense of those in charge of the county exhibits, and we are glad to say that there is a general disposition to make up in this way for the failure of the state administration to appreciate its opportunities and responsibilities. California must have an exhibit of gold mining, and Mr. van Barneveld has proposed the only feasible plan.

Metal Mine Accidents

Statistics of the metal mine accidents in the United States during the year 1912, compiled by Mr. Albert H. Fay and recently published by the Bureau of Mines, seem to be indicative of the success of the 'Safety First' movement. It is an encouraging and hopeful sign to find that there was a decrease in the number of fatalities in metal mines in 1912 as compared with the previous year, although this decrease amounted to only 5 per cent. During 1912 the number of men killed in and about metal mines in the United States was 661, compared with 695 killed in 1911, so we may consider that 34 human lives were saved. This saving of life is well worth while, but the number of fatalities and accidents is still appallingly large. Mine operators, however, have awakened to the necessity for keeping their workings in better condition and providing more adequate safety appliances, so it is hoped that there will be a gradually diminishing death list in the future. In many states the enactment of rather drastic workmen's compensation laws has forced operators to adopt elaborate precautionary measures, but a large number of mine managers have voluntarily provided better facilities for guarding the lives of their employees since they have found this to be wise from a purely economic standpoint. Mr. H. C. Hoover informs us that in Australia large sums of money have been spent to make the mines absolutely safe, and that these expenditures have invariably proved to be good business investments, resulting in increased efficiency and lower costs per ton of ore mined. The same result has followed from expenditures by the United States Steel Corporation and other American concerns.

An analysis of Mr. Fay's report reveals a number of interesting facts. During the year 1912 the total number of men killed in and about coal mines was 2360, out of 722,662 men employed, or at the rate of 3.27 per thousand. Of the 169,199 men employed in and about the metal mines of the country, 661 were killed, this being at the rate of 3.91 per thousand men employed. Among the metal mines the fatalities were greatest in the copper properties, where the rate was 4.62 killed and 34.90 seriously injured per thousand. The fatalities in the gold, silver, and miscellaneous metal mines were 3.99, and the serious injuries 13.89 per thousand. Statistics of the iron mines show that 3.76 men were killed and 39.35 seriously injured per thousand. In the lead and zinc mines of the Mississippi Valley, there were 3.77 fatalities and 10.26 serious injuries per thousand men employed. In other mines, such as asbestos, asphaltum, graphite, kaolin, phosphate, and salt properties, the rate was 1.52 killed and 10.23 seriously injured per thousand. This low rate may be due in part to the fact that accurate records are seldom kept in these mines.

An instructive comparison is made between the number of accidents in metal mines and those in coal

mines. Although the apparent fatality rate in 1912 was higher in metal mines than in coal properties, the comparison is not just, because, although the metal miners worked 287 days during the year, the coal miners worked but 225 days. Using a 300-day year as a basis, and reducing the figures from both the metal and coal mines to a common denominator, the average fatality rate for all of the metal mines becomes 4.09, and that for the coal mines 4.36 per thousand. On this basis, therefore, the fatality rate in coal mines is actually the higher.

The effect of careful management and systematic efforts to decrease the number of accidents on the part of the larger mining companies has been a material lowering of the fatality rate in the large mines as compared with small properties and prospects. In the case of the small mines the average number of days worked was only 105 for the year, compared with 305 days for the copper mines and 277 days for the gold and miscellaneous metal mines. On the basis of a year of 300 working days, the fatality rate in mines where less than 1000 days' work was performed during the year was 7.05, and that for mines with more than 1000 days' work was 4.02 per thousand. The fatalities in and about prospects and small mines were chiefly due to the careless handling of explosives, and secondarily to shaft accidents. The more careful supervision and regulation of the larger properties is evidenced by the smaller number of accidents caused by explosives, but there is marked lack of adequate provision against falls of rock in the mine workings. In the large mines deaths and serious accidents were caused primarily through poor stoping methods and inadequate timbering or filling of the workings. Of the fatalities, 34.52 per cent was caused by falls of rock; 22.55 per cent by falling down shafts, winzes, and stopes; 14.21 per cent by explosives, and 9.99 per cent was due to tramping and haulage systems. These figures show that the necessity for better methods of stoping and timbering, and more effective safeguards around shafts and winzes, is most imperative. It too often happens that in the endeavor to mine ore cheaply and quickly the condition of the mine workings is almost entirely disregarded until calamitous falls of rock have taken place.

What Is the Matter With Prospecting?

The series of letters upon this subject that we have been printing have proved distinctly worth while. They have been widely quoted and commented upon, and we can not but feel that they have helped to clear the air. They have punctured some fallacies and discouraged some hopes, but they have brought us all face to face with actual conditions, and that is always a prerequisite to progress. We are grateful to our friends for their generous response to our request for information, and we sincerely trust that in this case the bread cast on the waters may return to them after

the cost of living has gone up.

Summarizing the letters, of which the last are printed this week, it may be said that there is great unanimity with respect to the question of the availability of adequate amounts of money for finding and developing prospects. Almost without exception, it is agreed that there is plenty of money for the purpose, although at the present time there may be less than usual on account of the general depression in business circles. The reasons given for the apparent lack of interest in the mining industry as far as the search for and development of new mining camps is concerned, are numerous and varied. On one point there is general agreement, and that is the fact that this country has been so thoroughly explored that almost all of the orebodies which could easily be seen and recognized have already been discovered. Now that the entire country is fairly well settled, the *terra incognita* no longer exists and the spirit of adventure no longer stimulates. At the present time the old-fashioned prospector has almost ceased to exist, for his chances of 'striking it rich' are so remote that he has turned from the hardships of exploration to the comforts afforded by the large mining camps. Inasmuch as there have been no discoveries of moment in the past few years, there is no encouragement to grubstake and send out prospecting parties, although plenty of money is available for that purpose. In other words, funds for prospecting purposes now appear to be less plentiful than they formerly were, only because the chance of finding profitable mines has greatly diminished. In sparsely settled regions, like Alaska, and parts of Mexico and South America, where it may still be possible to obtain large rewards for the hardships endured, the old type of prospector is still found.

Most of the writers think that there is no need for additional money, as there is an ample supply of capital now seeking investment in mining, provided that thoroughly good properties can be found and investments in mines or prospects will be protected. If further funds should be required, they would be supplied by the public, if it were impossible for fake companies and wild-cat schemes to mulct the people. The restoration of confidence in legitimate mining ventures by means of the prompt prosecution of all swindlers and 'wild-eaters' would be followed by a resumption of investment by the general public in mines and prospects or in exploration companies.

The giving of any monetary aid to prospectors by the government is unanimously condemned. It is thought that any financing or 'grubstaking' of prospectors by the government would lead to no good results, but on the contrary would produce a large class of loafers and professional parasites. The government can greatly assist the prospector, however, by increasing the activity and usefulness of the Geological Survey and the Bureau of Mines. For this purpose larger appropriations should be made for the prompt undertaking of work in new districts. The government

should attempt to do more pioneer work. A revision of the mining laws is generally demanded in order that the prospector and the buyer may not be subjected to uncertainty and annoyance with regard to his title and to constant litigation if he succeeds in finding a valuable orebody. The government should protect the prospector in his possession and development of his claims "by providing some method by which title can be safely and surely secured to undeveloped or partly developed mineral land, or land which is sufficiently promising in mineral possibilities to justify serious investigation," as Mr. Stanley Easton phrases it. Mr. J. W. Malcolmson says that "our imperfect and obsolete laws should be revised with special reference to the rights of prospectors." It is also urged by many that the government should aid the prospector by building roads, providing government assay-offices where ores could be tested at small expense, and by assisting in the provision of transportation and other facilities in new districts where orebodies of promise are being opened. Mr. Albert Burch thinks that the government should carefully prospect and classify its own mineral land. "Prospecting methods can only be improved in the United States by raising the standard of intelligence of the prospector," one engineer notes, and "this virtually means that prospecting will have to be done by trained men—mineralogists, geologists, and mining engineers—and on geological principles." "The large, prominent, rich croppings have all been found in every country that has even been partly explored, and now the search must be for concealed outcrops, hidden veins, and orebodies whose existence can only be suspected by analogy and the deductions from careful geological study," as is noted by a number. This kind of prospecting will require large sums of money, and will therefore be confined chiefly to the larger exploration and mining companies. At present the methods to be used are none too well understood and the laws are not well adapted to permitting the temporary occupation of a suitable area prior to discovery.

The demand for undeveloped mineral land will increase with the exhaustion of the present productive mines and increases in the price of metals. At the present time there would be a greater demand for undeveloped properties if the owners did not hold them at exorbitant prices, thus driving away capital which might make the properties productive. Some engineers estimate that fully 95 per cent of the owners hold their undeveloped properties at prohibitive prices. On this account a large amount of mineral land is held for years, by the performance of a little unsystematic work, without becoming productive, and the prospective investor is driven to other fields. Coöperation and a better understanding between the owners of prospects and investors willing to develop them would create a much better demand. It is rather generally felt that undeveloped mineral land is unattractive to investors because of the great feeling of distrust which has been engendered by the acquisition of such

lands by unscrupulous promoters for the exploitation of the public. The market for undeveloped lands could be greatly increased by the creation of "a stronger public sentiment against fake promotions and charlatan engineers and geologists. The postal laws can always be invoked to check this kind of fraud if people would take the trouble to go to the proper authorities with well assured facts. Fraudulent promotion has been a great deterrent to the legitimate development of the country. Of course, dishonest promoters would go out of existence if there were not so many foolish and avaricious people with money ready to put into their schemes. We cannot hope to eliminate the fools, but we could make it very hot for the promoters that use the mails," as Mr. F. Lynwood Garrison states it, and this sentiment is echoed by many.

According to most of those who discuss that phase of the subject, there is little or no danger of a metal famine for many years to come, although few mines are now being discovered to take the places of those that are being exhausted. In and around the large mining centres new orebodies are continually being opened in the extensions of the workings of the older mines as well as in new properties, and the improvements in mining, milling, and metallurgical practice are continually making available millions of tons of ore which was unprofitable heretofore. With increasing scarcity of any metal, it is thought that rising prices will so increase the potential reward that active search will bring out ample supplies.

Mining, no more than any other industry, can continue unless money goes into development. More ore must continually be found, and more ore will be found, but just where and how to spend most wisely in search of more ore, is a problem that remains unsettled, and which, we believe, is not capable of universal and sure solution. We approach the question with certain prejudices growing out of the history of the industry. It is a tradition that an orebody is a treasure trove, and, just as every man thinks that with sufficient paper and pencils, he could write a 'best seller,' so he thinks that if he really wanted to and had a pick and a comfortable camp outfit, he could find a mine. From time to time the inexpert do make discoveries, and thereby further establish the dictum that in finding mines expert knowledge is unnecessary. A few of the inexperts stay in the business long enough to become expert—and a real prospector is expert, indeed. The picturesque vagabond who depended on whisky and luck, and the new-style claim staker who depends on the printing-press and the mails, die hard. Fortunately, the well informed, really expert prospector is also far from extinct. We anticipate that our discussion department in the weeks to come will bear evidence of the fact. Equally fortunately, he has, as the letters printed show, the confidence of moneyed men quite as much as ever. There is plenty of money for sending him to any virgin territory where his methods offer a reasonable chance of success. The practical problem is to develop a new system for the

finding of lodes in the combed-over territory.

In the meantime, the mining companies are furnishing metal as fast as the market demands it, as is shown by any careful study of prices. Despite the 'increased cost of living,' which has affected mining as well as other industries, there has been no consistent or general increase in metal prices in the last quarter century; except in the case of tin, where there is an admitted shortage. The increased demand has so far been met by finding new veins in old districts, by development of extensions of known orebodies, and by lowering production costs and increasing extraction so as to convert into ore what was formerly waste rock. Presumably there will some day be an end to this. No extraction can be more than perfect, all orebodies do have limits, and there is a minimum cost below which a ton of material can not be handled, whether it be gold ore, coal, or clay.

The world is not coming to an end and people are not going to cease using metals. New deposits will be found and the open field is in the search for blind lodes. That requires skill, and money. The old prospectors as a class do not have that skill, and a new order of prospectors must be developed. It is insight, not numbers, that is needed. The geologist has some of that, but he falls far short of having all that is needed. Some time ago we suggested that the United States Geological Survey had a large responsibility and a magnificent opportunity in this connection. Our suggestion has been partly misunderstood. Mr. Albert Burch believes that the Government should prospect its own lands, and we believe that something along that line can be done to advantage, but it is much more important that the organization that has the largest fund of information and at the same time the entire confidence of mining men, should do its share in developing the new methods that we must have. Whether the Geological Survey found a mine or not, would be relatively unimportant if it pointed the way to the finding of mines. The suggestion that young technical graduates be put with old prospectors has much to commend it, as both the prospector and the graduate would learn much that would be useful; but that is a detail of administration. We heartily agree with the unanimous sentiment of our contributors that direct government aid to prospectors would but lead to waste and graft. The gradual extension of the excellent work already being done by the Geological Survey and the Bureau of Mines is more to the point and will meet the situation, but specific attention is needed to the general methods of prospecting. Occasionally Mr. J. F. Kemp lets his imagination play around to the subject of how to find minerals without sinking or drilling, and the result is a delightfully humorous essay that we all enjoy, but in sober earnest, why should we not hope for improvement along these lines, and why should not a reasonable sum be constantly expended, under proper direction, in the search? The prize is worth the effort, and the field of the unknown stretches to a far horizon.

What is the Matter With Prospecting?—IV

A SYMPOSIUM

Ralph Arnold:—I have found it true that money is no longer available in adequate amounts for finding or developing prospects. The only way that additional money can be made available is for people to organize small syndicates for carrying on preliminary developments, after which they can secure all the capital necessary if their mines show large bodies of blocked ore. It is quite easy to secure money for developing oil prospects; in fact, much easier to secure money for this than for investments in proved and developed properties. I do not believe in government aid to prospecting or prospectors, except that I believe our land laws can be modified so as to protect the prospector, which will naturally stimulate work along this line, especially prospecting for petroleum. A better market for mineral lands can be created by educating the prospectors to consider reasonable terms for their holdings when they have little absolute proof of the value of the property. Most prospectors want to sell their holdings for a cash value equal to the amount of money that probably can be taken out of the property, not on the basis of what is absolutely proved.

J. R. Finlay:—I do not believe it is true that money is no longer available for finding and developing prospects. The proof of this is, that metals are being produced at normal price, at least with such fluctuations in price as have always occurred. The decline of old-time superficial prospecting in this country is simply the inevitable decline which must come when the surface is pretty thoroughly known. No one would think of encouraging prospecting in England or in Massachusetts, because those countries are full of people. I believe that discoveries of mineral deposits in this country from now on must depend mainly upon more expensive and scientific prospecting, and will consist mainly of extensions of deposits already partly known.

A. D. Foote:—We must realize that most of the easily found deposits have been found, especially those that can be found by men ignorant of geology. To find more mines, therefore, it is necessary that men of knowledge and experience should hunt for them. When the demand is sufficient, such men will be sent out properly equipped and financed to find and work prospects up to mines. There is plenty of money available for this purpose. The greatest detriment to new mining now is the easy way by which a location may be held year after year by anyone. There are thousands of claims held by men for a nominal hundred dollars per year who want thousands for a mere hole in the ground. Gradually these holders are getting worn out and are willing to sell at a proper price, and it is here that we are going to find most of the

mines of the future. The old prospector has had his day, and the sooner he realizes it and lets up on his grip on the holes he keeps all over this country, the sooner new mines will be found. I disapprove most decidedly of government aid to prospectors.

R. C. Gemmell:—It is my belief that, at the present time, money is not available in adequate amounts for prospecting and for the development of mineral claims, but I think this is due very largely to the unsettled condition of business. With the improvement in business conditions in this country and abroad—which is bound to come sooner or later—capitalists will be anxious to get their surplus money profitably invested, and they will then take a much greater interest in mining projects. More money would be available for prospecting and for developing claims if more small syndicates or associations were formed for the purpose of handling claims, and I believe that such syndicates will be organized when business becomes better and money easier. It does not seem to me that the Government should be called upon to give financial aid to the prospectors. The Government could assist by being more liberal in its mining laws, and by giving greater protection to prospectors and locators of claims who have complied with all the laws and regulations in the location of their claims. It is possible that it might be practicable and advisable for the laws to be so modified that the government would protect the locator of claims, who has complied with all the requirements of law, against claim-jumpers and adverse litigation. I do not see how a better market for undeveloped mineral lands can be created at the present time. When times are better, perhaps some plan could be promulgated that would enlist the concerted action and support of the men who are actively engaged in the mining industry. The Eastern investor is a speculator in stocks and is not a buyer of mining claims. Any plan of this kind would, therefore, have to be developed and carried out by the mining men of the West.

Charles W. Goodale:—The impression does not seem to exist in the Butte district that money is no longer available for finding and developing prospects, but if that is true in other mining districts, I think it may be accounted for by the fact that there is a lull in mining activity generally, and that this has been brought about to a great extent by the fact that a great deal of money has been lost in Nevada and elsewhere in questionable mining schemes. As president of a development company having funds available for developing favorable prospects, I have been impressed by the fact that many owners of claims are unwilling to make agreements on a reasonable basis. They

nearly always insist upon a cash payment before work is commenced, and do not distinguish between a company having funds on hand for immediate development and the adventurer who is simply taking options upon mining claims in the hope that he may be able to interest capital in the scheme, giving him a commission for having brought the property to their notice. It is to be suspected that in some cases, at least, the owners are afraid that a little work will "spoil the best mine in the Rocky Mountains." The prospector is very apt to tell us that all his property needs is depth, but he is generally unwilling to let us determine by doing some work whether depth is the only thing needed, unless we are disposed to give him some cash for the privilege. Some of my friends here are inclined to attribute the depression in prospecting to the regulations of the Forest Service, for since the setting apart of large areas of Rocky Mountain lands for forestry reserves the prospector is subject to scrutiny by forestry agents in any work which he may do, and in many cases these agents are not competent to pass upon the question of whether the prospector has made a valid discovery or not. I do not see how government aid can be given to the prospector except in such a way as is carried out in British Columbia, where the Government is inclined to aid in the development of new country by spending money for wagon-roads and trails. I am inclined to agree with H. C. Cutler in his remarks, in your issue of November 22, 1913, when he calls attention to the fact that there is hardly any area of new country which has not already been run over by the prospector.

James W. Malcolmson:—I believe it is quite true that at present money is obtained with greater difficulty than formerly for finding and developing prospects in the United States. This is probably because the country has been already explored very carefully and the number of undiscovered mines left with ore outcropping at surface is small. The chance of easily finding a mine, or of discovering a mine at all, is very much less than in former years. Another reason, perhaps, is because in past years the speculator did not have a 'square deal,' much of the money subscribed for mining ventures having been expended improperly before reaching the mine or prospect. There is usually an increase in the amount of money invested in mine exploration following a general rise in the prices of securities on the New York Exchange and elsewhere. This is because many holders of stock are able to sell with profit and without personal effort; such persons are always inclined to gamble, in the hope of discovering or developing a new mine. Government aid should be given to prospecting and prospectors by relieving them from the unjust and costly burdens now imposed on them. Today if a prospector discovers a mine in the United States he is immediately assailed by a number of adverse claimants, a condition which is the scandal of every new mining district. Instead of receiving protection, the discoverer finds the law

used to destroy his rights and to impoverish him. Prospecting methods can only be improved in the United States by raising the standard of intelligence of the prospector. Unfortunately, however, if this be done under existing laws and legal methods, the individual will thereupon probably cease to be a prospector. The market for undeveloped mineral lands will be improved by the advance of lines of communication, such as roads or railways, by an increase in the value of the metal in the ore, a decrease in the costs of operations, or in general by anything which will enable the miner to operate undeveloped properties more profitably than before.

W. W. Mein:—Money is available to support prospecting, and prospectors are available for the work, just as long and as plentifully as results prove favorable. The only factor required to stimulate enterprise is success, and the present phase of comparative inactivity is due to lack of recent finds of great importance. The area of unknown territory is constantly decreasing. Further, when prospecting is most active, it is generally the most wasteful and poorly directed. The natural laws governing the situation lend themselves little to control by artificial measures. The practical utility of government aid to prospectors is largely a matter of historical and physiographical conditions. In a little developed, heavily timbered, and mountainous country like British Columbia, the prime function of the Government toward prospecting should be in the improvement of roads and trails, as is creditably recognized by the provincial authorities; in California, the most valuable work of the state lies in the collection and distribution of accurate knowledge, so that past experience can best be applied in the search for new occurrences; in a desert country like Arizona, where the outcrops are usually less obscured, the most direct aid to prospectors might lie in the loan of state drills, as in Western Australia and Nova Scotia. Broadly, I feel conservative in my views of governmental relations to the speculative industry of mineral exploration. Fearing the danger of faddist legislation more than the effects of undue indifference, I prefer to see official energies confined, almost exclusively, to the geological surveying, statistical and publicity work, and the fundamental duty of improving the accessibility of difficult regions.

Reno H. Sales:—It is my opinion that it is not true that money is no longer available in adequate amounts for finding and developing prospects. We all must realize that the most easily found good things have already been taken up, and therefore prospecting for hidden outcrops, blind veins, etc., has come to be a matter of much more expense than in early days. I am inclined to think that additional money can be made available only by reason of conditions under which there will be greater demands for the various metals. I believe in government aid to prospecting and prospectors to a certain extent. Canada is far in advance of us in one respect, and that is in the matter

of building wagon-roads to inaccessible properties. As far as my experience goes, the prospector in this country receives no help along these lines, until he has developed his prospect into a producing mine, and then help comes only from the county in which the mine is situated. Even then the help is so much delayed that it is of doubtful value. The conservation movement has had its bad effect on prospecting in this country, and this is especially true when it is realized that it is becoming more expensive now to find veins than it was in former years. The establishing of government assay offices, where assays could be made for the prospector at a slight expense, would be of some benefit. A good service could be rendered to the prospector, and the mining industry, by increasing the field forces of the U. S. Geological Survey.

F. F. Sharpless:—There is not so much money available today as there once was for grubstaking and the development of prospects. The reasons for this are numerous, but among them one stands out prominently, and to my mind is all important. I refer to the fact that a different condition of affairs confronts the prospector of today from that which confronted his father and grandfather. In other words, the chances of the prospector of average intelligence have grown less from year to year as the more easily prospected ground has been taken up and eliminated from his available hunting ground. We hear of few new and important finds, not so much from the lack of prospectors as from lack of important discoveries made. The backer of the prospector—that is, the local merchant, saloon-keeper, hotel proprietor, etc.—failing to reap returns as he formerly did, is growing less and less inclined to furnish the grubstake which is as necessary as the prospector himself. I doubt much if it would be possible to get up a real good old-fashioned mining boom on short notice, even with the proper settings; it would certainly require some very high-grade ore and high-grade advertising; but, if the prospector is to have his innings again, this is the most likely way in which he can secure his ample funds. People who make a business of mining have learned to stick to mining rather than to attack the prospecting business. It pays better to buy at a price something that has been developed than to pay nothing for a prospect and develop it into little or nothing. Prospecting by the larger companies has been conducted on lines too closely resembling those adopted in the handling of a mining property. The care and refinement with which the prospects have been handled have cost too much, the money set aside for that work has not gone far enough, the company has not been able to investigate as many prospects as it should, so the result has been rather discouraging. Some day this side of the mining business will be so developed, so thoroughly understood and capably handled, that money for legitimate business will not be lacking. Government aid to prospectors is practicable along certain lines, mainly through the revision of mining

laws. The Government may not be able to throw open to the prospector land that has already been deeded to another, but in the future it can draw these deeds to surface rights in such a manner that later, if the prospector cares to, he will have an opportunity to investigate what is under the surface.

W. Y. Westervelt:—To my mind there is little doubt that the number of old-time prospectors is steadily lessening. Further, it seems to me inevitable that these men will eventually disappear entirely, at least from the territory occupied by the present states, as the natural result of the disappearance of wilderness sections. The prospector is essentially a frontiersman and pioneer. His methods are adapted primarily to wild life. His search is for rich deposits but little concealed beneath the surface, and his reward must be secured, if secured at all, through a rich find which will yield large and quick returns with comparatively little capital investment. As is well known, the development of new camps in recent years has been largely due to the proving of large low-grade masses of ore by heavy expenditure in districts long known to be mineral bearing and long since passed from public to private ownership. The prospector did his part in them many years ago by noting and reporting the presence of valuable mineral. As soon as he became convinced of the unlikelihood of the presence of bonanzas, however, he either moved on to more promising fields or settled down on his claims while awaiting the opening up of his district by large capital with its all-essential transportation facilities. The prospector of the future, and I am inclined to think of today, is the development company which combines practical geological, engineering, and business skill with capital. Such companies can take the risks of extensive prospecting by sinking and boring, of technical investigations, of experimental plants, etc., necessary to establish the existence, quantity, quality, and feasibility of working large low-grade or refractory deposits.

Louis A. Wright:—I am of the opinion that there is plenty of money available for development of attractive prospects, but that the active search by financially strong companies or individuals has waned considerably during the past year. Additional money would be available immediately in any given district if a success were made of a group of claims and sufficient area not included in such a group were available for development; that is, there would be many people looking for chances in the district, provided that the promising ground was not all held by the successful corporation or individual. I most emphatically do not believe in government aid in prospecting. I personally know a good many cases in which undeveloped mineral lands would be worked if owners' prices and terms were more reasonable. It seems to me impossible to remedy this condition until prospector-owners have been further educated and brought to a better understanding of business principles.



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ARTIST'S SKETCH OF THE PLACER MINING QUADRANT
of the Proposed California Mining Exhibit
Panama-Pacific International Exposition, San Francisco 1915



California Miners and the Exposition

By CHARLES E. VAN BARNEVELD

In just one year the exposition to be held in San Francisco will open its doors to the world. Many look upon an exposition as a gigantic and expensive commercial advertising scheme. Nothing could be farther from the mark. While it has legitimate advertising possibilities from the standpoint of the exhibitor, the motif is educational; to bring together men and women from all walks of life and from all activities so that each may learn what the other is doing and how it is done. If a number of public-spirited men were to get together and ask themselves, "What can we do to promote the welfare of industrial and professional America, to show our triumphs and our shortcomings, to set a mark for progress, to promote a better understanding among the nations, among the various states, among the industries?" the answer might well be: promote an international exposition. An exposition always inspires new ideas, gives impetus to inventive genius and to powers of execution, and makes for decided progress.

What the Exposition Means

This exposition will be a record of the history of the world's progress in all the arts and industries; an inventory of the world's status at the commencement of this new trade era presaged by the Panama canal. Its exhibits, gathered from all over the world, will tell the casual observer, the student, and the thinker, by object-lessons instead of by words, what mankind is, does, and seeks to do. It will be a living picture illustrating and interpreting the cold and bare statistics which, without such interpretation, are incomprehensible and meaningless to the average mind. It is, therefore, the privilege and the duty of each industry to properly represent its activities, each industry being in turn host to all others.

What is California's mining industry going to do, on the one hand, toward making a success of the exposition, and, on the other hand, toward making the most of this opportunity to display intelligently and attractively its mineral resources to an audience drawn from the four quarters of the globe, and thereby uphold the prestige of the industry which has played so important a part in the development of the state?

The history of the opening, development, and settlement of the western United States is the history of the prospector and miner. This is especially true of California. The lure of gold, following Marshall's discovery in 1848, drew to the Pacific Coast the mighty throng of intrepid pioneers whose splendid achievement wrought the present western civilization, the climax of which is seen in the construction of the Panama canal, that great trade shortcut, which has been appropriately referred to as "the greatest

liberty ever taken with nature."

The great gold belt of California which stretches for a distance of 250 miles from Mariposa to Plumas county, is one of the most impressive mining spectacles on earth. Since 1849 this territory has created new wealth at the rate of \$2,000,000 a month. After adding over one and a half billion dollars to the purchasing power of the nation, California is still in the lead in American production. The oil industry of California is of paramount importance to the future development of the state. The great westside oil-fields, from Coalinga on the north, stretch southward in one unbroken formation to the Midway-Sunset field, a distance of nearly 150 miles. The coast fields occur in a stretch of territory covering four counties, within which are geologically connected areas of great productivity. Petroleum and its products occupy a large place in the commerce of the world; in fact, no industry surpasses the petroleum industry in magnitude and diversity of operations. Capital the world over is eagerly seeking new fields. Governments realize the advantage from both a naval and a commercial standpoint of having a dependable and readily accessible supply. California's store of petroleum is one of its richest endowments. As the premier oil producer, the world looks to this state to make such an exhibit of the industry as will mark a new epoch in its history.

Why Mining Should Exhibit

There are some who feel that in addition to altruistic and patriotic reasons for devoting time, thought, and money to an exhibit, they must have a good business reason. On the cover of the official call of the American Mining Congress, there appears this statement regarding mining: "It is the one indispensable industry; through coöperation only can its importance command recognition and the best results be accomplished." This was followed by the invitation, "Come, let us reason together." That is exactly what the exposition offers you; an opportunity to reason effectively with the public, with a select and highly influential portion of the public—the thinking public—in a way that will make a lasting impression. The mining industry of the country at large is not flourishing; it is not receiving its due share of attention. Among the basic reasons for this is public misinformation and mistrust. One of the greatest assets an industry can have is public confidence, for that means public sympathy and coöperation. We all recognize, in a general way, the importance of education; it is the greatest remedy for prejudice, superstition, and ignorance; it makes for greater all round efficiency. A well planned exposition is of incalculable value

as an educator of the public mind, and no industry is in greater need of this service today than mining. Many important questions in which the miner is vitally interested are pressing for settlement. The public is taking an increasingly active part in forcing these settlements. When not blinded by prejudice and ignorance, the public is essentially fair-minded; it only needs to be educated. You have before you now an opportunity which probably will not recur for a decade to give the public an insight into the importance, stability, and solidarity of your industry, its legitimate speculative and investment features, your need of capital, of fair treatment, of wise legislation, of public support and coöperation. Surely this is sufficient commercial incentive.

In considering this question from the standpoint of an industry which has no direct interest in stimulating the retail markets of the country, we are prone to allow the lack of apparent direct individual benefit to blind us to the decided indirect, collective benefits to be derived from the right sort of publicity. Every mining man should see in this exposition an opportunity for some broadcast sowing. The higher he has risen in his profession, the more important the enterprise he owns, directs, or is associated with, the greater will be his opportunity. To approve the sentiment that the industry should be properly represented is only the first step. While the result will be collective, the responsibility is individual, and only as the individual interests himself in the matter will we attain results.

The mining industry of California has been struggling under disadvantages, many of which could be removed by an educational campaign. The exposition offers an opportunity to those interested in copper smelting and gold dredging to show what these branches of the industry mean to the state. The smeltermen could show what they have done toward suppressing the smelter fumes, which at one time threatened to extinguish this important industry. The dredgers could show the progress they have made in re-soiling dredged areas and restoring them to the horticulturist in an improved condition after adding millions annually to the gold production, thereby stimulating every industry in the state.

The Public and the Oil Industry

The American public, on account of ignorance, has failed to interest itself sufficiently in the oil industry of California and has failed to supply the necessary capital for a proper development of this state's magnificent oil resources. It appears, however, that foreign capital fully recognizes the opportunity for investment in California fields, and there is increasing danger of our industry falling into alien hands. California should conserve this magnificent heritage to its own use; it should not have to pay tribute to foreign capital. The exposition offers the oil industry an opportunity to make a collective educational ex-

hibit which will make a lasting impression on the public mind.

Many of the states can point to a much larger mineral production than can California, but none can point to a combination of like potential value. California is the leader among this nation's gold producers, creating yearly \$20,000,000 of new capital. California is the leader in petroleum production, with roughly 40% of the American production, or about 25% of the world's production; the heaviest producer among the states by over 60%, exceeding the output of the heaviest foreign producer, Russia, by over 40% (1912). Not only does California, through its vast oil resources, command an abundance of cheap fuel which is an aid to transportation, mining, agriculture, and horticulture, and a stimulus to manufacturing industries, but the lighter California oils have a great potentiality as raw material for many lines of manufacture as yet undeveloped.

Minor Metal Production

Besides leading the world's oil production and heading the American gold production, California is credited with the entire American borax, magnesite, and chrome production. To this must be added such important products as: copper, running up into the millions and destined, on account of its wide distribution, to assume far greater importance; quicksilver, to the extent of furnishing 80% of the American production; cement to a value of \$8,000,000; and many other products making a grand total of \$91,477,385 for the year just ended. It is a notable fact that each of California's 58 counties contains mineral deposits of some description and with very few exceptions all of them produce commercially.

It would seem as though an industry of such magnificent proportions and of such wide importance should do something more than have a series of unrelated county displays. It is entirely proper for the counties to wish to make a display of their various resources, agricultural, horticultural, forestry, mineral, and oil, in the California Counties building. Each county can thus draw attention to what it has to offer the investor and the homeseeker in each line. Such an exhibit has its rightful place; it is, however, merely an exhibit of mineral resources and very far from being an industrial mining exhibit, which latter is a graphic portrayal of the mining industry, without which the mineral exhibit would be flat and unprofitable. The exhibit which impresses the public and teaches the valuable lesson is the complete exhibit which begins with undeveloped mineral resources, ends with the article sold to the retail trade of the country, and shows, in so far as possible, intermediate processes. The public must be educated regarding the importance of the mining industry. The right kind of an industrial exhibit will teach them the lesson in coöperation which they need. They do not realize the problems of the industry, its need for public support and coöp-

eration. A beautiful collection of mineral and ore specimens, or a well lighted and well arranged collection of crude and refined oils, attracts the color sense, the sense of the artistic, and very little else, unless it forms a link in the complete exhibit of the industry. The mining man who knows all about mineralogy, about ores and their occurrence, is interested in these mineralogical exhibits because he has the supplementary information needed to make the exhibit instructive. The thousands who know little or perhaps nothing about the details of mining see in it something pretty and attractive, but it does not teach them a lesson. An exhibit which does not teach a definite lesson is a waste of money and effort on the one hand, a waste of valuable space on the other.

Need of a Central Exhibit

The proper place for California's mining and oil exhibit is unquestionably the Palace of Mines and Metallurgy—in a mining atmosphere, in competition with the mining exhibits of the other states and nations. There is where the world will expect to find it, and unless it is made there, the world will not see it. Everyday life teems with illustrations of the value of coöperation and united effort in a common cause. The mining industry of the state is far greater than that of even the leading producer among the counties. Then, aside from questions of the right kind of public spirit, industrial and state pride, would it not be a good business policy to draw the world's attention to the greater? A county would unquestionably derive more individual benefit from a comprehensive, well worked out, complete state exhibit of an industry than it would derive from the same amount expended on an individual exhibit. This is merely another striking case where coöperation will bring results which cannot be secured in any other way. Furthermore, the counties need not lose their identity under this plan. There are other, more dignified, more effective ways of attracting attention to a county's position than by needless duplication of exhibits. The counties could at best make relatively small individual exhibits of minerals, ores, and oils supplemented by photographs, maps, and an occasional model. There would be an endless array of these individual exhibits and much inevitable duplication. Such exhibits are tiresome to the visitor who has heard much of California's wonderful mining history; they are disappointing to the visitors from other states, and from all over the world, who have come to see and learn something about the mining industry. Collectively, the industry can make an exhibit which will be spectacular, beautiful, instructive, and which will impress the world with the importance of the mining industry of the state and therefore with the importance of the mining and oil-producing counties. That is what the state wants, and what the counties want. Unfortunately, no funds have been provided for a state exhibit. To remedy this deficiency, I suggest that the counties unite in

financing such an exhibit out of the exposition funds which they are raising by taxation.

In the centre of the Palace of Mines and Metallurgy, under the dome, which towers to a height of 160 ft., is a space of 150 by 200 ft. The main aisles from the four entrances to the Palace converge toward this space, so that it naturally divides itself into four quadrants, each one opposite a main entrance. This is the choicest space in the building, and I would like to see placed in it a mountain having a peak of 45 to 50 ft. Each quadrant of this mountain, facing a main entrance to the building, would be finished to represent some main subdivision of the industry. One of these could represent an important oilfield reproduced in such detail as to give a comprehensive idea of California's wonderful oil industry. Another, a placer mining section to include primitive methods, a reproduction of the La Grange mine with giants throwing streams of 20 to 25 ft. in length, and at the base of the mountain a working model of a dredge showing all operations in detail. Another section could show the copper industry. The fourth side could be devoted to the representation of quartz mining. Several veins might be shown, one being prospected with the meagre equipment characteristic of prospecting work, another fully developed, producing, and fully equipped. A section of the mountain could be cut away here, and behind a plate-glass front the underground working details could be shown.

Such an exhibit would, on account of its prominent position, visible from each of the main entrances, on account of its completeness, its unique features, its very boldness, surpass anything in the building and would make California's exhibit the centre of attraction. The expense, viewed in the light of its being the exhibit of an industry which in one year produces over \$90,000,000, would be relatively small. It would have a tremendous stimulating and otherwise beneficial effect on the industry. The state's debt of acknowledgment to the pioneer miner would be complete. The miner's pride, his community pride and his industrial pride would be satisfied.

Coöperation Essential

This plan insures the best state and the best possible counties display at the least cost and under conditions where each one's exhibit reinforces and is reinforced by his neighbor's exhibit. Each county might rightfully say, "this is our mountain." The quartz counties could exhibit opposite the quartz section of the mountain; the placer mining counties opposite the placer section; Shasta county opposite the copper section; the oil-producing counties' individual exhibits would be deployed in magnificent array around the oilfields. If this plan is carried out, the mineral industry of California will present a solid front, will be the centre of attraction, and, best of all, the various natural subdivisions of the industry and the individual counties will maintain their individuality.

Electric Blasting in Shafts With Delay Action Exploders

By C. W. MORSE

Blasting with electricity in shaft-sinking is not receiving the attention it deserves. The principal reason seems to be that comparatively few mine superintendents and engineers are familiar with the delay-action exploders as perfected by the California Cap Co. The largest powder company in the United States attempted to perfect such an exploder, but was not entirely successful. Charles S. Hurter, whose article, 'Electric Blasting,' appears in your issue of November 8, was a member of the technical division of that Company at the time. Had he been familiar with the California product, I believe he would have recommended it strongly, not only in shaft-sinking, but in driving and raising in close places.

Shaft-sinking is an anxious period with most of us, and anything that will render it less dangerous is surely welcome. The delay-action exploder is something that many of us have hoped for. These exploders were used in sinking the South Jackson shaft, at Jackson, Amador county, California. The superintendent, Jeffrey Schweitzer, reports that they were most satisfactory. Jack Collier tried them later at the Sultana mine, at Grass Valley, with equally good results. The exploders are made up with an electric fuse igniter, a short length of time fuse, and a detonator, all contained in a waterproof covering. They are made in ten periods; the different periods being obtained by varying the lengths of fuse. The longest will go into the regulation stick of powder. They can be obtained with any length of wires.

In blasting in a wet shaft, current should be taken from the light circuit, as there are many sources of leakage and the ordinary blasting machine will not supply sufficient current. Two wires are brought from the light circuit to a small box which should contain fuses of lower amperage than those on the light circuit, a knife switch opening down and held open with a weight or spring, and two binding posts; an indicator lamp is convenient. This box should have a lock for which the blaster only has a key, and should be placed near the collar of the shaft or at a convenient station. Nearby is a reel for holding and playing out a No. 10 encased cable. The inside end of the cable is left protruding sufficiently to permit its being connected to the binding posts when the box is opened.

The cable reaches to within a few inches of the bottom of the shaft, and to each of its two wires a length of bare telephone wire is attached and placed horizontally across the shaft, being kept off the bottom with blocks of wood. To these wires the exploders are attached in parallel by the insulated wires with which each is supplied. In loading the holes the first delays are, of course, used in the cut holes. For most work, five periods of delay are all that are required.

When the men, including the blaster, reach the sur-

face, the blaster unlocks the box, connects the ends of the cable to the binding posts, and throws the switch. At the South Jackson, they took the additional precaution to have a break in the cable, the ends being held together during the blasting.

All miners can recall many horrible accidents that would have been avoided by the use of this method of blasting, and not only are accidents avoided, but the fumes from long lengths of burning fuse are also done away with, and the air in the shaft is rendered less foul by the round.

A Motorcycle Hoist

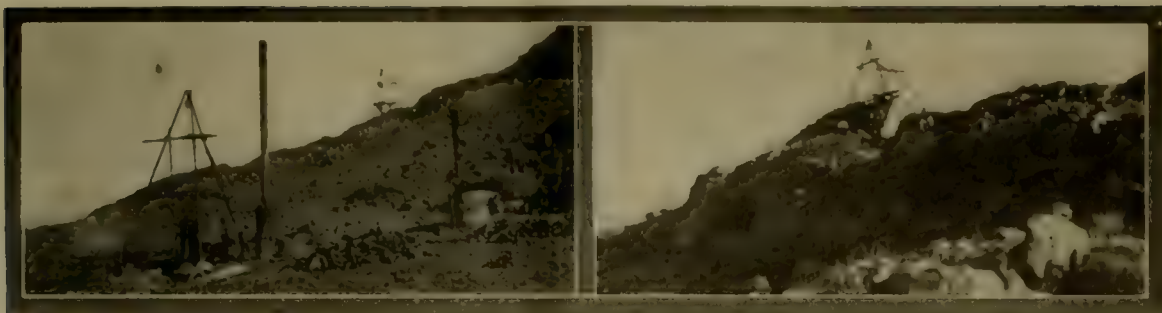
The figure with this shows a successful application of a motorcycle to hoisting ore at one of the leases on the Stratton Estate property at Cripple Creek, Colorado. The lease operator, Jerry Mackey, after riding his machine to the mine in the morning—a long uphill pull, by the way—then puts it to work at raising the ore on his lease. For this purpose, the motor-



MAKING THE MOTORCYCLE WORK.

cycle is held tightly in a wood frame, and a long chain run from the sprocket, past the front forks, to a gear-wheel on the hoist.

The hoist is of the geared type ordinarily employed on hand derricks for quarry work. The duty demanded of this outfit is hoisting a total load of about 300 lb. from a depth of 90 ft. One man can handle the engine, and dump buckets at the shaft top; and the hoisting is much more rapid than would be the case with the usual whim. Mr. Mackey has placed a powerful band brake on the drum, and for additional safety there is a ratchet dog in mesh during hoisting, which is held up during the lowering of the empty bucket. A flexible steel cable is used in preference to hemp rope.



Diamond-Drilling at Ajo, Pima County, Arizona

The recent announcement in the *Mining and Scientific Press* that the Calumet & Arizona Mining Co. had exercised its option to purchase the New Cornelia property at Ajo, Pima county, Arizona, recalls the interesting fact that this is the first of the large low-grade copper deposits to be thoroughly explored by diamond-drills. It is needless to say that the Calumet & Arizona Mining Co. had given the Ajo property a thorough examination before securing an option late in the summer of 1911. It determined to do a small amount of work at first, and laid out a plan which called for drill-holes approximately 200 ft. apart.

Although having an organization and equipment of its own, the Company asked for bids from independent contractors, on a small amount of diamond-drilling as a preliminary test. The contract was awarded to the E. J. Longyear Co., exploring engineers, of Minneapolis, Minnesota. The work, beginning in November 1911, resulted satisfactorily, and a much larger amount of drilling was decided upon. The exploration continued until June 1913, when five outfits were in operation and approximately 25,000 ft. had been drilled. The geological and engineering departments of the Calumet & Arizona company had charge of the work, and with the representatives of the E. J. Longyear company spent a large amount of time and money in determining the best method of sample recovery. The method finally adopted for collecting the sludge consisted in the use of a number of steel barrels or small tanks, which were filled in rotation from the drill, no overflow being allowed. As the sludge in the barrels settled sufficiently, the clear water was drawn off by a siphon. The residue in the barrels was then carefully collected into one barrel and again set aside to settle, after which, the clear water having been siphoned off, it was poured into tubs and taken entire to the drying racks, dried, and quartered down to the desired volume.

The core recovery was excellent, considering the nature of the rock, and composed an important part of the sample. It also afforded an opportunity not otherwise obtained for geological study of the character and occurrence of the ore. Both single and

double-tube core-barrels of the standard 1½-in. size, outside diameter, were used, and a minimum of 'grinding core' resulted. The shattered and fissured condition of the rock offered abundant opportunity for the loss of water, but the methods used for casing and cementing prevented delay on this account, as an extra outfit was always at hand, to which the crew was transferred. The crew did not continue drilling after the bit blocked, nor when the flow of water was insufficient to procure a proper sample. The diamond-drilling was checked in several instances by test shafts sunk on the drill-holes, and the results show the reliability of the drill samples.

The machinery used consisted of the E. J. Longyear Co.'s 'UG' drills and one hydraulic. The 'UG' is a light, two-cylinder, screw-feed drill of steel construction, and proved very satisfactory and convenient, and especially adapted for this work, a large proportion of the drill-holes being on the sides and tops of steep, bare, rock hills; moving from hole to hole having to be done almost entirely by hand. The work as a whole did not offer any difficulties that could not easily be overcome, although the operating conditions were somewhat complicated by the situation of the camp, necessitating a 50-mile haul from the railroad. Among other features dealt with were a very limited water-supply for drilling purposes, and excessive heat at times requiring a modification of the usual working hours. The closest and heartiest coöperation was maintained between the mining and exploring companies.

That diamond-drilling is the logical method of exploration in the Southwest, as elsewhere, is argued from the fact that the equipment is a collection of comparatively small units easy of transportation, that holes may be drilled in any desired direction and an excellent opportunity afforded for studying ore formations by inspection of the drill-core. The fact that so progressive a company as the Calumet & Arizona has used this method and found it satisfactory, and has adopted it in exploring its low-grade copper properties, suggests that the diamond-drill, under careful direction, may occupy a much larger place than it has heretofore held in the development of the West.

The Speel River Electro-Chemical Project

By W. P. LASS

The Alaska Hydro-Electro Chemical Co. contemplates the development and utilization of hydro-electric power in the vicinity of Speel river, southeastern Alaska. From the data available it is estimated that from 40,000 to 100,000 hp. that may be developed from the river and the lakes adjoining by a capital expenditure of less than \$40 per horse-power. Detailed estimates by E. P. Kennedy have already been published.* The cost of electric power at Speel river, allowing 8% interest on the investment, will not exceed \$5 per horse-power year, it is believed. Were a lower rate of interest obtainable the power costs would be decreased accordingly. This is much below any known power development in the United States and compares favorably with that of Norway.

The selling price of power at Niagara Falls varies from \$8 per horse-power year for those buying only the water rights and putting in their own machinery, to \$20 to \$25 per horse-power year for those buying the working current adapted for their particular use. In 1911 Niagara was producing 275,000 hp. of electric power. Of this total amount, 146,000 hp. was employed in the manufacturing industries attracted to Niagara Falls by reason of the cheap power. Of this 146,000 hp. so employed, 128,000 hp., or 87%, was used for electro-chemical processes. The Keokuk & Hamilton Water Power Co. has about completed the development of 200,000 hp. at the Des Moines rapids of the Mississippi river. The cheapest contemplated power in the United States is at the Dalles, on the Columbia river, where the cost is estimated at \$77 per horse-power for a 300,000 hp. development, and the cost of producing low-tension power at the station \$6.90 per horse-power year.

COST OF WATER POWER DEVELOPMENT IN NORWAY AND SWEDEN

	Hp.	Head, ft.	Cost per electric hp.
Joesefors, Sweden	1,800	26	\$70
Frykfors, Sweden	4,000	27	64
Yngerdfors, Sweden	8,250	60	38
Vanafos, Norway	75,000	86	26
Tya, Norway	73,000	3290	36

Most of the above power is used for electro-chemical purposes. One plant at Notodden is now using 60,000 electrical horse-power in the manufacture of nitric acid from the air.

Much has been said of the resources of Alaska: the rich placer deposits of the interior, the vast coal and copper deposits to the westward, the large low-grade gold deposits in the vicinity of Juneau, and the extensive timber lands in southeastern Alaska; but little has been said of the water-powers of southeastern

Alaska that are allowed to run to waste, while millions of dollars are being expended for hydro-electric developments in other countries for the manufacture of electro-chemical products.

The proposed undertaking should not fail to meet the approval of all conservationists because it is "the application of common sense to common problems for the common good." In order to successfully undertake any large electro-chemical industry it is of prime importance to have: (1) a large amount of cheap power the year around; (2) accessibility to the market, location suitable for cheap transportation of products; (3) to have accessible the various raw materials to be used; (4) in order that the concern may operate most efficiently it is necessary that the industry be large and so varied as to allow the utilization of its various by-products and thus avoid waste.

Proposed Power Development

The proposed power is the hydro-electric power generated from Long, Crater, and Tease lakes, and Speel river. The industrial plant will be situated alongside the generating plant on Speel river. This allows for a deep water harbor for handling raw materials as well as the various marketable products. From the most reliable data at present available it is thought possible to generate electric power near Speel river in units of 10,000, 20,000, or 30,000 hp. at a cost not to exceed \$5 per horse-power year. Speel river is between Ketchikan and Skagway, 35 miles southeast of Juneau. It is but 10 miles from the course of all boats sailing from Seattle to southeastern Alaska and the westward by what is known as the Inland Passage. The present freight rate to Seattle is \$2 to \$4 per ton.

It is doubtful if the electro-chemical plants of Norway or Niagara would ever be strong competitors in the Pacific Coast markets, to a plant on deep water in a sheltered harbor in southeastern Alaska, 1000 miles north of Puget Sound, a location which would permit shipments to be made from the plant by barges to Puget Sound and San Francisco, or by boat direct to any foreign port.

As regards the supply of raw materials it would be hard to find a spot more favored. The surrounding islands are densely covered with timber and contain limestone, sulphur, and many other raw materials used in the manufacture of electro-chemical products. Suitable coal could be obtained by boat from the westward or from Vancouver. Oil may be obtained at a price of \$1 per barrel. An electro-chemical industry here would stimulate prospecting among the islands along the whole coast of southeastern Alaska and would supply a market for the gold, silver, copper, lead, and zinc ores and concentrates.

*See *Western Engineering*, January 1914, and *Mining and Scientific Press*, January 24.

The Speel river project consists of several individual lakes and a river so situated as to allow the development of 10,000 or 20,000 hp. for the same low capital expenditure per horse-power as would be required for the full development. The maximum amount of power which can be generated will depend upon the run-off and precipitation, records of which are to be gathered during the next few years. The run-off and precipitation records for the year 1913 indicate the possibility of developing 100,000 hp. Were such a power development possible it would mean the establishment of a large electro-chemical and industrial plant and would furnish permanent employment to several thousand men. The scope of such an electro-chemical industry would be the manufacture of carbides from lime and coke; of sulphuric acid from pyrites; of pig iron from clinkered iron; of pulp from wood and sulphur; of nitrates from the air; of explosives from nitrates and glycerine; of zinc and lead salts; of cyanide for treatment of gold ores; of cyanamide and fertilizers; of potash, silica, and aluminum from feldspar; of potassium and fertilizers from kelp; and the treatment of zinc and lead ores by electric furnaces.

Raw Materials Available

That there is a field for a large electro-chemical industry is shown from a consideration of the raw materials to be had and the demand for these when put into a marketable shape.

One of the limestone claims located on Speel river contains 15,000 tons of calcite above tidewater. Chemical analysis of this calcite is:

	Per cent.
Calcium carbonate	98.50
Iron and aluminum	0.31
Insoluble	0.22
Water	0.80

There is an abundance of limestone containing less than 1% magnesium and iron to be had on Admiralty island. For the manufacture of calcium carbide, lime should be pure and contain not more than 1% magnesium. The cost of producing one ton of calcium carbide from the raw material may be estimated as below:

2000 lb. lime	\$ 3.00
1200 lb. coke	6.00
4600 kw-hr. at \$5 per kw-year	2.75
Electrodes	1.25
Labor and repair	10.00
Interest and depreciation	2.00
Freight to Pacific Coast ports	4.00
General expense	1.00

Total cost per ton of calcium carbide f.o.b. San Francisco or Seattle

Assuming a market value of \$40 per ton, there would be a profit of \$10 per ton of calcium carbide marketed. In practice a power consumption of one horse-power year would be required to produce 1.5 tons of carbide, yielding a profit of \$15 per horse-power year of electric power generated. A carbide works having a daily capacity of 55 tons would cost \$150,000, and would re-

quire 13,000 hp. for which it would pay \$5 per horse-power year. After paying \$65,000 for power such an industrial plant should market 19,500 tons of carbide for \$30 per ton, at which rate it would earn a yearly profit of \$195,000. Such an industrial plant would be able to meet all operating expenses, fixed charges, interest and depreciation, and in three years' time earn sufficient funds to pay for its own works as well as the original power development costs. Or, paying 8% for interest and depreciation on the power development, it would pay dividends of 100% on the industrial plant.

In 1910 seven Norwegian carbide works used 60,000 hp. and marketed 50,579 tons of carbide. In 1912, Norway produced 64,000 tons valued at \$2,500,000. In 1909, the world's production of calcium carbide was 280,000 tons.

The chief industry of any electro-chemical plant would no doubt be the manufacture of nitrogen from the atmosphere, and the various products composed of nitrogen such as calcium nitrate, calcium cyanamide, cyanide, ammonium nitrate, and nitric acid. In 1910, Chile exported 2,308,000 tons of nitrates, and Norway produced 22,000 tons of nitrates from the air. One kilowatt year will produce half a ton of nitric acid by either the Pauling or Birkeland & Eyde electric furnaces. This acid would have a market value of 3c. per pound.

The use of 10,000 kw. would require 24 Pauling furnaces and five absorption towers, making an estimated cost for the industrial plant of \$500,000. Such a plant should produce 6500 tons of nitric acid having a market value of \$400,000. The cost of producing such an amount of acid would be:

Operating and general expense	\$100,000
13,000 hp. at \$5 per hp-year	65,000
Interest and depreciation at 12%	60,000

Total cost of 6500 lb. nitric acid.....	\$225,000
Market value of 6500 lb. nitric acid.....	400,000

Profit 35%, or.....\$175,000

Powder Making

Among the supplies of greatest interest to the gold mines of the West are cyanide and powder. At the present time cyanide can be imported from London, and after paying a duty of 25% be sold in Seattle or Juneau for the same price as our home product which has to be obtained from New York. The demand for cyanide will increase as the price is lowered; for instance, if the Treadwell companies were to cyanide their tailings the expenditure for cyanide at the present rate of consumption would be \$164,000 yearly. This cyanide could be manufactured at Speel river for one-third of the above cost. With the price of cyanide reduced, treatment of low-grade ores becomes more profitable. Cyanide could be manufactured at Speel river and compete in the open market at a price much lower than the present quotations.

The mines of Douglas island purchase annually

2,000,000 lb. of blasting powder. Should the Alaska Juneau and the Alaska Gastineau companies each use a like amount this would mean 6,000,000 lb. of powder manufactured in the United States from nitrates imported from Chile, although the whole industry could be carried on within 40 miles of the mines and the powder manufactured at a smaller cost.

Acid Making

The Treadwell companies produce yearly 30,000 tons of pyrite, having the following chemical analysis—and no market value: iron, 34%; sulphur, 32%; gold, \$1.25 per ton; arsenic, none. This pyrite could be concentrated into 20,000 tons having the following chemical composition: iron, 45%; sulphur, 40%; gold, \$1.50 per ton. It could be delivered to Speel river for \$1 per ton. The cost to Treadwell companies for marketing pyrites would be:

Washing 30,000 tons, at \$0.10.....	\$ 3,000
Loading 20,000 tons at \$0.15.....	3,000
Freight to Speel river on 20,000 tons, at \$0.70.....	14,000

Total\$20,000

These concentrates could be sold by the Treadwell company for \$2 per ton, or \$0.05 per unit of sulphur, at a profit of \$20,000 per year to the Company.

By a combination of the iron-oxide contact process with the lead chambers one ton of 40% sulphur will produce 1.88 tons of 50° sulphuric acid, using a combination of fine Herreshoff burners followed by lump burners. Thus, if satisfactory arrangements could not be made with the Treadwell companies, lump pyrites could be used from known deposits on Admiralty island and at Skagway. Such a plant designed to treat 20,000 tons of pyrite yearly should produce 37,600 tons of 50° (Baumé) acid. This acid would contain 20% of sulphur.

Comparing 11c., the unit price of the sulphur on the Pacific Coast used for sulphuric acid manufacture, with 5c., the unit price of local sulphur is equivalent to \$1.20 per ton of acid when making 50° acid. This sulphuric acid from Alaska could afford to pay \$1.20 per ton freight and compete with acid manufactured in San Francisco. No doubt such a freight rate could be obtained from the oil boats which desire a return cargo and also wish sulphuric acid for their own oil refineries. There is no available farm land near Speel river to be injured by fumes. At Speel river sulphuric acid would be used for the manufacture of sodium carbonate, nitric, hydrochloric, and acetic acid.

Sulphuric acid is largely used in the manufacture of blasting powders, some powders requiring as much as 50% acid. In recent years the price of sulphuric acid on the Pacific Coast has been in excess of \$10 per ton. The cost of making 37,600 tons of 50° sulphuric acid at Speel river would be:

Raw materials	\$40,000
Labor and repairs	12,000
Interest and depreciation, \$100,000 plant at 20%.....	20,000
Total	\$72,000

or \$1.92 per ton of 50° acid at Speel river. Allowing a freight rate of \$2 and a selling price of \$10 per ton in San Francisco or Seattle, a profit of \$6.08 per ton or \$228,608 per year would be realized were the whole amount to be marketed for \$10 per ton. The sulphur would be used in the manufacture of wood pulp or combined with phosphates to make fertilizers. Sulphur is also the basis of most chemical industries.

After roasting the 20,000 tons of pyrites for the manufacture of sulphuric acid there would be left 8000 tons of clinkered iron oxide, free from arsenic and lead, containing less than 1.5% sulphur, and less than 0.12% phosphorus. This could be reduced in an electric furnace forming a pig iron that would contain 3% silica and less than 0.02% sulphur.

From the above it may be seen that any development that would deliver during the entire year electric energy to tide water for \$5 per horse-power year is a very attractive undertaking for electro-chemical and industrial purposes. According to the report on Long Lake power development by E. P. Kennedy, 13,000 hp. may be developed at a cost of \$28.36 per horse-power. Allowing 8% interest and depreciation on the plant the cost of producing electric power would be \$3.48 per horse-power year.

Possible Electro-chemical Development, with Costs

Development of Long Lake, 13,540 hp. at \$27.95, \$375,476.

The operating cost of electric plant were:

Interest and depreciation, 8% of cost.....	\$30,030
Operating labor	6,000
Supplies, etc.	4,000
General expense and taxes	6,000

Total cost of generating 13,405 hp-year.....\$46,030
Cost of generating 1 hp-year.....\$3.43

Were this power to have a market value of \$10 per horse-power year at Speel river, there would be a profit of \$6.57 per horse-power, or \$88,012, or a profit of 23% on the investment of \$375,476.

Calcium carbide factory, 50 tons daily capacity, capital cost \$300,000.

The cost of producing 16,000 tons of carbide per year would be as follows:

Interest and depreciation, 10%.....	\$ 30,000
Electric power, 10,660 hp-yr. at \$10.....	106,000
Lime, 16,000 tons at \$3.....	48,000
Coke, 9600 tons at \$9.....	86,400
Electrodes and repairs	30,000
Labor	38,000
General expense	16,000

Total cost of producing 16,000 tons.....\$355,000
Cost of producing 1 ton of carbide\$22.20
Cost of containers 4.00
Freight to Pacific Coast ports 4.00

Total\$30.00

Were it possible to sell 16,000 tons of carbide yearly on the Pacific Coast for \$40 per ton there would be a profit of \$160,000 from the carbide plant or a profit

of 54% on an investment of \$300,000. Were the power plant and carbide factory controlled by one company using all the power for manufacturing carbides, the profit would be \$248,012 or 36% on the total investment of \$675,476. Were the carbides marketed at cost, namely \$22.20 at Speel river or \$30 per ton delivered in containers at San Francisco, there would still remain a profit of \$88,012 for the power or 13% on the total investment in power plant and carbide industry. Provided there were no market for the calcium carbide, the whole amount could be converted into calcium cyanamide and from calcium cyanamide into sodium cyanide and ammonium sulphate. The cost of producing calcium cyanamide by combining calcium carbide with nitrogen would be:

Cost of nitrogen plant (including royalties to produce 15 tons of nitrogen daily by the Lande process), \$100,000.

The operating cost per year, producing 500 tons nitrogen, would be:

Interest and depreciation	\$10,000
Operating labor and repair	10,800
100 electric hp. year at \$10	1,000
General expense	5,400
Total	\$27,200
Or \$5.40 per ton of nitrogen.	

In addition to the nitrogen the above plant would produce 1200 tons of 99% oxygen. Were this utilized the cost of the nitrogen would be less.

Cost of additions to carbide plant to convert 50 tons of carbide to cyanamide daily, \$100,000.

Operating cost per year to produce 17,500 tons of calcium cyanamide:

Interest and depreciation, 10%	\$ 10,000
16,000 tons of calcium carbide at \$22.20	355,000
5000 tons of nitrogen at \$5.40	27,000
3000 electric hp. year at \$10	30,000
Labor and repairs at \$5 per ton	87,500
General expense at \$3 per ton	52,000

Total cost of 17,500 tons calcium cyanamide.....\$562,000
Or \$32.17 per ton.

The calcium cyanamide would no doubt be most profitably marketed by conversion into sodium cyanide or ammonium sulphate. Calcium cyanamide treated with superheated steam rapidly liberates all of its nitrogen in the form of ammonia. This ammonia may be absorbed in sulphuric acid, forming a pure ammonium sulphate which finds a ready market at 13c. per pound of nitrogen content when in the form of ammonium sulphate. To convert 17,500 tons of calcium cyanamide into 28,875 tons of ammonium sulphate would require 21,437.5 tons of H_2SO_4 . This acid could be manufactured for \$10 per ton at a profit. One ton of calcium cyanamide costing \$40 per ton produces 0.425 ton of ammonia which combines with 1.225 tons H_2SO_4 , costing \$12.25 to form 1.65 tons ammonium sulphate having a market value in excess of \$90. To produce 21,437.5 tons of sulphuric acid requires 7000 tons of sulphur which could be supplied from the pyrite now run

to waste at the Treadwell mines. The ammonia obtained from the carbides may be neutralized by nitric acid produced by either the Birkeland & Eyde or Paulding process and marketed at a higher price than any of the other ammonium or nitrate compounds. Such a plant would use the oxygen formed in Lande machines to enrich the air fed to the Birkeland & Eyde or the Paulding furnaces and increase the output of nitrogen. There would be calcium and carbon left after removing the ammonia from the carbide. This could be used again for the manufacture of carbides.

German Iron Ore Production

The statistics for October 1913 show a surprising advance in the German iron-ore production. Thus, according to data collected by the Association of German Iron and Steel Concerns, the production of iron ore in Germany and Luxemburg amounted to 1,650,205 tons in October, compared with 1,589,197 tons in September 1913 and 1,633,539 tons in October 1912. The daily production in October 1913 amounted to 53,232 tons against 52,973 tons in September 1913 and 52,695 tons in October 1912. The development of the total production during the past two years is shown in the following table:

	1913.	1912.
January	1,610	1,385
February	1,493	1,320
March	1,628	1,424
April	1,587	1,458
May	1,642	1,492
June	1,608	1,454
July	1,647	1,505
August	1,639	1,527
September	1,589	1,519
October	1,650	1,634
November .....	....	1,537
December .....	....	1,566
Total for year .....	....	17,853
January-October	16,094	14,749

Thus the first ten months of 1913 already showed an increased production of nearly 1,145,000 tons over the same period of the previous year. The production divided among the different classes of the iron industry is as follows, in metric tons:

	1912.	1913.
Cast iron	294,727	298,828
Bessemer	31,748	31,670
Thomas	1,062,529	1,048,318
Puddled	44,703	38,953
Miscellaneous iron and steel	199,832	232,436

Central electric light and power-stations in several states in 1912 were as follows:

State.	Number.	Generator capacity, kw.	Station output, kw-hr.
Arizona	16	14,756	32,960,084
Connecticut	44	77,655	130,672,201
Maine	79	58,757	117,092,565
New Mexico	21	7,981	9,027,824
Rhode Island	8	38,509	62,106,528
Vermont	61	29,468	56,552,977

Gyratory Versus Jaw Crushers

By C. T. HUTCHINSON

As a rock-breaker is ordinarily considered an integral part of a stamp-milling plant, the question as to the selection of a type of machine is one of the problems confronting the machinery buyer. Rock-breakers as ordinarily manufactured may be broadly classed in two types: the Blake, or oscillating jaw type; and the gyratory. The Blake breaker may be

further subdivided into two types. One advocated by some makers is constructed with sectional frames tied together with heavy steel tie rods which take the strain of crushing and are in tension; other builders advocate the solid one-piece frame in which the frame, including the two sides and the two ends, are cast in one piece. In discussing comparative

merits of the two types, it can be said for the former that there is good reason for this method of construction within certain definite limitations. Forged steel is obviously better adapted to withstand a tensile strain than cast iron, as the latter has no elasticity of any consequence and a comparatively low tensile strength per unit of area. In order to manufacture a solid-frame crusher that will render satisfactory service, it is necessary to use a large factor of safety in designing the frame. This results in a very heavy crusher which is difficult to transport and which in case of failure of the frame is very expensive to repair. On the other hand, in constructing a sectional-frame type of machine beyond certain sizes, the mechanical difficulties, in tying the end-frame sections together and keeping them tight and rigid, greatly increase.

With the gyratory type of crusher for small sizes the principal objection is the high first cost as compared to the Blake machine; and also the feed-opening, which is small in proportion to the rated tonnage.

Comparisons of first cost may best be studied by means of curves. Curve sheet No. 1 shows the cost at the factory for all three types of machines. The ordinates represent the area of the feed-opening in square inches and the abscissae represent dollars in first cost at the factory. In studying these curves it will be noted that the gyratory crusher is by far the cheaper in sizes down to the No. 3 machine, which had feed openings 8 by 30 in. and the combined openings 8 by 60 in. The builder's rating for this machine is from 10 to 20 tons per hour, and it is conceded that as far as first cost is concerned the gyratory breaker cannot compete with the Blake below this size. A further reference to sheet No. 1 will show the curve of the solid-frame Blake type machine crossing that of the sectional-frame machine

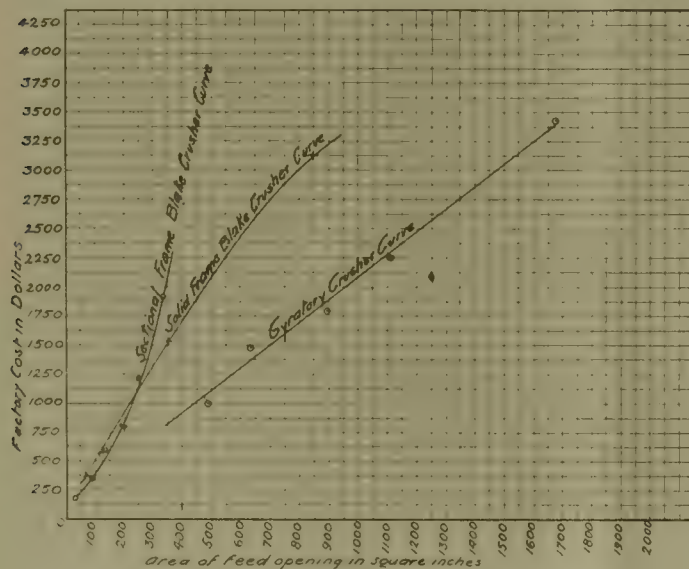


FIG. 1.

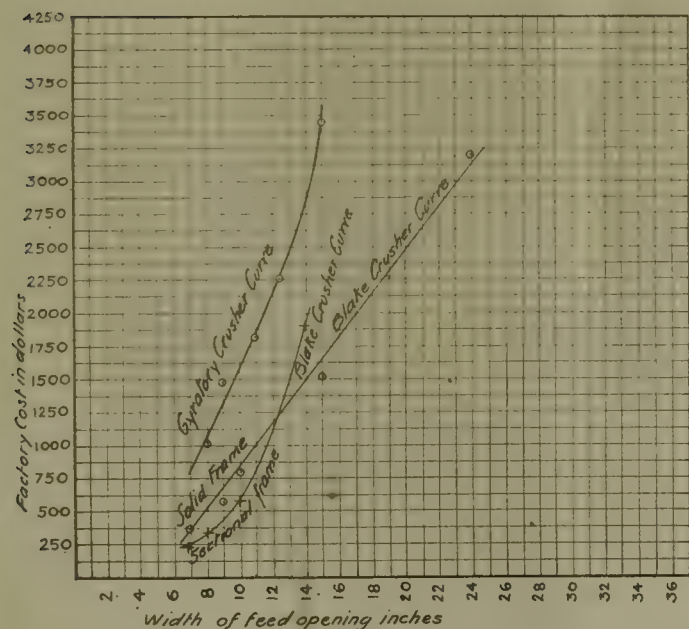


FIG. 2.

at a point that would indicate that, as far as this basis of comparison is concerned, the sectional-frame machine is cheaper in first cost in sizes of about 10 by 16 and smaller. Beyond that point, however, the advantage apparently lies with the solid-frame machine. It is admitted that the most satisfactory basis for comparison would be that of the actual tonnage output, but as this varies so widely in different localities, and as it is obviously most difficult to obtain examples where all three types of machine may be crushing the same rock under exactly the same conditions, this basis of comparison is out of the question. The manufacturer's ratings also vary within wide limits, the difference between the maximum and the minimum given in trade catalogues being in many instances as much as 100%. A comparison by means of the area of the feed-opening is also misleading as giving an advantage to the gyratory to which, in view of the true function of a rock-breaker, it is not entitled.

The object of installing a rock-breaker is to avoid doing by hand what can be done better and more cheaply by machinery, regardless of the theoretical capacity of a breaker which cannot crush a rock that is too large to permit of its entering the feed-opening. For instance, a No. 3 gyratory, as mentioned above, has two feed-openings, each of 8 by 30 in., and is rated at from ten to twenty tons per hour. The area of the feed-opening, therefore, is 240 sq. in. To obtain an equivalent area of feed-opening in the Blake type machine requires one with an opening 12 by 20 in. The manufacturer's rating for this size machine is given at 15 tons per hour. On the other hand, a piece of rock larger than an 8-in. cube would not be taken in a No. 3 gyratory, while the equivalent-by-area Blake machine would take a rock up to 12-in. cubes, or 50% greater than the gyratory. Using the basis of the width of the feed-opening as a means of comparison, the 12 by 20 Blake crusher rated at fifteen tons per hour would be the equivalent of the No. 6 gyratory, which has a combined dimension of feed opening of $12\frac{1}{2}$ by 90 in., a total of 1125 sq. in. The latter machine is rated at from 50 to 80 tons per hour. While there is no doubt that the latter machine would have a capacity within the manufacturer's rating limit on any ordinary rock, it cannot be denied, on the other hand, that if the run of ore from the mine contains any appreciable amount of ore larger than 12-in. cubes, an investment in a machine of this type would not be a wise one.

Curve sheet No. 2 compares the factory cost of the three types of machine as in curve sheet No. 1, except that the ordinates represent the width of feed-opening in inches instead of area of feed-opening. On this basis of comparison, the situation becomes changed, and the gyratory machine will be seen to be the most expensive. The solid-frame Blake crusher curve crosses that of the sectional-frame Blake machine at the 12 by 20 size, thus indicating that below this the 12 by 20 sectional-frame Blake is cheaper, and

above this the solid frame machine has the advantage.

Reduced to the final analysis, the entire question of the selection of a crusher is an economic one, and the true basis of comparison is one of operating rather than first cost. While exact figures are not available in order that a curve may be plotted depicting the comparative merits of all the types of machine on this basis, it is the consensus of opinion of experienced operators that replacements and renewals may be more easily and more cheaply accomplished with the Blake than with the gyratory. The principal factor influencing the selection of the latter for the great majority of crushing plants having capacity in excess of twenty tons per hour lies in the lower first cost, and the fact that the average run-of-mine rock is of such a size that the greater percentage of it may be taken into a crusher feed-opening 8 in. wide and larger.

It is argued that the expense of an attendant for the crusher is inevitable under any circumstances, and that he will have ample time to break by sledging such pieces of ore as may be too large to be fed directly into the crusher-opening.

The work of plastering Recreation hall, at Lead, is nearly completed, and it is now but a question of a few months when the magnificent structure will be dedicated to the purposes for which it is intended, namely, a clubhouse for Homestake employees. In the building will be installed, in commodious quarters, the Hearst library, a donation of Mrs. Phoebe A. Hearst, which has long been an institution of Lead. The board of directors of the Aid Fund have announced that, beginning with January 1, death benefits will be \$1000 for accidental death and \$800 for death from illness, an increase of \$200 in each case over the amounts which have been paid since the fund was established some three or four years ago. The cash resources of the fund have been constantly growing, and it appears that the increased amount can easily be met from present revenues without embarrassing the fund or levying special assessments. Under the plan of operation of the fund, each employee contributes \$1 per month and the Homestake company not less than \$1000 per month. For all time lost from work, the fund pays the employee \$1 per day, whether he is sick or injured.

The dredging of placer tin in the York district, in the western part of the Seward Peninsula, Alaska, was continued during 1913. Work was also carried on at the lode tin mine on Lost river, in the same district. A small concentrating mill was erected there and some concentrate was shipped. It is reported that there was considerable prospecting for lode tin at Ear mountain, in the north-central part of the peninsula. A little placer tin has been mined which occurs with the auriferous gravels of the Hot Springs district. It is reported that in 1913 lode tin was found in this region, according to Alfred H. Brooks, of the U. S. Geological Survey.

Gold and Silver Movements in 1913

Although the past year was a highly prosperous one for trade, it was memorable for a combination of circumstances which cast a gloom on markets generally. These include the revolutions in China and Mexico, war in the Balkans, and uncertainty as to the military movements of European powers. Prudence demanded the careful handling of monetary resources, resulting in an unusually high rate for money during the second half of 1913, and a consequent decrease in speculative activity. Nevertheless, the effect of these factors on gold, the basis of international finance, cannot be said to have been very apparent, for with the exception of considerable exports from the United States, in order to pay for securities returned from Europe, no remarkable movements of gold took place as a result of the widespread unrest.

Gold

The gold output of the world was probably £98,000,000 in the past year, a decrease compared with the previous term. A new source of gold supplies is likely to be found in British Guiana. Future prospects of Poreupine, Ontario, are good.

In 1912, India absorbed £27,600,000 in gold, but the net imports in 1913 were only £18,000,000. The Indian people are now disposed to invest in local securities, and a large coinage of new silver rupees was made, and a readjustment of government balances resulted in the decreased gold supplies. The report of the Royal Commission on Indian currency and finance is awaited with interest, as recommendations may be made bearing on the relation between silver and gold in the currency of the country and on the adaptation of the present currency system to the habits of the people, who have lately shown a greater desire for gold. Reserves of gold held by the Indian government are £25,642,000, against £24,820,000, and £13,260,000 at the end of the last three years.

The great state banks of Europe held gold as follows at the close of the last two years:

	1913.	1912.
Great Britain	£33,874,535	£29,294,455
Austria-Hungary	51,666,000	50,380,000
Belgium	9,960,000	8,559,000
†Denmark	4,260,000	4,305,000
France	140,696,000	128,293,000
Germany	59,887,000	38,504,000
Holland	12,624,000	13,390,000
†Italy	48,585,000	46,019,000
Norway	2,657,000	2,353,000
Russia	168,355,000	155,841,000
Spain	19,168,000	17,485,000
Sweden	5,672,000	5,563,000
Switzerland	6,813,000	7,092,000

†It is possible that the figures set against these two banks include a small portion of silver.

[The United States Treasury holds about £260,000,000, while the United States national banks have about £31,000,000 in gold. Australian, including the Commonwealth government reserve, and New Zealand banks hold about £30,000,000.—EDITOR.]

Bar gold maintained the steady price of 77s. 9d. (\$18.66) per ounce.

Germany absorbed a good deal of gold in March, May, June, and September, while Russia was a buyer in October and November. Imports of bar gold to Great Britain in 1913 were £47,137,000 from Africa, India, Australasia, South and Central America, and other smaller countries. Exports totaled £25,477,000 to India, European countries, and £600,000, included in the total, to the United States.

English sovereigns continued to be coined in large numbers. In 1912 the issue in England was 30,248,742; Australia mints, 8,974,401; and Canada, 515; a total of 39,223,658. Only a small proportion remains in Great Britain, the bulk going to India, the British Empire, and foreign countries. The circulation of the English sovereign is extending to most countries, including India, Egypt, Turkey, South American republics, and even the Bank of France makes special efforts to keep a large stock of them in its vaults. The coin has become a handy form of international remittance. The imports and exports of sovereigns in 1913 was £11,947,000 and £19,740,000, respectively. Sovereigns held in the reserves of the Indian note currency at the end of the last year were £21,100,000, against £24,570,000 at the previous period. Owing to the higher rates for money in Europe, there was a falling off in the net export of sovereigns to South and Central America. The low price of coffee and rubber in Brazil had a deterrent effect. Light-weight coins valued at £453,025.5 were sent from India to England. The sweating of gold coins to the lowest weight accepted by the Bank of England is still being illicitly done. Imports and exports of foreign gold coin were £294,000 and £869,000, respectively. A noteworthy feature of the year was the gold exported from New York to France and South America, the net exports from January 1 to December 13, 1913, being £9,000,000.

Silver

During the year 1913, prices were dominated by the operations of the Indian government. Its acquirement of over £6,000,000 in 1912 had imparted strength to the market, which was continued into January 1913 by a further purchase of £1,000,000. Prices on January 7 were the highest for the year, being 29¾d. (\$0.59) per ounce. On account of disappointment in negotiating the Chinese government loan, prices fell away in February. Near the end of that month, a 'squeeze' for delivery in Bombay was manipulated by the Indian Specie Bank, during which operators

caught 'short' were mulcted 7% or 2d. (4c.) on the London price. 'Bear' sales depressed the market in March, forcing almost the lowest figure for the year, 26 $\frac{1}{16}$ d. (\$0.52). From this point a steady recovery set in, owing to better news from the Balkans, and the hopeful negotiations of the five powers with the Chinese loan. This was floated on May 22, and silver had advanced a fortnight previous to this transaction to 28 $\frac{3}{16}$ d. (\$0.56). The loan was followed by a dull market, and prices sagged. Supplies were scanty, and a more or less constant demand arose from China in July, improving matters. During the next three months, the Indian government's transactions were felt, there being about £4,500,000 of silver purchased.

The Banks and the Government

Owing to steady withdrawal of all supplies over ordinary market demands, the cash price went to 28 $\frac{1}{16}$ d. (\$0.57) on September 22. From this date the tendency of prices was downward, and it became evident that trouble was in sight. The Indian Specie Bank had been able to dispose of part of its colossal holding to the Indian government on very favorable terms. The Bank was doubtless more unable than unwilling to sell more before it became too late. Heavy 'bear' sales hastened a fall in prices, and on November 29 the Bank failed. A short account of events leading up to the crisis is of interest: In 1910, Chunilal Saraya, managing director of the Bank, without much difficulty, obtained control of the silver market in India. The time seemed favorable, owing to the likelihood of the Indian government purchases. But having made over-purchases in 1907, the Government delayed taking the step counted on by the speculators. This resulted in the Bank being obliged to acquire more silver to maintain the price of its stock. Gradually the bank's operations became a monopoly in India and London, where the bulk of the stock had to be financed. Then came a duel between the Indian government and the Indian Specie Bank, in which the former was able to acquire silver worth £6,000,000 in 1912, but not from the speculators at the prices they anticipated getting. The Bank was under a big strain, and had to pay as high as 8 $\frac{1}{2}$ % interest. Clever attempts were made by the Bank to recoup itself, but without much avail. A heavy bear movement from India set in, prices sagged away, and the Bank could not fulfill its engagements in London. The sudden death of Mr. Saraya completed the debacle and the Indian Specie Bank closed its doors. Prices fell to 25 $\frac{1}{16}$ d. (\$0.52) on December 1, 1913, the lowest quotation for the year. A strong syndicate, headed by the Hongkong and Shanghai Banking Corporation, and the Chartered Bank of India, Australia, and China, well known in the East, took over the unrealized stock of the defunct Bank. This was followed by a marked improvement in the tone of the silver market.

Stocks at the close of 1913 were as follows: at sea,

2,000,000; Bombay, 1,320,000; London, 15,800,000; and Shanghai, 52,960,000 oz. (including 50,300,000 in sycee or small bars), a total of 72,080,000 ounces.

Imports of silver to England in 1913 were 114,800,000 oz., including 88,300,000 from the United States and Mexico, and 19,600,000 oz. from Canada. Exports were 117,000,000 oz., including 78,000,000 oz. to India, 14,700,000 oz. to Germany, and 6,000,000 oz. to China. The net imports to India on private account were 35,052,341 oz., and 255,814,141 oz. since 1908. Vast sums of money are lying scattered in individual hoards in India, which should be gathered into properly conducted native institutions.

The internal affairs of China, a great silver-consuming country, are full of interest to people connected with silver. When the republic was established in February 1913 it was thought that there would be a wave of prosperity, but due to several movements, the contrary was the case. Instead of silver being freely absorbed by China, the tendency has been for it to move from the interior to the treaty ports. Sycee and big bars in Shanghai, in October 1913, were worth £6,405,000. Imports of silver to Hongkong and Tonkin were £443,650 in 1913. Since the institution of the Chinese Republic, large quantities of notes have been circulated in the country, thereby adding to the currency difficulties.

The Future of Silver

Regarding the future of silver, Samuel Montagu & Co. state that, although industrial consumption must ultimately absorb all surplus silver, prices are unlikely to give way much for that reason. A slight rise in price is not likely, however, to reduce the amount used in the arts, but this means a great deal to the mining industry. The support given to silver on account of Chinese loans has hitherto been fitful and temporary. It is unlikely that China will be a predominant factor in the silver market of 1914. The demand by India, apart from coinage, shows no sign of diminution. The industrial consumption will decrease very little, if at all. The probability of India requiring silver for coinage depends entirely on the monsoon of 1914, and if the harvests are good, the demand will be from £4,000,000 to £5,000,000.

Germany and other European countries will continue to absorb the metal. Mexico will probably use a large quantity for coinage, as was done in 1913. The Mexican silver output in 1914 may be further checked, while Canada will show little, if any, improvement. Mining in the United States of America is on a very sound basis, and the better price level of late has encouraged the mining of lower-grade ores, yet there is no likelihood of an important increase in the current year's silver production. In conclusion, the demand as a whole for 1914 is likely to be good, especially as a large Indian bear is still in existence. Production has little chance of increasing, and the world's apparent stock is considerably reduced.

Discussion

Readers of the MINING AND SCIENTIFIC PRESS are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment. Insertion of any contribution is determined by its probable interest to the readers of this journal.

The Rand Banket

The Editor:

Sir—To one who has followed the discussions as to the genesis of the gold deposits of the Rand Banket only incidentally to the general study of the problems of ore deposits, C. B. Horwood's articles have a satisfying completeness and their conclusions can be readily accepted on the weight of the detailed evidence so capably assembled. To establish so definitely in the case of the Banket deposits the actual relation in origin of the gold and associated minerals and the dikes which apparently are a comparatively minor feature of the accompanying rock formation, suggests certain interesting analogies and comparisons and may lead to light on the ultimate origin of some of the other 'unique' ore deposits of the world. The Canadian geologists have worked out a similar relation in the explanation of the origin of the silver veins of the Cobalt district of Ontario. These veins occur mainly in a conglomerate (Huronian) and in an inert metamorphic rock (Keewatin). Their origin is now attributed to the direct influence of a diabase 'sill' which was intruded into this formation and furnished the 'mineralizer' for the cracks and fissures in the other rocks.

The same cause is apparently the explanation of the genesis of the rich gold veins in the conglomerate at Kirkland Lake, Ontario. These veins all seem to have a connection in origin with the nearby dikes and masses of syenite, which in this case have a relation similar to the dikes of the Rand Banket and to the sill at Cobalt. The copper in the conglomerate at the Calumet & Hecla mine in Michigan obviously has its origin in the associated eruptive flows, similar to allied deposits in the porous amygdaloidal flows of the same district. At Las Vegas, east of Chihuahua, in Mexico, is a deposit of copper sulphide ore in a tilted sandstone interbedded between slate walls. The genesis of this 'unique' deposit, too, can best be explained by the acceptance of the 'mineralizing' effect of an underlying later eruptive formation. Likewise the real origin of the so-called 'limestone' ore deposits of the Mexican plateau and of southwestern United States is in most cases to be found in the effects of the intrusive rocks invariably accompanying them more or less near. The Silver Reef mine in Utah (silver ore in sandstone) is 'unique' not in origin but only in the locus of the minerals in a sedimentary formation, for the close relationship of the eruptive rocks is here again obvious.

These instances and Mr. Horwood's final solution of

the Banket enigma suggests that perhaps we should not rest with the present accepted origin of some of the other metalliferous deposits. Perhaps the lead and zinc deposits of Missouri and of northern Arkansas may have had their real origin in some deep lying eruptive masses related to the Ozark uplift feature of that region. It is not so easy to suggest the application of the idea to the Wisconsin zinc and lead deposits, but it is conceivable that these, too, had their first origin in deep buried eruptive rocks and that they have wandered through the porous sandstone beds to their present 'habitat' in the limestone formations. May not the real origin of most of the metalliferous ores have been in connection with eruptive manifestations and their present status be due chiefly to the accidental and real influence of the physical and chemical characters of the rocks in which they have finally found a more or less permanent abiding place?

KIRBY THOMAS.

New York, January 5.

Theory and Practice of Crushing

The Editor:

Sir—In your editorial notes of December 13, under the head of 'Tube-Mill,' referring to the different opinions advanced relative to its practical action, you mention that "theoretical knowledge alone is not sufficient." In this you recall a fact which has recently and forcibly come to my attention in the form of an article in the *Transactions* of the American Institute of Mining Engineers, by Arthur O. Gates, of Lafayette, Indiana, in which he criticizes the inclination of the cones of the Hardinge mill and gives, according to his idea, 'correct' diagrams based upon theories which he probably obtained from text-books. My own paper, read at the February 1913 meeting of the Institute, is the basis for his criticisms. I feel positive that Mr. Gates' theories would be greatly modified could he have the opportunity of practical study and observation of a pebble mill of the Hardinge type, but in order to do this successfully he would doubtless follow my example and discard his textbook and drawing board and resort to overalls, shovel, and screens before deciding as to the line on which the mill should be constructed.

That theoretical knowledge alone is not sufficient, was the basis for the inclination of the cones which form the Hardinge mill, for, as I state in the above mentioned paper, "practice was evolved from practice and not from theory," as the latter did not conform to the former. It is one thing to theorize with the known density of an atmosphere or the gravity of a liquid, and entirely another thing to practice with absolutely unknown qualities, when it will be found that theory and practice not only clash, but often annul expected results. In one case the basis for the theory is a known condition, but these known conditions do not exist in a swirling mass of pebbles of different diameters (consequently surface frictions) operating at different dis-

tances from the periphery in a medium of sand, slime, and water, having densities of vastly varying viscosity. It would be equivalent to an artillerist basing his calculations for a projectile upon the specific gravity of the lead or steel. Certainly even the layman in physics would not expect an ounce of lead in the form of bird shot to be projected the same distance as would an ounce of lead in a bullet, even though the motive force was the same amount of powder. This comparison is not strained, in view of the fact that both cases are dealing with projectiles. The main basis of the results much be considered from a frictional standpoint. We would ask the theorist how much resistance is set up by a 3-in., 2-in., or 1-in. pebble when projected through an unknown quality of frictional interference, and owing to this frictional resistance how far will a given sized pebble be projected by centrifugal force when the pebble is retarded by constantly varying resistances?

The answers would be as various as the problems involved in a pebble mill.

II. W. HARDINGE.

New York, December 29, 1913.

Natomas Consolidated

The Editor:

Sir—Your journal of December 6, 1913, has come to hand, and I notice in your editorial remarks, when discussing Natomas Consolidated of California, that you lapse into an error when you state that the estimate of yield "was made, it is to be noted, not by engineers of the staff, but by a consulting engineer chosen by the London bondholders. It is also fair to recall that the money furnished to the Company was \$2,000,000 less than E. J. de Sabla asked."

It is with reluctance that I take note of your remarks, for when a company is in financial straits, it is not a good time to ventilate private grievances, and the least said, the better it is for the Company, particularly when those who have asked to furnish new money know the facts in question: but I must state that you are in error in both your statements and that your London correspondent has misled you.

Mr. Griffin, the president, frankly summarized for the bondholders the causes which have led to the present financial embarrassment, namely, that the gold dredging fleet was not completed until two years after it was due under the original schedule, and that the burning of one dredge and sinking of three others in addition, curtailed the gold earnings. He further stated that the gold recovery was about 15% less on the gross gold, or about 27% on the net, than the bore-holes indicated; that the cost of the dredges exceeded the estimates by about \$800,000, and that more lands were acquired than was originally contemplated, and that, in consequence of all, the present shortage of money resulted.

At the time of the flotation of the 5,000,000 bonds in London, my report on Natomas was published and accompanied the prospectus. As I never made any

estimate of cost of dredges or plant, the excess of cost cannot be laid at my door. It is a matter between the Company engineers and the Bucyrus Co., or Yuba Construction Co. The loss of money through completion of the dredging fleet two years behind the original scheduled time, if blame is to be attached to it, falls on California, London having repeatedly pointed out by correspondence the inevitable consequence which would follow the delay. Regarding the 15% shortage in gross gold recoveries from what the bore-holes indicated, I point out that I checked the report made by the general manager of the Company, and that I stated in my published report that I based my valuation on the average results of the individual values of 1274 drill-holes and test pits, as inscribed on the Company's map.

I stated in the computation of the average values, that I found the Company estimate \$418,000 too large, which I considered a permissible error in so large a gross value as \$28,814,000, which was the Company's estimate, in round numbers, for Natomas Development Co. and Folsom ground. Immediately after this, I added the following sentence, which I copy literally from my report: "The writer wishes to emphasize that, according to the statement of the general manager, Newton Cleaveland, the values of the different bore tests, which are marked on the Company's map, are the original values calculated, reduced by 15%, in order to make them representative of actual extraction. The different test bores are marked on the larger map in places where drilling or shaft sinking took place." My valuation of the Folsom and Natomas ground is conditioned distinctly by the qualification quoted.

As dredging proceeded over a longer period, I was enabled to collect data to check this statement. I then wrote Mr. Griffin that extraction results did not bear out above quoted statement, and I added the extraction results up till then. Mr. Griffin took immediate steps to satisfy himself as to the correctness of my assertion, and from his statement quoted to begin with, it is seen that he admits what I pointed out to him.

CHARLES M. ROLKER.

London, England, December 23, 1913.

A Premature Announcement

The Editor:

Sir—I have noticed frequently of late paragraphs in the newspapers to the effect that I was to take the management of the West Eureka mine (a prospect) at Sutter Creek, in Amador county. This is an error, and such publication was made without my knowledge. Moreover, I have no present intention of going to the West Eureka, though I have done some geological and other work for that concern. The object of causing the above-mentioned statement to be published, I can only surmise.

W. H. STORMS.

Berkeley, California, January 21.

Concentrates

Most of these are in reply to questions received by mail. Our readers are invited to ask questions and give information dealing with the practice of mining, milling and smelting.

Back-gear electric motors of 25 hp. have been installed in the mills of the Homestake company, South Dakota, each driving 10 stamps.

Oregon pine has been largely used for timbering in Broken Hill mines, Australia; but of late there has been a tendency to use an increasing quantity of Australian hardwoods.

The Cathed Gold Mines Co., working near Ararat, Victoria, mined 2790 fathoms of 'wash' during the past half-year, yielding gold worth \$77,000. At one point the profitable gravel is 250 ft. wide. Dividends totaled \$7500. To date the Company has treated 24,226 fathoms, yielding \$893,000, of which \$264,000 was paid in dividends.

Labor conditions in the Joplin district, Missouri, are exceptional, and the work accomplished per man is very high. Miners work 8 hours, and millmen 10 hours, and wages average \$2.72 and \$2.70 per day, respectively. At 57 mines, 2877 men average 5.77 tons per man per day, including all departments, at a cost of 46.8c. per ton mined.

Lightning arresters on the Great Falls smelter stack, Montana, consist of 16 one-inch round copper rods, lead coated for protection against acid, and tipped with platinum points $1\frac{1}{4}$ in. high. The rods are all connected to a copper cable which encircles the chimney a few feet below the top. From this cable, two $\frac{5}{8}$ -in. copper cables lead to the ground on opposite sides of the chimney. The lower end of each cable is fastened to a copper plate about 6 sq. ft. in area, which is buried several feet under ground, and some distance from the foundation, where moisture is usually present. The stack is 506 ft. high, and 50 ft. in diameter at the top.

Diesel engines are gradually being introduced, and there are increases in installations for every purpose. They are internal-combustion engines, and will operate on oil as heavy as 14°B., with an asphalt or paraffin base, like that from California and Borneo respectively. A recent visitor to San Francisco was the cargo boat *Siam*, of about 9000 tons net register, propelled by Diesel engines. The two screws are driven by two sets of engines of 1600 hp. each. These have 8 cylinders each, 590-mm. diameter and 800-mm. stroke (23.23 and 31.49 in. respectively). The propeller shafts run at 125 r.p.m. The engines are started by compressed air at 20 atmospheres (300 lb. pressure), generated by another Diesel engine and compressor. The compression in the cylinders during

working is 35 atmospheres (525 lb.), and a temperature of 1000°F. is generated. This heat is sufficient to burn the oil fed into the cylinders at 60 atmospheres (900 lb.), no sparking being necessary as in other gas-engines. Oil from Borneo was used on the vessel's trip to San Francisco, but a supply of California oil was taken on before leaving. Oil consumption for the two engines and an auxiliary was about



SHOWING LAY SHAFT OF ONE DIESEL ENGINE ON THE 'SIAM.' THIS SHAFT CARRIES CAMS FOR WORKING VALVE RODS FOR THE CYLINDERS, FOUR RODS TO EACH. THE CAMS ARE FOR MOVING AHEAD OR ASTERN.

20 tons per day, which equals nearly 0.5 lb. per horsepower hour. The fuel cost is 2c. per horsepower day. Exhaust from the main engines is through two 6-in. pipes alongside of one of the masts. Oil storage is 1174 tons, and the steaming radius is $58\frac{1}{2}$ days without replenishing the tanks. Power and light throughout is generated by a 250-hp. Diesel engine coupled direct to a 150-kw. generator, working at 170 r.p.m. A similar engine is used as a standby. The space usually occupied by boilers and coal bunkers in steamers is devoted to cargo on the *Siam*, there being an increase of 15 to 20% in carrying capacity. There are 12 electric winches for hoisting material in and out of the 6 holds. At the Panama-Pacific International Exposition, to be held at San Francisco in 1915, more than 12 large firms have contracted for space in which to install engines constructed on the Diesel principle, in the Palace of Machinery. They will be seen in operation connected to other machinery.

Special Correspondence

JOHANNESBURG, TRANSVAAL

DECREASE OF GOLD IN RAND ORES WITH DEPTH.

A good deal of discussion has been caused in local mining circles by H. H. Webb's report to the Consolidated Gold Fields of South Africa on selective mining; but the admission by the same authority that, so far as the mines of that group were concerned, the average gold content of the ore developed has been decreasing as greater depth was attained, has, although generally recognized, caused no little surprise to be expressed. A short time ago the directors of the Consolidated Gold Fields were highly indignant when one of their engineers made a similar general statement about the Rand, and immediately called upon him to resign, not because the statement was not generally known to be correct, but probably because it was made without first obtaining the usual official permission. There is probably not a single mining group on the Rand which has not suffered considerable disappointment and loss through this decrease of gold content in depth, but none more so, perhaps, than the Consolidated Gold Fields of South Africa, whose misfortune it was to own and control an extensive area in the Germiston district, where even at the outcrop the gold content was below the average of the Rand. Twenty years ago the Simmer & Jack property was recognized as low grade when compared with the Central Rand, and was the first property on the Rand, after its control passed into the hands of the Consolidated Gold Fields, to adopt the big-mill policy which enabled the Simmer & Jack to frequently head the list of gold producers. It was about this time that the value of the deep-level ground began to be recognized. A large area of Germiston ground came within the sphere of influence of the Gold Fields group, and nothing was more natural than that it should fall into its control. That the gold content would decline with depth was not at that time foreseen, because the oxidized zone had not in all cases been passed; but not only has the gold content decreased with depth in this particular area, as in most cases on the Rand, but it has been troubled with more than the usual number of faults and dikes. Still, the Gold Fields, undismayed, continued to open and develop these poor areas, and when the working capital provided proved unequal to the task, the group did not hesitate to raise and guarantee additional debenture capital to complete the development and equipment of these areas. It is doubtful whether any other mining group on the Rand would have displayed the same pluck or gone about the work in such a confident and workmanlike manner; but in those days capital for Rand ventures was easily obtained, and the results should not be judged from today's mining and market conditions. In those days, nothing less than \$10 ore was regarded as profitable, but today the deep-level areas of the Simmer & Jack have made small working profits on ore assaying much less than \$5 per ton. This achievement has not been obtained without the expenditure of considerable working capital in equipment, and perhaps the Simmer Deep will favorably compare in this respect with many better known and more showy mining equipments on the Rand. It is not generally recognized that in these poor deep-level areas, controlled by the Consolidated Gold Fields of South Africa in the neighborhood of Germiston, the working costs compare most favorably with the cheapest worked mines on the Rand. If the Simmer Deep is taken as an example, it must not be forgotten that normal development costs have to be included, while with many of the cheaper worked mines they are either fully developed or the cost of development amounts to a mere trifle per ton. That the Simmer Deep does not earn more than £3000 per month is not due to the higher

cost of deep mining on the Rand, but to the lower gold content of the ore when compared with its richer and outcrop neighbors. Low as the working costs of the Simmer Deep are, the controlling group hopes still to bring them lower by enlarging the scale of working, while the technical advisers express the opinion that working costs will ultimately come down to such a reduced level as will enable these poor deep-levels of the Rand to be worked at a satisfactory profit. Coming from such a quarter as the engineers of the Consolidated Gold Fields, whose experience in working and equipping poor areas on the Rand is unique, such an expression of opinion is valuable, as is also that of the decline of gold content with depth; but the time seems far distant on the Rand when it will be possible to mine and treat \$4 ore from a vertical depth of over 4000 feet.

MAGALIA, CALIFORNIA

DRIFT MINING IN BUTTE COUNTY.—THE ROYAL, STEIFER, DOUBLE EAGLE, INDIAN SPRINGS, SMITH, EMMA, KIRBY, AND MINERAL SLIDE MINES.—SUGGESTIONS FOR FUTURE WORK.

The heavy storms of the past few weeks have resulted in a shut-down of practically all the mines in the Nimsheew district. It being cheaper to close and let the surface water run off than to keep them drained. Some damage was done, of course, but this is more than offset by the prospects of one of the best seasons for water in the history of the state. The Royal drift-gravel mine, near Forest Ranch, is employing six men, and a lower adit is being driven to tap the old river channel, known to contain high gold content. The adit will be continued for about 170 ft. to cut the channel at the lowest point. J. W. Chilton, of San Jose, is principal owner, and he and his associates are optimistic regarding the property. The Steifer Mining Co., near Magalia, extension of the old Magalia mine, is now busy constructing its power dam. P. B. Steifer is manager. Ex-Governor Gage and son have the old Springer quartz property under bond and are busy at prospecting work. This property is near De Sabla, Camp One, and has a good record. Mint receipts in the past show over \$7000 in gold recovered from it, and wasteful methods have lost considerably more. The mine has a promising future. Assessment work is finished at the Double Eagle drift-gravel mine, near Berdan. C. D. Campbell and associates, of San Jose, own this property. At the Robbers Roost drift mine, near Nimsheew, extension of the Emma drift, five men are working, and driving in gravel is now under way. S. M. Anderson is superintendent.

The Indian Springs drift-gravel mine is to be reopened through the old workings. Disagreement among the owners has kept this famous producer quiet for a long time, but Norman Torrison, the present owner, will soon start operations. It is nine years since the mine has been worked. The published production is \$2,500,000, but men who worked in the mine say that the output was nearer \$4,000,000 in gold. All this was taken out from 4000 ft. of the channel.

The old Smith drift-gravel property, near Lovelock, has been bonded to the Nugget Gravel Mining Co., of San Francisco. The ground is an extension of the famous Indian Springs channel. Development has been done during the past six months, and an electric equipment, consisting of hoist and pump, is now being installed. The gravel taken from this mine so far has averaged over \$6 per yard, and the owners expect a good return on the investment.

In October 1913 Aubrey Rue found a mass of gold and quartz that contained gold worth \$826, in the old Emma mine, near Lovelock. Mr. Rue was just prospecting around in the old workings when he made this pleasant discovery. The Emma is a drift-gravel mine. In fact, this district contains some very famous drift-gravel mines, the Pershbaker or Magalia mine having been the greatest gold-producing drift-gravel mine in the world. Men who worked in this great

mine claim that in the richest part of the channel from \$80 to \$100 could easily be picked up on a shovelful of the gravel. It is reported that this property is again to be opened by a long adit. A large quantity of water flowed from the mine at one time, and the largest pumps in the state were in operation there. A lower adit would thoroughly drain the mine.

The Conger drift-gravel mine, near Nimshew, has just broken into the old Emma workings. Eight men are working, with Mr. Conger as superintendent. O. G. Martin is principal owner. The Kirby mine, in the Nimshew district, now owned by the New Indian Spring Gold Channel Mining Co., has employed six men. The recent storms filled the mine with water, but the Company will start as soon as the surface water has run off. Pay-gravel is being mined. The mine is well equipped with electric machinery, and low costs and high efficiency are maintained. C. G. Kirby is manager. The Loughlin, a promising property on Butte creek, is being operated under bond by G. F. Dyer and new associates.

The Mineral Slide drift-gravel mine, near Magalia, has



IN THE MINERAL SLIDE DRIFT-GRAVEL MINE. WATER IS TAKEN UNDER PRESSURE TO THE WORKINGS, THE GRAVEL WASHED IN THERE AND THEN RUN THROUGH SLUICE-BOXES.

been operated steadily during the past year. Some coarse gold has been recovered, one piece taken out in August last weighing nearly 10 oz. and worth \$182. Last month's storm damaged the flume and ditch to some extent, but these have been repaired. A profitable year is looked forward to by the company. S. P. Moody is superintendent.

A great deal of interest would be taken in this district were it not for the fact that claim-owners, considering the splendid record of the past, put altogether too large a price on their properties. As an old resident of Magalia said: "They want a fellow to come along and fill their hole in the ground with 20-dollar pieces! And if the man has that many 20-dollar pieces he does not want anybody's hole in the ground." It seems to be the difficulty all over the state—the proper valuation of a 'hole in the ground,' of a prospect, and of a mine, and a definite understanding of the term. Capital is naturally against the old methods. It seems that the fairest kind of a deal, and one that is best for all parties, is for an operating company to advance money and the claim-owner to take 10% of the gross output of the mine. Of course, if a company stopped work for any length of time, the mine should revert to the original owner. Another thing concerns the bad condition that titles get into. It would take a 'Philadelphia lawyer' to straighten some of them sufficiently to

risk operating the properties. A mine is never wanted until it has 'proved up,' and then it is always pleasant to find seven or more claimants to it, that you have never been introduced to. A company should protect the title to the property first of all. Miners are an optimistic class, and hard to talk business with. All expense arguments are answered by 'What is going to come out of the mine?' It is time, however, that the old river channels of the Tertiary period were receiving more attention. Over \$300,000,000 has been recovered from them in the past in this state alone.

BRITISH COLUMBIA

THE KAMLOOPS DISTRICT.—IRON MASK MINE DEVELOPMENT.—WORK AT THE PYTHON, EVENING STAR, AND WHEALTAMER.

In the early nineties, several prospectors located mineral claims on which outcrops of copper-gold ore had been discovered, and about 250 or 300 claims were then taken up within a radius of a few miles of the town of Kamloops. Owing to lack of smelter facilities and the cost of transport, either to the Trail smelter or to the coast, the owners of most of these claims performed sufficient work to entitle them to crown grants or patents, and allowed nearly all the properties to remain idle. The Iron Mask group has been an exception, having been in active operation continuously, with more or less success, since about 1905, when it was acquired by an English corporation. The management attempted to overcome the difficulties of transport costs from the mine to the railroad, thence to the smelter, by erecting a concentrating plant, and later a small matting plant. Neither of these proved quite satisfactory, and the English company, about three years ago, sold out to E. C. Wallinder and associates of Duluth, Minnesota, who formed the Kamloops Copper Co., and in 1912 reopened the mines after a temporary suspension of work for organization and other purposes. The mines are situated on Coal hill, at an elevation of 1600 ft. above Kamloops lake, about six miles southwest from the town of Kamloops, and about 3½ miles from a siding on the Canadian Pacific railway. In order to overcome, as far as possible, the extra costs entailed for fuel for steam, the present management has made a contract with the town for the supply of electricity to drive the recently installed motors for the hoist, pump, concentrating plant, carpenter and machine-shops. An auto-truck, with a capacity of 5 tons of ore or concentrate, has been placed in commission. The concentrating plant has been remodeled, and it is expected will do more satisfactory work in the future. On the Iron Mask claim, a main shaft was sunk 600 ft. by the English company, and all the ore stoped from all levels except between No. 5 and 6. On the Erin claim, one of the group, a shaft had been sunk to a depth of 130 ft. prior to September last, and the ore extracted during development was shipped to the Trail smelter. The orebodies, of which there are several outcropping on the group of claims which embrace, in the aggregate, an area of about 600 acres, occur as veins in diabase country rock. The vein-filling is composed of copper carbonate and some bornite and chalcocopyrite, usually associated with magnetite as the matrix, having an average value of about 6% copper, with low gold and silver content. The depth to which oxidation has extended varies, but usually is about 150 ft. below the surface. The extent of the various orebodies has not been fully determined except in one shoot on the Iron Mask, which is about 200 ft. long and from 4 to 20 ft. wide, but at the greatest width the ore is lower grade, and for treating this the concentrating plant was installed. The management proposes an energetic policy in future with regard to mining operations, and expects to decrease the cost of production and haulage considerably below what it was prior to the present year.

No other property in this copper belt is being operated at

present, but there are about a dozen claims in addition to the Iron Mask group on which prospects are sufficiently promising to warrant more thorough development, providing cheap haulage to the railway and fuel for driving machinery can be obtained. At some of these claims, notably on the Python, Evening Star, and Wheatlamer, considerable development has been done, and a large tonnage of low grade oxidized copper ore has been opened.

NEW YORK

BUSINESS CONDITIONS AND NEW BOND ISSUES.—THE COPPER MARKET AND VIEWS OF CONSUMERS.—FEDERAL MINING & SMELTING, BATOPHAS, AND HOMESTAKE.—MINING AT COBALT.

There has been a good deal of optimism regarding the outlook for business since the first of the year, but the strongest kind of evidence of an actual basis for optimism was disclosed last week. The state of New York has issued \$51,000,000 in 4½% bonds for the construction of canals and roads. These were advertised in the usual way, and a syndicate composed of W. A. Read & Co. (a bond house) and Kuhn, Loeb & Co. secured the entire issue on a bid of 106.077. When the syndicate put the bonds on public sale at 107½, the issue was oversubscribed twice over, and the syndicate in about two hours made a profit of \$550,000 on the transaction. No evidence could be clearer that plenty of money is available for well secured investment, and that the financial position is fundamentally sound.

The future of the copper market is naturally a never failing source of interest to all copper producers, and the opinion of large consumers is of much interest because of the point of view. The National Conduit & Cable Co. is a large user of the metal, and it is worth while to reproduce the views which it expresses in a recent circular:

"The new year began with material changes in the copper situation, and developments during the next few months will be watched with peculiar interest. The last half of December witnessed a firmer market for copper as the result of some important sales made to European buyers. Dealings were in large volume, especially with foreign interests, and a fair degree of activity extended to domestic manufacturers. London dealers and operators were prominent in the recent movement which lifted prices of electrolytic copper from 14¼ to 15c. It soon became evident, however, that consumptive demand did not warrant the rise in prices engineered in the closing weeks of last year, and early in the present month the market began to show a sagging tendency.

"Although domestic consumption at present is much below capacity, there is no reason to expect that it will remain at the low level represented by last month's deliveries. We fully expect to see larger quantities of copper going into home consumption each month before long, and in the coming weeks we look for more active buying. It is not probable, however, that manufacturing activity will be immediately resumed at approximately full capacity, but it is reasonable to assume that consumption will gradually reach a more normal basis within the first half of this calendar year, provided fundamental conditions are favorable."

Another consumer believes that stocks here are being kept low to bolster the market and expresses himself as follows:

"We have had to pay 14½ to 14¾c. for electrolytic over the past few days. The strength of copper prices is due to heavy shipments of copper to Europe. This country is exporting more copper than ever before in its history, notwithstanding a substantial falling off in consumption in Germany, Great Britain, and France. Exports so far this month are at the rate of nearly 1,000,000,000 lb. per year. Consumers are not able to reconcile these large shipments with industrial conditions abroad, but one thing is certain, they are not allowing large stocks of copper to accumulate in this country. They are shipping it almost as fast as it is produced and in this way

the agencies are in a position to mark up the price of the metal."

The Federal Mining & Smelting preferred stock was a source of much interest last week, since it suddenly advanced from 35½ to 40 on sales of 1600 shares. As nearly all the preferred is in the hands of people who hold less than 50 shares, naturally everyone was keen to know what had happened. At the time of writing the mystery has not been solved. The Wetthauer Lorrain has made its report for 1913, showing a net profit on its operations of \$38,912. As dividends amounting to \$141,659 were paid there was a considerable deficit for the year, cutting down the company's surplus to \$156,124. The Batophas Mining Co. did better with a total of \$712,568 income and a net profit of \$160,094. The Company has a surplus of \$3,219,816. The Homestake makes a new record, even for itself, having paid \$2,167,620 in cash dividends and a 15% stock dividend. The new stock represents \$3,000,000 which has been put into new construction and equipment during recent years.

Cobalt mines continue to be favorites in the New York share market and the large dividends which many of them pay furnish an excellent atmosphere in which to foster the growth of new enterprises. Thus the Nipissing Mines has just paid dividend No. 32, which brings the total to date to \$11,340,000, or nearly 200% on its capitalization. Crown Reserve has paid \$5,508,290 to date and is paying at the rate of 2% per month. The production is showing a decrease from 1912, when it was 3,430,900 oz. of silver, but much is hoped for from the five acres of ground made available by the draining of Kerr lake, which is counted on to yield 51,000,000 oz. Crown Reserve has another string to its bow in the McEneaney mine at Porcupine, which it has re-christened the Porcupine Crown, since acquiring it in 1911. A 20-stamp mill has been built and much is expected from this promising property.

TORONTO, CANADA

HOLLINGER DEVELOPMENT.—DOME RETURNS.—DOME LAKE CAPITAL.—COBALT ORES TO ENGLAND, GERMANY, AND THE UNITED STATES.—SILVER QUEEN MINE.

The Hollinger mine has recently considerably improved underground. The winze from the 425-ft. level of No. 4 vein has reached a vertical depth of 550 ft., at which point a station will be cut and a new drift driven. The directors have inspected the mine and decided to start diamond-drilling to a depth of 3000 feet. A large increase in the capacity of the mill is under consideration, and will probably be undertaken in the near future. Results at the Dome in December show a slight falling off, the tonnage milled amounting to 13,470 and the gold production to \$106,904, as compared with 13,820 tons and \$121,150 in November. The directors of the Dome Lake have decided to increase the capital from \$750,000 to \$1,000,000, and the shareholders will be asked to ratify the increase at a meeting to be held on February 9.

Cobalt ores are finding a market in England and Germany, several shipments having recently been made to Birmingham, Manchester, and Hamburg. The Crown Reserve has a contract for consignment of high-grade ore to the last port. Ores having a high cobalt content are also becoming marketable to advantage, the Nipissing having recently shipped two carloads to England and one to the United States. At the Silver Queen, now operated by the Aladdin-Cobalt under lease, an ore-shoot 6 in. wide and 30 ft. long, containing 1400 oz. ore, which had been overlooked in former operations, has been discovered and is being stoped. The Aladdin-Cobalt, which has now a controlling interest in the Chambers-Ferland, has made an offer to buy out the stockholders of that Company by giving them one \$5 share of Aladdin stock for every 20 shares of Chambers-Ferland. The Coniagas has declared its regular quarterly dividend of 6%, with an additional 3% bonus, which brings the total returns to shareholders up to \$6,080,000.

General Mining News

ALASKA

By a vote of 46 to 16 the United States Senate passed, on January 24, the Alaska railway bill, directing the President to purchase or construct 1000 miles of railroad in Alaska at a cost not to exceed \$40,000,000.

JUNEAU

December results from the three companies operating on Douglas island were as follows:

	Alaska Mexican.	Alaska Treadwell.	Alaska United.
Development, feet		108	1,185
Ore in stopes, decrease or increase, tons	+1,417	-53,529	-5,955
Stamps working	120	540	240
Ore crushed, tons	19,758	80,094	37,912
Gold by amalgamation	\$21,771	\$119,165	\$41,919
Gold from concentrate	23,159	99,809	30,048
Realizable value	44,480	216,784	71,248
Yield of ore treated, per ton..	2.27	2.73	1.90
Operating expenses	23,106	82,739	49,560
Construction	5,207	27,146	8,230
Estimated net profit	16,167	106,899	13,456

KETCHIKAN

Litigation has resulted in the old Cymru copper mine, known as the North Arm, situated at the head of the north arm of Maori sound, being shut down since 1907; but it was recently bonded to a local company formed by G. V. Bland, W. P. Powers, and others. The property is equipped with a Fairbanks-Morse compressor, 4200 ft. of surface tram, and orebins. Two shafts are down 95 and 105 ft., respectively. A good deal of surface mining has been done. In 1906, 3000 tons of ore sent to a smelter averaged 4.5% copper and \$1.25 per ton in gold and silver. Work is to be started at once, and shipments made in April.

ARIZONA

COCHISE COUNTY

The Hermitage company's 50-ton mill, 7 miles south of Hereford, is in operation. Two Harz jigs are included in the plant. The Hermitage Mining Co. is composed of Memphis, Tennessee, people, and John Moffett is manager. There are 144 Holquist patent machine-drills working in the Warren district, made by the Cochise Machine Co. Results are said to be quite satisfactory. The ore from the mines contains lead, zinc, and silver.

GILA COUNTY

(Telegraphic Correspondence.)—A contract has been let to the American Bridge Co. for the erection of a smelting plant for the International Smelting & Refining Co. The cost will be over \$2,000,000.

Miami, January 28.

(Special Correspondence.)—Extensive development continues at the Inspiration. Part of the Joe Bush ore dump is ready for caving. The Scorpion hoist is hauling about 700 tons of ore per day at present. During the first fortnight of January, 2000 tons came through this shaft, 8500 tons of ore and waste through the Colorado shaft, and 4600 tons of waste through the incline shaft. This material came from 2700 ft. of development. The flotation plant is working full time, and an Oliver filter is being tried, while a Trent filter is being erected. Other filters may be tested for their suitability in this treatment. The usual construction work is going on at the concentrating plant. The International Smelting

& Refining Co. is receiving bids for steel work for the smelter as well as for a power-station.

Miami, January 17.

(Special Correspondence.)—Ore from the Superior & Boston now averages between 7 and 8% copper. The faulted vein has been found 210 ft. from the fault, where it is 30 ft. wide, 3 ft. being good ore. Cross-cutting is under way on No. 13 and 14 levels of the Arizona Commercial. It is intended to bail the water flowing from the 1200-ft. level, after it flows down the shaft. High-grade ore is still being shipped from stopes above 650 ft. in the Iron Cap. For a width of 10 ft. and 75 ft. in length the stope has averaged about 20% copper and 31 oz. silver. In 1913 development totaled 1610 ft., and 4899 tons of ore yielded 763,882 lb. of copper. Revenue was \$91,814, and profit \$38,460. The annual meeting was held at Portland, Maine, on January 6, 1914.

Globe, January 17.

MARICOPA COUNTY

Negotiations for the sale of the claims of the Sunflower Cinnabar Mining Co., 75 miles northeast of Phoenix, have fallen through, and the Company, composed of Phoenix people, will operate the property for itself. Probably a 50-ton plant will be erected to replace the present 10-ton installation. Robert Scott, the mercury furnace inventor, has just examined the Sunflower group.

YAVAPAI COUNTY

The Humboldt smelter is not working at present, but the mill is producing concentrate for the Hayden smelter. A new reverberatory furnace is being constructed at the Humboldt, and a flotation plant will soon be at work. Development at the Baumann copper mine is promising. The Cherry Creek Mines Co. is diamond-drilling at Cherry. At the Poorman mine, in the Walker district, a hoist is being installed to unwater the shaft.

CALIFORNIA

AMADOR COUNTY

The South Eureka Mining Co. paid \$251,000 in dividends in 1913, making a total of about \$740,000 since the Company was formed. The South Eureka owns the Oneida mine, and two



SOUTH EUREKA MINE AND MILL.

stamp-mills are operated. The Zeila mine is being sampled by B. M. Lynder, of Los Angeles, Robert E. Cranston and Alex. Nise of San Francisco, and R. H. Elliot of Berkeley. The new shoot at 1500 ft. is being carefully examined.

ELDORADO COUNTY

(Special Correspondence.)—The Central El Dorado Gold Mining Co. is developing the Davidson mine, in the Mud Springs district. It has also acquired adjoining claims called the Three Champenoise mines. The old workings, which proved profitable for the owners thirty or forty years ago, have been reopened and found to consist of a 400-ft. adit, with stopes and an incline shaft 300 ft. deep with a few hundred feet of drifts. Since then an incline shaft has been sunk 300 ft. on the west vein. At 200 ft., 3 ft. of ore gave

satisfactory results in the mill. This was also good at 250 ft., and 500 ft. of drifts have been driven at the 300-ft. level. The mill returns at this depth were \$3 per ton. Active work will be started again in the spring. The property is equipped with an 80-hp. oil-burning boiler, 25-hp. hoist, 35-hp. compressor, five 1000-lb. stamps driven by steam, assay office, and all necessary appliances to make the plant as complete as possible. Water power was installed a year ago, and a change was made in driving machinery from steam to water. Rene Bordier is manager, and George Blanchin and M. Bordier in France are heavily interested. It is probable that additional stamps and concentrators will be erected during the current year.

Eldorado, January 19.

E. E. Shook, agent for the Placer County Properties Co., was recently at Placerville with a view to locating and obtaining control of all the magnesite and asbestos deposits in the county.

NEVADA COUNTY

A 40-hp. electric triplex pump is being installed at the 1000-ft. level of the Oustomah mine. When this is working, the shaft will be sunk to 1200 ft. The mill is kept busy on ore from the 600-ft. level. E. C. Klinker, the superintendent, has resigned to take charge of the Eagle Bird and Fritz Meister mines, near Washington, in this county. The Oustomah offices are to be moved from Los Angeles to Nevada City. Diamond-drilling drift-gravel areas on Columbia hill by F. S. and F. M. Phelps has defined the extent of the gravel, and an adit will be driven in the spring to get under the channel.

PLUMAS COUNTY

Six claims, containing good ore, have been located two miles from Quincy by A. D. Le Roy and J. B. Gillespie. Bad weather has caused a stoppage of work in the district.

SACRAMENTO COUNTY

Gold produced by the Natomas Consolidated's 10 dredges at Natoma, and 3 at Oroville during 1913, amounted to \$2,299,260, against \$2,020,634 in 1912, and \$2,053,593 in 1911. The net profits over bond interest are over \$300,000.

SHASTA COUNTY

A two days' trial of the Hall process at the Coram smelter has proved satisfactory. The Balaklala sampling works was burned on January 21, the loss being \$25,000. The Hall plant was not damaged. Storms have interfered with the electric-power service. Ore from the Balaklala mine is being sent to the Mammoth and Mason Valley smelters. The Mammoth Copper Co. has 50 men employed at the Stowell claims, and at all mines and the smelter 910 men are busy. The monthly payroll is about \$100,000.

SIERRA COUNTY

The interior shaft being sunk from No. 4 adit of the Plumbago mine has cut 4 to 6 ft. of ore containing free gold and rich arsenical pyrite. About 40 men are employed about the mine and 20-stamp mill.

A new adit will be driven at the Mountain House drift mine, to open the gravel, the present workings being too high. The adit will be 500 ft. long. Shaw brothers, of Oakland, are working the property. East of the Kate Hardy mine, R. D. Norris has staked two claims on a vein outcropping on Oregon creek.

SISKIYOU COUNTY

At the Hardscabble mine, the cross-cut adit has cut 12 ft. of mineralized rock, and it is figured that the main vein will soon be cut. The Company will install an electric power-plant, machine-drills, and a stamp-mill.

TUOLUMNE COUNTY

(Special Correspondence.)—The complete unwatering of the Dutch mine shows that 300 ft. of unexplored ground

remains between the 1500 and 1800-ft. levels, and the management has decided not to sink the shaft below its present depth until drifts have been extended into the undeveloped orebodies. The Columbus mine, one mile north of Tuolumne, is being unwatered preparatory to the resumption of operations by a new company. T. G. Winwood will be in charge as superintendent. Ten new cottages have been erected at the Shawmut mine. The shaft at the Black Oak, 1700 ft. deep, is being sunk 200 ft. A large electric pump is being installed in the mine. It is expected that New York and Philadelphia capitalists will shortly reopen the Seminole and Mayflower mines, near Tuolumne.

Sonora, January 24.

COLORADO

CLEAR CREEK COUNTY

The mills in the Idaho Springs district are kept fully employed. Thirty men are at the Combination plant, which is treating ore from the Saratoga. The Jackson mill is treating custom ore, and from the Golden Eagle and Bride mines. E. F. Gustafson has leased this mill.

GUNNISON COUNTY

A revival of mining at Crested Butte, and the opening of a considerable quantity of lead ores, has started some discussion as to the feasibility of smelting in that district. Transport to distant smelters is costly, while coke is made nearby.

LA PLATA COUNTY

Rich gold and silver ore has been discovered by D. Cason, two miles from Needleton, and 33 miles from Durango, at a height of 9500 ft. above sea-level. The mine shows 18 in. of high-grade and 6 ft. of low-grade ore.

MONTROSE COUNTY

(Special Correspondence.)—This place is the centre of the Paradox district, which is known for its uranium ores. As the mining for this ore is mostly at the surface, and the ground is frozen at present, there is not as much work being done as usual. Indications point to a greater output during the current year than any previous period.

Bedrock, January 12.

SUMMIT COUNTY

During the week ended January 10, the Tonopah Mining Co. completed its purchase of the property of the Reliance Gold Dredging Co. at Breckenridge. This included 30,000 acres of placer ground, a fine machine-shop, and three dredges. B. Stanley Revett is to be resident manager.

TELLER COUNTY (CRIPPLE CREEK)

(Special Correspondence.)—Proposals from contractors are desired for building to specifications, in whole or in part, a 300-ton mill for the El Oro M. & M. Co., Elkton, Colorado. The work will be under the direction of William H. Kritzer, superintendent, and, weather permitting, construction is to begin in March.

Cripple Creek, January 22.

The Golden Cycle company has resumed sinking its main shaft near Goldfield from 1700 to 1900 ft. The shaft collar is 10,066 ft. above sea-level. The Vindicator main shaft will also be deepened from 1600 to 1800 ft. This shaft collar is 10,209 ft. above sea-level. A Fairbanks-Morse pump, of 200 gal. capacity per minute, has been installed on the 500-ft. level of the El Oro company's Eclipse shaft. On No. 9 level of the Mary McKinney, the ore-shoot has been opened for 300 ft., it being 10 ft. wide and yields up to \$30 per ton. A dividend, equal to \$26,184 was paid on January 24. A new set of rolls from the Colorado Iron Works is being installed in the Rex mill. A lease has been taken on the Pharmacist dumps, the ore to be treated in the Rex plant. The Kavanaugh mill is working full time. Rich ore is still

being mined from the 400-ft. level of the W. P. H. mine, worked by lessees. At 1350 ft. depth in the Granite a cross-cut has intersected the main Granite vein, where the ore contains sylvanite, calaverite, and iron pyrite containing 5 oz. gold per ton.

IDAHO

Mining men who have spent some time in the Sawtooth mountains, during the past few summers, state that there are good chances for prospectors in the region. The range lies partly in Boise, Blaine, Custer, and Elmore counties. The snow is deep in winter, and little can be done with the present state of transport.

According to Stanly A. Easton, manager of the Bunker Hill & Sullivan company at Kellogg, the draft of the workmen's compensation act being discussed at Boise has apparently met the approval of all interests.

CUSTER COUNTY

Near the town of Custer, the Bonanza Gold Mining Co., composed of Salt Lake City people, has been pushing development until the winter set in. About 400 ft. of work has opened a wide decomposed vein of ore worth \$10 per ton. A 40-ton mill was completed just before winter. It is driven by a Dubois gasoline engine. Near the Bonanza is the Wall Street property, containing gravel and lode claims. A large dam is being constructed for hydraulicking.

SHOSHONE COUNTY

The Stewart Mining Co. reports that the gross value of mine and mill products for the last quarter of 1913 was \$325,866. Deducting all expenses, including development, the net income was \$177,942. No. 2 dividend of 10% and an extra one of 2 1/2% was paid on October 3, while No. 3 of 10% was paid on December 29. Cash at the end of 1913 was \$342,650. The Hecla Mining Co., of Burke, has paid its first monthly dividend of 2c. per share for the year. This makes \$20,000, and \$2,990,000 to date.

The raise connecting the lower and upper workings of the National mine at Mullan has been completed, and the upper workings, a 200-ft. shaft, and numerous stopes, filled with water, were drained through the raise and the long lower adit, which is practically a mile long. With the completion of the raise, the Company will cut stations every 100 ft., from which ore will be mined. The new mill is fast nearing completion, and, if delayed shipments of machinery are received in the near future, it is expected that the National will be ready for active operations early in February. The motor tram from the mine to the mill, a distance of nearly two miles, has been completed and is ready for service.

MONTANA

JEFFERSON COUNTY

(Special Correspondence.)—Lessees at the Baltimore mine, near Boulder, are shipping a mixed sulphide ore, carrying 25 oz. silver, 7% lead, 2% copper, and \$2 in gold. At present the stoping width is 5 feet.

Boulder, January 24.

LEWIS AND CLARK COUNTY

Work being done by E. R. Purnell in the Scratch Gravel hills is opening good silver, copper, and lead ore, and prospects are encouraging. The property of the Copper-Montana Silver Mining Co. is situated six miles north of Helena.

NEVADA

CHURCHILL COUNTY

During December the Nevada Hills Mining Co. treated 4140 tons of ore averaging \$10.27 at a cost of \$7.45 per ton. The loss in tailing was \$1.52 per ton. Net returns were \$5401. Cash on hand and in banks at the end of 1913 was \$110,618; supplies, \$43,600; concentrate and bullion in transit, \$11,820; and metals in solution, \$20,000. The annual meeting of the Company was held on January 23.

CLARK COUNTY

The Good Springs Anchor Co. has been organized with Frank A. Keith president and manager, Seeley W. Mudd vice-president, and R. L. Rogers, Philip Wiseman, and J. W. Keith directors, to develop and operate a zinc mine in the Good Springs, Nevada, district. The mine is eight miles from Jean, on the Salt Lake road, and an 1800-ft. aerial tramway and other equipment has been ordered. A contract has been made with the Empire Zinc Co. for two years for shipments at the rate of 10 tons per day. Based upon 40% zinc concentrate, the price at Jean nets \$16.90 per ton, from which is to be deducted mining, estimated at \$3, and hauling at \$2. On the 132-ft. level samples cut in 5-ft. sections in a 30-ft. cross-cut gave the following results:

Silver, oz.	Zinc, %.
6.0	34.5
5.6	46.9
2.0	45.8
1.0	31.1
3.6	13.4
3.0	11.8

A variable amount of lead is also found in the ore.

ELKO COUNTY

According to J. C. Griffen, Jarbidge is improving. A 10-stamp mill is being erected at the Flaxey mine, and 30 stamps are working at the Alpha, owned by Chicago people. Owing to high transport charges, only rich ore can be shipped from the camp. The Bluster mine has a shipment of \$100 to \$150 ore ready. This was mined at 300 ft., where the vein is 4 1/2 ft. wide for 225 ft. in length, worth \$19 per ton. A mill may be erected in the spring.

ESMERALDA COUNTY

The Goldfield Consolidated mine produced 28,804 tons of ore during December, giving a net realization of \$153,353. Costs totaled \$6.46 per ton. Development covered 3071 ft. at a cost of \$4.53 per foot. On the new No. 1 level of the Sheets-Ish area of the Mohawk, the 3-D sill produced 272 tons of \$40 ore. The 815 drift of the Grizzly Bear produced 75 tons of \$16 shipping ore. The mill was run to full capacity throughout the month, without drawing heavily on second-class dumps, but the average grade of the ore was low.

Great interest is being taken in the Florence mine, where from 8 to 18 in. of rich ore was cut in an incline raise above the 350-ft. level. This has since been opened 40 and 50 ft. northwest and southeast, respectively. A winze from the 250-ft. level is down 18 ft. in 3 ft. of ore worth \$96 per ton, and will be sunk to meet the raise from 350 ft. Ore worth \$20 to \$30 is being shipped to the mill. At a depth of 650 ft. the Oro shaft has got into broken vein formation. A station has been cut at 550 ft., and the pumps are handling the water with ease. The Silver Pick shaft is down 485 ft., and has opened a vein for over 80 ft., assaying from \$2 to \$10 per ton. A station is to be cut and extensive development done. A larger ventilating plant is being installed at the Merger for this and the Atlanta mines. The temperature at 1750 ft. is very high.

EUREKA COUNTY

(Special Correspondence.)—It is stated that a company under the management of Mr. Berardi, is constructing a 50-stamp mill at Mill cañon, a short distance from Beowawe.

Beowawe, January 23.

HUMBOLDT COUNTY

Seattle men, headed by Charles G. Heifner, have taken an option on the Kramer Hill mine, near Golconda. The purchase price is said to be \$350,000, and the buyers have 90 days in which to sample and make mill tests of the ore opened. If satisfactory, a large mill will be erected. Butte men have taken an option on the Elko Prince. They have

already spent about \$60,000 on the property. Rich ore is being shipped from the Seven Troughs mine. There is 2500 tons of \$30 ore on the Delaware dump, and about 30,000 tons blocked out in the mine. At present there are about 100 men employed at Seven Troughs. A road is being constructed to the cinnabar property of C. E. Dolbear, 22 miles south of Lovelock, and a retort is being installed to treat the ore. This was made by the Joshua Hendy Iron Works of San Francisco.

LANDER COUNTY

(Special Correspondence.)—The Austin Manhattan Mining Co.'s property at Austin was sold by auction recently, to Pittsburgh interests. The Mariposa Mining Co., whose mine and plant is situated at New York cañon, near Austin, is completely closed down after operating its new mill for six weeks. Austin, January 23.

MINERAL COUNTY

(Special Correspondence.)—A little activity is apparent at Gold Dyke, where several prospectors are working in a small way. Small shipments of copper ore continue to be made from Luning to the Mason Valley smelter at Wabaska.

Luning, January 23.

NYE COUNTY

(Special Correspondence.)—The Nevada Cinnabar Co., at Lone, is continuing construction work through the winter under the direction of Mr. Pearce, who was for many years connected with the Quicksilver Mining Co. at New Almaden, California. The plant will be complete in every detail. The ore will be dried in a rotary machine and elevated to a 50-ton storage bin on top of the 50-ton Mirabel-type Scott furnace.

Lone, January 23.

Snowstorms and slides of ground have interrupted the electric-power service to the mining districts of the county.

STOREY COUNTY

A heavy snowstorm caused a considerable amount of inconvenience at Virginia City during the past week. The water in the Con. Virginia winze was only 3 ft. above the 2700-ft. level on January 29.

WHITE PINE COUNTY

No. 6 steam-shovel, at Copper Flat, was being moved to a



COPPER FLAT, ELY, NEVADA.

new position recently, when it partly turned over, injuring four men in charge of it.

Reports filed with the county assessor for the last quarter of 1913, in compliance with the bullion tax law, show the following results:

	Nevada Con.	Giroux Con.
Ore mined, tons	848,826	38,916
Gross value of metals	\$2,984,867	\$78,019
Mining cost	558,484	29,261
Transport	228,553	13,273
Treatment	1,513,569	54,375

Net profit	684,261	
Bullion tax on profit	14,780	(loss) 18,890

NORTH CAROLINA

MONTGOMERY COUNTY

(Special Correspondence.)—The mill of the Uwarra Mining Co. is now in operation, and an excellent extraction is reported. Candor, January 26.

OREGON

BAKER COUNTY

Eighty acres of ground near Sumpter was sold by N. Hatley for \$6000 to the Powder River Dredging Co. The greater part of this area includes creek gravels.

JOSEPHINE COUNTY

The organizing of a mining experiment station at Grant's Pass is being discussed in Congress at Washington, the bill having been introduced by Mr. Hawley. It provides that the station be under the control of the Bureau of Mines, the appropriation necessary being \$25,000. A survey of the Dothan quadrangle is also suggested.

SOUTH DAKOTA

LAWRENCE COUNTY

A statement regarding the Homestake Mining Co.'s employees' aid fund showed the following position at the end of 1913:

Bal. at Dec. 31, 1912..	\$23,338	Death benefits, 1913..	\$16,000
Employees' contribution in 1913.....	27,584	Injury benefits, 1913..	9,691
Homestake Co. contribution in 1913.....	12,000	Sick benefits, 1913....	7,921
Interest, etc.	925	Insane benefits, 1913..	200
		Bal. at Dec. 31, 1913..	30,935

Total\$63,847 Total\$63,847

There is promise of considerable activity in the Tinton district this year.

UTAH

JUAB COUNTY

The following table shows results of operation at the Iron Blossom mine during the past year:

Development, feet	6,080
Cost per foot	\$6.06
Ore mined, dry tons	39,526
Metals produced:	
Gold, ounces (0.18 oz. per ton).....	7,289
Silver, ounces (34.29 oz. per ton).....	1,355,392
Lead, pounds (7.78%)	6,153,265
Copper, pounds (0.35%)	277,922
Gross value	\$1,112,787
Sampling and freight smelting	361,709
Net return	751,078
Developing and mining	240,470
Profit	510,608
Dividends paid	400,000

The Lower Mammoth Mining Co.'s report for 1913 contains the following information: The past year's work in new ground has been unsatisfactory, the orebodies being low grade. This was especially so at 1800 and 2000 ft. The Gold Chain company is extending work in its property from 1500 and 1800 ft. in the Lower Mammoth. The general manager suggests further prospecting, although the directors have considered the question of shutting down. Copper ore shipped was 101 tons, worth \$979; zinc ore, 806 tons, worth \$9673; and lead ore, 68 tons, worth \$89. Total receipts, including an assessment of \$10,000, were \$22,901. The expenditure was \$26,326. Cash on hand at January 2, 1913, was \$1162.

During 1913, a total of 6383 ft. of development was done in

the Chief Consolidated, making 23,000 ft. to date. On February 2 a dividend of \$43,822 was distributed by the Company.

PIUTE COUNTY

New York people have leased and bonded, with a purchase option, the Glen Eyrie, Cascade, Shamrock, Roosevelt, Taft, and Deseret groups of claims in Bullion Creek cañon, seven miles southwest of Marysvale. These claims cover over 1000 acres. The Bully Boy, adjoining, may be included in the deal. It has produced between \$400,000 and \$500,000. A 100-ton mill was erected there last year. Several long adits have been driven in the leased properties, and the ores contain lead, silver, copper, and gold. Men have already started work here, and a large number is expected by May.

SALT LAKE COUNTY

The Alta Tunnel & Transportation Co.'s tunnel was in 444 ft. last week in blue limestone. The face of the drift was streaked with stringers of manganese, which is often associated with ore in the Wasatch range. It is hoped that the work will cut all the veins in the Alta district, within a total length of about one mile. F. V. Bodfish is president of the Company, and Roy L. Mack is superintendent. Two Austrian miners were imprisoned in the Boston part of the Utah Copper Co.'s mines last week by a fire in the hoisting shaft. Three other Austrian miners made an attempt at rescue, but lost their lives as a result. Oxygen helmets were used later by L. W. Anderson, mine superintendent, J. T. Bowen, and Julius Sorensen, of Salt Lake City. They were assisted by several other employees. Heavier crushers have been recommended for the Ohio Copper Co.'s mill at Lark, by the general manager, George F. Waddell. The plant is treating 210 tons of ore per day at present.

UTAH COUNTY

At the mouth of the Santaquin King adit there is about 2000 tons of \$8 to \$10 ore containing lead and silver, while 200 tons of \$30 ore is ready for shipping. An ore-shoot containing 38 to 40% zinc was recently opened, and further driving cut silver-lead ore. This is in limestone. Further development in the mine gives assays of 8 oz. silver, 51% lead, and 9.2% iron. The adit, 4½ by 6½ ft. in the clear, is to be extended 100 ft., at a cost of \$6.50 per foot. Transport facilities have hindered profitable work in the past, but on January 12 a contract was let to the Utah Industrial Transportation Co. to install, at its own expense, a monorail system of tramway to carry ore to the railway. This will cost about \$35,000.

WAYNE COUNTY

A good discovery of carnotite (uranium ore) has been made 2½ miles southeast of Fonita by S. W. Mulberry, an old prospector. Two tons of the ore was taken to Richfield. The deposit is irregular in size, and occurs between white and red sandstone. There is also a 75-ft. layer of blue clay. Eleven claims has been staked, and 11 outfits are going to the new field.

WASHINGTON

FERRY COUNTY

(Special Correspondence.)—The following ore production was made from mines at Republic during November and December:

	November, tons.	December, tons.
Ben Hur	3,080	3,322
Knob Hill	310	2,002
Hope company	71	....
Quilp	92	235
Republic Mines Corporation:		
Lone Pine	227	....
Pearl	80	....
Surprise	2,180	1,709
Total	6,046	7,268

The output for December exceeded that of any month of 1913. The January yield will not be as large as the two previous terms.

Republic, January 25.

CANADA

BRITISH COLUMBIA

The sixteenth annual convention of District 6, Western Federation of Miners, was held at Nelson on January 20, when there were delegates from all mining camps in the Kootenai and Boundary districts. James Cuthbertson of Greenwood is president. He spoke on compensation in Washington, and a universal 8-hour day. The membership of the union increased 20% in 1913.

ONTARIO

The Miller Lake-O'Brien company, at Gowganda, is producing 60,000 oz. silver per month. The Mann mine is being sunk to 200 ft., and a car of rich ore is to be shipped.

Two Italians were sentenced to six months imprisonment on January 20 for stealing silver ore from Cobalt. The ore was returned to the Mine Owners' Association. During the work of draining Cobalt lake, the foreman, W. E. Janes, was killed by a falling derrick. In December, the McKinley-Darragh-Savage property produced 159,022 oz. silver, making the year's total 2,212,557 oz. This is a decrease of about 500,000 oz. compared with 1912. The large tube-mill at the plant was out of commission in December. On February 14 the Seneca-Superior Mining Co. will pay a dividend of 12½%, equal to \$59,548. The total paid since February 15, 1913, will be \$369,297.

YUKON

A dredging record was put up during the past season by No. 2 boat of the Canadian Klondyke Co., which operated 271 days, or 33 days longer than the previous record, which was held by the same boat.

KOREA

The Oriental Consolidated Mining Co. reports as follows for November: 240 stamps crushed 25,602 tons of ore yielding \$134,633 from all departments. Operating costs were \$97,281, leaving a profit of \$37,352, of which \$11,761 was spent on improvements and development. The net profit was therefore \$25,591.

JAPAN

The output of the Imperial Steel Works at Wakamatsu for 1913 is placed at 200,000 tons of pig iron and the profit for the year is estimated at \$2,000,000. This includes profit on final products, a large variety of which are made at the works.

MEXICO

CHIHUAHUA

The Batopilas Mining Co. reports as follows for the year ended December 31, 1912: total revenue, \$742,568; expenditure, interest, etc., \$582,473; profit, \$160,095. There is a surplus of \$194,913, an increase over the previous year. Cash totals \$58,027; current liabilities, \$46,260; and current assets, \$174,372.

SONORA

The Lucky Tiger-Combination company of Kansas City, Missouri, reports as follows for December:

Ore crushed, tons	6,209
Tailing treated, tons	7,672
Revenue from shipping ore, concentrate, and bullion	\$148,092
Expenditure, including development, marketing, and taxes	89,041
Profit	\$ 59,051

A dividend, No. 58, of 6c. per share was paid on January 20. On December 18 and January 8 all outstanding bonds were authorized to be purchased, this to take place on January 26 and February 1.

Schools and Societies

The INSTITUTION OF MINING AND METALLURGY, on January 13, celebrated its twenty-second anniversary, and the opening of its new quarters at 1 Finsbury Circus, London, E. C.

The Mine Owners and Operators' Association of the Cripple Creek district met at Colorado Springs on January 25. The meeting was called to order by the president, E. A. Colburn. Mine taxation was one of the subjects discussed.

Colorado mining men will hold a convention on February 19, at a place to be decided later. There will be present representatives of the counties, Bureau of Mines, U. S. Geological Survey, state geologists, and the commissioner of mines, T. R. Henahan.

The UNIVERSITY OF ARIZONA will give a six weeks' course in mining early in the spring. Twelve distinct branches of the industry will be included, from mineralogy to ore treatment. The mining department of the university has collected information regarding the working of 1397 mines in the state.

The INSTITUTION OF PETROLEUM TECHNOLOGISTS in London has appointed its first council. The president is Sir Boverton Redwood, with Lord Cowdray of Midhurst as vice-president, and 15 ordinary members. David T. Day, of the U. S. Geological Survey, and C. Engler have been elected honorary members. Over 100 applications have been received for membership.

The third annual mining exhibition, under the auspices of the CHEMICAL, METALLURGICAL, AND MINING SOCIETY OF SOUTH AFRICA, will be held at Johannesburg, from May 19 to 29, 1914. Commercial firms, for whom a limited space will be provided, desirous of exhibiting machinery, apparatus, natural products, etc., will be charged for the space occupied at from \$1.25 to \$2.50 per square foot, according to position, and whether stands are provided or not.

The Montana branch of the AMERICAN INSTITUTE OF MINING ENGINEERS will hold its annual meeting at Butte on February 6. This includes a dinner, business meeting, and reading the following papers: 'The Drumlummon Mine,' by C. W. Goodale; 'Reverberatory Smelting with Low-Grade Coal,' by C. E. Demond; and 'The Labor Crisis in Chile,' by Bancroft Gore. E. P. Mathewson is chairman, and D. C. Bard secretary.

The UNIVERSITY OF ILLINOIS has issued an interesting illustrated booklet covering the work of the College of Engineering. This includes 11 departments covering architecture, civil, electrical, mechanical, mining, municipal, sanitary, and railway engineering, mechanics and physics, and the experiment station. A short course in highway engineering will be given from January 19 to 31, 1914. There are no charges for the course, and it is open to anybody without examination. This is an important subject and a series of highly interesting practical demonstrations is to be shown.

The SAFETY FIRST CONVENTION opened at Reno on January 26. The following papers were presented on the first day: 'The Safety-First Movement in Nevada,' by John J. Mullin; 'Safety First on the Oregon Short Line,' by L. E. Abbott; 'Safety First in Practice,' by Frank Ingram; 'Safety Regulations for Electrical Power Companies,' by W. K. Freudenberger (this was discussed by officials of the principal power concerns of Nevada); and 'Electric Headlights,' by J. G. Scrugham, which was discussed by representatives of engineers, firemen, trainmen, and conductors of railroads in Nevada. The evening session consisted of demonstrations of electricity by members of the University of Nevada, and motion pictures on various subjects.

Personal

L. A. GREENE is in New York.

W. H. LANAGAN is in London.

T. W. E. DAVID is in London.

F. LYNWOOD GARRISON is in Colorado.

R. Y. HANLON is at Santa Ynez, California.

E. H. LESLIE is visiting Arizona mining regions.

J. FORDYCE BALFOUR has returned to Nigeria from London.

J. E. SPURR is inspecting the Tonopah Mining Co.'s properties.

PAUL M. PAINE has moved from Fellows to Taft, California.

F. A. VOORHEES left San Francisco, and is at Pearce, Arizona.

R. E. CRANSTON and R. H. ELLIOTT are sampling the Zella mine at Jackson.

J. N. ESSELSTYN has moved from Orogrande, New Mexico, to Denver, Colorado.

G. MACFARLANE, manager at the Wallis property in West Africa, is in London.

REIJI KANDA has been investigating operating conditions at the Hasami gold mine.

T. N. TURNER, who has been with the Orsk Goldfields in Siberia, has returned to Palo Alto.

JOHN MOCINE will become manager for the National Copper M. Co., at Mullan, succeeding CHARLES MCKINNIS.

ALBERT BURCH has been elected president and ELMER KING vice president of the newly organized Goldfield Unity Club.

PERCY E. BARBOUR has returned to North Carolina from attending the annual meeting of the Mining and Metallurgical Society in New York.

Obituary

GODFREY D. DOVETON, the well known and active metallurgist, died at Guadalajara January 20 as the result of an injury sustained the day before. While working around machinery his right arm was caught in gearing and he was so badly injured that he did not recover. Doveton was a New Zealander, one of the pupils of James Park. He studied at Auckland University College, 1891-93, and the next two years at the famous School of Mines on the Thames where so much of the pioneer work on the cyanide process originated. After graduation he worked for five years with various New Zealand companies, including the Waionio, Puhli Puhli, Anglo Continental, and the Moanatairli. In 1900 he came to America, making his headquarters at Denver. Almost immediately he was called to take charge of the mill at the Camp Bird mine, and he spent two years there as superintendent and metallurgist. In 1902-04 he served as metallurgical engineer for the Creston-Colorado, returning to the United States to take up general consulting work, in which he was associated with Spurr and Cox. He did especially important work at Cripple Creek and Tonopah, being responsible for the designing of some of the largest mills in Nevada. In 1905-06 he was with the Lincoln California at Telluride, Colorado, and since then has been almost continuously in Mexico, where he has done notable work at El Oro, Zacatecas, and Pachuca especially. When the Sta. Gertrudis mill was to be built Doveton was selected to make the preliminary studies and to determine the process and plant to be adopted. His report was a model of careful conscientious work. That, however, was characteristic of his entire career and he obtained an enviable reputation for fairness and thoroughness in all that he did. His death is a real loss to the industry and his career illustrates the fact that hard work and ability carry men far in the profession of metallurgy.

The Metal Markets

LOCAL METAL PRICES

San Francisco, January 29.

Antimony	9 — 9 3/4 c
Electrolytic copper	15 1/2 — 15 3/4 c
Pig lead	4.35 — 5.30
Quicksilver (flask)	\$39.00
Tin	11 — 12 1/2 c
Spelter	6 1/2 — 6 3/4 c
Zinc dust, 100 kg. zinc-lined cases, 7 1/2 to 8c. per pound.	

EASTERN METAL MARKET

(By wire from New York.)

NEW YORK, January 28.—There has been a steady increase in the price of copper during the past week, the market is active and firm, with good demand from Europe. American smelting agencies and Hirsch are quoting 14 1/2c. for electrolytic, and the Amalgamated 14 1/2c. in London. There is a fair inquiry, and Continental dealers are selling at 14 1/2c. per pound. The Greene Cananea Copper Co. paid a dividend of 50c. per share today. Earnings are at the rate of \$6 per share per annum. Ray Consolidated copper output for December was 5,232,167 lb., and Utah Copper, 10,624,790 lb. Lead is firm, and spelter is strong. London metal prices yesterday were: copper, £65 12s.6d. and £65 17s.6d.; lead £20; spelter, £21 10s.; and tin, £179 5s. for spot, up £1 10s., and £180 for futures, up £1 10s., with strong demand. Investment issues were buoyant and Consols advanced 1/4. Bonds were active in New York, and shares sold on the Stock Exchange on January 28 totaled 460,598.

SILVER

Below are given the average New York quotations in cents per ounce, of fine silver.

Date.	Average week ending.
Jan. 22.....57.37	Dec. 17.....57.79
" 23.....57.50	" 24.....57.77
" 24.....57.62	" 31.....57.82
" 25 Sunday.....57.62	Jan. 7.....57.50
" 26.....57.62	" 14.....57.58
" 27.....58.00	" 21.....57.58
" 28.....57.50	" 28.....57.60
Monthly averages.	
Jan. ....1912. ....1913.	July .....60.67 58.70
Feb. ....59.06 61.25	Aug. ....61.32 59.32
Mch. ....58.37 57.87	Sept. ....62.95 60.53
Apr. ....59.20 59.26	Oct. ....63.16 60.88
May ....60.88 60.21	Nov. ....62.73 58.76
June ....61.29 59.03	Dec. ....63.38 57.73

Writing on January 8, Pixley and Abell state that from January 2 to 5 the market remained quiet and somewhat dull in tone, as the demand was barely sufficient to absorb the daily offerings. On the 6th, a premium of 1/16d. (1/32c.) was established on cash, the effect of which was immediately felt, for, on the following day, the Indian bazaars, doubtless having fears of another 'corner,' sent large covering orders for near dates, and in addition limited orders for shipment, in consequence of which the premium increased 1/4d. (1/8c.), the quotations being 26 1/4d. (53 1/2c.) and 26 7/16d. (53 3/4c.), respectively. Today the premium has eased off to 1/4d. (1/16c.), as the buying has been chiefly for forward dates, and, at about the previous day's difference, there were 'bulls' who were willing to extend their purchases falling due shortly for a further two months. There are still a good many 'bears' whose sales must be covered during this month, and their position may not be an easy one to adjust, as the Continent is shipping freely from London, while silver worth £150,000 was sent to Bombay.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.	Average week ending
Jan. 22.....4.10	Dec. 17.....3.90
" 23.....4.10	" 24.....4.02
" 24.....4.10	" 31.....4.15
" 25 Sunday.....4.10	Jan. 7.....4.10
" 26.....4.10	" 14.....4.10
" 27.....4.10	" 21.....4.10
" 28.....4.10	" 28.....4.10
Monthly averages.	
Jan. ....1912. ....1913.	Jul. ....4.71 4.35
Feb. ....4.43 4.33	Aug. ....4.54 4.60
Mch. ....4.07 4.32	Sept. ....5.00 4.70
Apr. ....4.20 4.36	Oct. ....5.08 4.37
May ....4.20 4.34	Nov. ....4.91 4.16
June ....4.40 4.33	Dec. ....4.20 4.02

COPPER

Quotations on copper as published in this column represent average wholesale transactions on the New York market and refer to electrolytic copper. Lake copper commands normally 1-5 to 1-4c. per lb. more. Prices are in cents per pound.

Date.	Average week ending
Jan. 22.....14.25	Dec. 17.....14.17
" 23.....14.30	" 24.....14.28
" 24.....14.35	" 31.....14.56
" 25 Sunday.....14.35	Jan. 7.....14.39
" 26.....14.35	" 14.....13.97
" 27.....14.10	" 21.....14.03
" 28.....14.45	" 28.....14.35

Monthly averages.

1912.		1913.		1912.		1913.	
Jan.	14.09	16.54	July	17.19	14.21		
Feb.	14.08	14.93	Aug.	17.49	15.42		
Mch.	14.68	14.72	Sept.	17.56	16.23		
Apr.	15.74	15.22	Oct.	17.32	16.31		
May	16.03	15.42	Nov.	17.31	15.08		
June	17.23	14.71	Dec.	17.37	14.25		

The copper market gained strength during last week. On January 19 one of the large agencies sold 18,000,000 lb. at a little under 14 1/2c. (this includes delivery charges and 30 days interest). The following day less business was done, but the price was firm at 14 1/2c. On January 23 the United Metals Selling (Amalgamated) asked 14 1/2c., and London quotations advanced 5s. to £67 5s. The following day a fair business was done at this price. Exports of copper for the week ended January 22 totaled 8822 tons; since January 1, 25,217 tons, and 17,967 tons in the same period last year.

Preliminary estimates by L. Vogelstein & Co., of the 1913 copper production in the world give a total of 989,000 tons, as against 1,006,900 tons in 1912. Principal decreases were in the United States and Mexico. The world's consumption was 1,048,500 tons. Stocks in Europe at the end of the past four years were as follows: 94,800, 60,750, 35,041, and 23,670 tons, respectively. Prices moved illogically compared with statistics, for while stocks decreased, prices have fallen. Inasmuch as there is no immediate prospect of increased smelter production or imports, it is reasonable to assume that refinery output must decrease during the first half of 1914.

QUICKSILVER

The primary market for quicksilver is San Francisco, California, being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending	Jan. 15.....39.50
Dec. 31.....40.00	" 22.....39.00
Jan. 8.....39.50	" 29.....39.00
Monthly averages.	
Jan. ....1912. ....1913.	July .....43.00 41.00
Feb. ....43.75 39.37	Aug. ....42.50 40.50
Mch. ....46.00 41.00	Sept. ....42.12 39.70
Apr. ....42.25 41.00	Oct. ....41.50 39.37
May ....41.75 40.25	Nov. ....41.50 39.40
June ....41.30 41.00	Dec. ....39.75 40.00

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date.	Average week ending
Jan. 22.....5.20	Dec. 17.....5.00
" 23.....5.20	" 24.....5.15
" 24.....5.20	" 31.....5.13
" 25 Sunday.....5.20	Jan. 7.....5.02
" 26.....5.20	" 14.....5.08
" 27.....5.20	" 21.....5.05
" 28.....5.20	" 28.....5.20
Monthly averages.	
Jan. ....1912. ....1913.	July .....7.12 5.11
Feb. ....6.42 6.88	Aug. ....6.96 5.51
Mch. ....6.50 6.13	Sept. ....7.45 5.55
Apr. ....6.57 5.94	Oct. ....7.36 5.22
May ....6.63 5.52	Nov. ....7.32 5.09
June ....6.68 5.23	Dec. ....7.09 5.07

TIN

New York prices control in the American market for tin, since the metal is almost entirely imported. San Francisco quotations average about 5c. per lb. higher. Below are given average monthly New York quotations, in cents per pound:

Monthly averages.		1912.		1913.	
Jan.	42.53	July	44.25	Jan.	40.70
Feb.	42.96	Aug.	45.80	Feb.	41.75
Mch.	42.58	Sept.	48.64	Mch.	42.45
Apr.	43.92	Oct.	50.01	Apr.	40.61
May	46.05	Nov.	49.92	May	39.77
June	45.76	Dec.	49.80	June	37.57

The Stock Markets

SAN FRANCISCO STOCKS AND BONDS (San Francisco Stock and Bond Exchange.)

BONDS

January 28.

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Associated Oil Co.	97½	98½	General Petroleum Co.	45	48
E. I. du Pont pfd.	—	90	Natomas Consol. Co.	—	28½
Unlisted.			Pac. Port. Cement Co.	—	100½
Am. Oil Co.	78	—	Santa Cruz Cement Co.	88½	91

STOCKS

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Amalgamated Oil	82½	—	Noble Electric Steel	—	3
Associated Oil	42½	43½	Natomas Consol.	1½	—
Giant	82½	85	Riverside Cement	60	—
Pac. Cat. Borax, pfd.	68½	—	Santa Cruz Cement	48	—
Pacific Crude Oil	—	35c	Stand. Port. Cement	18	—
Sterling O. & D.	1.35	—			
Union Oil	62	—			

NEVADA STOCKS

(By courtesy of San Francisco Stock Exchange.)

January 29.

Atlanta	18	Mirzap Extension	39
Belcher	40	Montana-Tonopah	127
Belmont	7.75	Nevada Hills	43
Big Four	12	North Star	42
Con. Virginia	18	Opfir	20
Florence	85	Pittsburg Silver Peak	35
Goldfield Con.	1.62	Round Mountain	43
Goldfield Oro	15	Sierra Nevada	107
Halifax	1.06	Tonopah Extension	192
Jim Butler	56	Tonopah Merger	67
Jumbo Extension	22	Tonopah of Nevada	7.00
MacNamara	11	Victor	33
Mexican	1.12	West End	1.47
Midway	41	Yellow Jacket	37

COPPER SHARES—BOSTON

(By courtesy of J. C. Wilson, Mills Building.)

January 29.

Bid	Ask	Bid	Ask
Allouez	97½	38	44
Ariz. Commercial	4½	43	16
Butte & Superior	34½	34½	28½
Calumet & Arizona	66½	67	51
Calumet & Hecla	429	430	77½
Copper Range	38½	38½	61
Daly West	2½	2½	63
East Butte	12	12½	64
Franklin	4	4½	28
Granby	82	82½	30½
Greene Cananea	38½	39	41½
Isle-Royale	21	21½	93
Mass Copper	2½	8	31
			45

NEW YORK CURB QUOTATIONS

(By courtesy of E. F. Hutton & Co., Kohl Building.)

January 29.

Bid.	Ask.	Bid.	Ask.
Braden Copper...	7½	7½	
Braden Co.	150	160	
B. C. Copper...	3½	3½	
Con. Cop. Mines...	2½	2½	
Davis-Daly	1½	1½	
Dolores	1	2	
El Rayo	2	4	
Ely Con.	4	5	
First National...	3	3½	
Glroux	1	1½	
Iron Blossom...	1½	1½	
Kerr Lake	4½	5	
La Rose	1½	2	
Mason Valley...	3	4	
McKinley-Dar.	1	1½	
Mines Co. Am.	2½	2½	
Nipissing	7½	7½	
Ohio Copper	½	½	
San Toy	15	20	
Sioux Con.	1	2	
Stand. Oil of Cal.	284		
Tri Bullion	¼	¼	
Tuolumne	½	½	
United Copper	¼	¼	
Wetlaufer	6	8	
Yukon Gold	2	2½	

NEW YORK STOCK EXCHANGE

(By courtesy of J. C. Wilson, Mills Building.)

January 29.

Bid	Ask	Bid	Ask
Amalgamated	75	75½	
Anaconda	36½	36½	
A. S. & R.	68½	68½	
Calif. Pet.	26½	30	
Chino	40½	41	
Guggenheim Ex.	49½	50	
Inspiration	16½	16½	
Mexican Pet.	62	63	
Miami	24	24½	
Nevada Con.	18	18½	
Quicksilver, com.	2½	2½	
Ray Con.	18½	19	
Tenn. Copper	34½	34½	
U. S. Steel, pfd.	111½	111½	
U. S. Steel, com.	64½	64½	
Utah Copper	58½	59	

LONDON QUOTATIONS

(By cable, through the courtesy of Collin & Powell Co.,

New York.)

January 29

	£	s.	d.		£	s.	d.
Alaska Mexican	1	7	6	Kern River Oilfields	0	7	6
Alaska Treadwell	8	0	0	Mexico Mines	6	0	0
Alaska United	3	7	6	Messina	1	10	0
Arizona	1	17	6	Oroville	0	15	0
California Amalg	0	1	3	Pacific Oilfields	0	3	9
California Oilfields	6	0	0	Itto Tinto	71	5	0
Camp Bird	0	13	9	Santa Gertrudis	0	18	9
El Oro	0	15	0	Stratton's	0	1	3
Esperanza	1	1	3	Tanganyika	1	16	9
Granville	0	11	3	Tomboy	1	5	0

AUSTRALASIAN

January 29.

	£	s.	d.		£	s.	d.
British Broken Hill	1	15	0	Mount Boppy	0	16	9
Broken Hill Prop.	1	16	9	Mount Elliott	3	7	6
Golden Horse Shoe	2	15	0	Mount Lyell	1	2	9
Great Boulder Prop.	0	13	9	Mount Morgan	3	5	0
Ivanhoe	2	17	6	Waihi	2	11	3
Kalgoorlie	1	16	9	Waihi Grand June	1	7	6

Portland Cement Production

According to returns received by the U. S. Geological Survey up to January 12, 1914, it is estimated by Ernest F. Burdard that the quantity of portland cement manufactured in the United States in 1913 was approximately 92,406,000 bbl., compared with 82,438,096 bbl. in 1912, an increase of about 9,967,900 bbl., or 12%. The estimated shipments of portland cement during 1913 were 88,853,000 bbl., compared with 85,012,555 bbl. in 1912, an increase of about 3,840,400 bbl., or 4.5%. On account of a large surplus of production over shipments, stocks of cement at the mills apparently increased more than 45%, or from 7,811,329 bbl. in 1912 to 11,375,000 bbl. at the close of 1913. In 1913 the relations between production and shipments were the reverse of those for 1912, when shipments exceeded production. It may be necessary to revise considerably the estimates of stocks, but it is believed that these figures for production and shipments are very close to those that will be shown by complete returns from all producers. The average price per barrel was appreciably higher than in 1912, several plants in the Central and Eastern states reporting increases of 10 to 25 c., while there were small decreases in the Rocky Mountain district.

Gas, Tar, and Ammonia Production

Artificial gas produced in the United States in 1912, as reported by 1062 establishments, amounted to 228,076,510,000 cu. ft. About 7% was lost or unaccounted for, so that the quantity sold or utilized was 212,391,168,000 cu. ft. This was valued at \$148,282,725, or 70c. per 1000 cu. ft. Coal gas used for illumination was 31,864,052,000, and for fuel purposes 57,829,320,000 cu. ft. Oil and water gas used for illumination was 68,136,269,000 and for fuel 54,561,527,000 cu. ft. The products in manufacturing gas from coal were 12,490,757 short tons of coke, valued at \$48,380,009; 134,796,438 gal. of tar, valued at \$3,802,047; 51,527,074 lb. of anhydrous ammonia (the ammonia liquor being reduced, when strength of liquor was reported, to its equivalent in NH_3), valued at \$4,776,386; 35,242,549 gal. of ammonia liquor (strength not reported), valued at \$1,002,807; and 99,070,777 lb. of ammonium sulphate, valued at \$3,740,075, according to Edward W. Parker, of the U. S. Geological Survey. The output of tar was 134,796,438 gal., worth \$3,802,047, and that from oil and water-gas plants was 9,168,834 gal., worth \$229,582.

SULPHURIC ACID manufactured by the Tennessee Copper Co. in December amounted to 20,100 tons, and totaled 197,673 tons during the past year.

Recent Patents

1,071,893.—PROCESS OF REMOVING SUSPENDED MATTER FROM GASEOUS FLUIDS. Henry L. Doherty, N. Y.

The process of separating from a body of gaseous fluid particles suspended therein, which consists in imparting a spiral motion to the said gaseous fluid first in one direction of rotation and then in the opposite direction.

1,072,010.—PROCESS OF PRODUCING ALKALI-METAL HYDROXIDES DIRECTLY FROM ALKALI-METAL CHLORIDES. Julius Kersten, Dell-bruck, near Cologne, Germany.

Mixing an aqueous solution of an alkali metal chloride with hydroxide of lead, whereby an alkali metal hydroxide containing basic chloride of lead is obtained, and in separating the chloride of lead from the alkali metal hydroxide.

1,071,856.—TREATMENT OF METAL-BEARING SOLUTIONS. Edgar Arthur Ashcroft, Balestrand, Norway.

Process for the treatment of metal-bearing solutions to obtain the zinc therefrom which consists in adding to the solution a cyanogen compound and subsequently heating the mixture, whereby the zinc is obtained in the form of an insoluble compound.

1,071,962.—AUTOMATIC CHARGING DEVICE FOR ROASTING-FURNACES AND THE LIKE. Ludwig Singer, Bochum, Germany.

For roasting-furnace and the like, comprising a plurality of bottomless exchangeable charging-vessels and a rotatable false bottom provided with a discharge-opening adapted to register successively with the lower end of each of said charging vessels.

1,071,917.—DEWATERING DEVICE OR MEANS FOR SEPARATING SOLIDS AND LIQUIDS. Wilbur Alson Hendryx, New York, N. Y.

A tank having a lower converging portion, an upwardly extending undivided conduit directly connected to the bottom of said lower portion and a pair of oppositely rotating screws in such conduit, said screws having their edges approaching each other and the sides of the conduit.

1,072,209.—PROCESS OF EXTRACTING ZINC FROM RESIDUES CONTAINING ZINC, ESPECIALLY SLAGS, IN REVERBERATORY FURNACES. Adolphe Henri Desgraz, Hanover, Germany.

Recovering easily reducible and volatile metal from substances containing the same, which consists in forming such substances to a molten liquid bath of slag, and reacting upon said molten bath with a suitable basic agent, thereby driving off said metal from the bath.

1,072,276.—MAGNETIC SEPARATOR. Georg Ullrich, Magdeburg, Germany.

A stationary magnet, a non-magnetic guard entirely covering the active part of said magnet and against which guard the material is held by the magnet, said guard rotating to remove the adhering material when beyond the action of said magnet, a counterpole adjacent to said magnet also attracting the material, said counterpole also constructed to rotate.

1,071,975.—ORE CONCENTRATOR. Joseph Weatherby, New Cumberland, Pa., assignor by mesne assignments to Electric Ore Separator Co., New Cumberland, Pa., a corporation of Delaware.

Combination with a table, of means for feeding materials to be separated to said table, means for agitating said table to pass said materials gradually along the table to effect stratification and separation thereof, and means for creating a magnetic field in the path of the moving material and with the lines of force converging to lines lying in a plane coincident with the path of the body of material traveling over the table.

1,071,850.—ORE CONCENTRATOR. Henry Ellsworth Wood, Denver, Colo.

The combination with an inclined vibrating ore concentrating table of the kind described and provided with longitudinal riffles, of means for maintaining a stream of water transversely across the same at the feed end, means for feeding the material to be treated in a finely divided state upon the surface of the stream, a spillway adjacent the feed end of the table to permit the discharge from the table of the surface film of said stream with the particles floating thereon, and means for separately discharging the submerged concentrates and gangue from the table as set forth.

1,072,359.—ROCK DRILL WITH WATER FEED. Alexander Palmros, Syracuse, N. Y., assignor to The Pneumatic Electric Co., Syracuse, N. Y., a corporation of New York.

In a rock drill and a housing therefor, the combination with a reciprocating hammer in the housing, a drill steel and a chuck for said steel, of a dolly pin situated between the hammer and the drill steel, a duct in the drill steel and a corresponding duct in the dolly pin, an elastic bulb inclosing part of the dolly pin, a hollow chamber in said bulb communicating with the duct in said dolly pin and connection for supplying water under pressure to said chamber.

1,072,277.—APPARATUS FOR THE MAGNETIC SEPARATION OF ORES AND OTHER MATERIAL. Georg Ullrich, Magdeburg, Germany.

Means for producing a plurality of magnetic fields in a circle about a vertical axis, in each magnetic field two stationary poles of which the upper pole comprises lamellae adjustable vertically and independently of each other, said lamellae being downwardly sharpened, for the purpose of providing, in each magnetic field, a plurality of single adjustable zones and an extracting body revolving between said poles, said extracting body being corrugated to conform in shape with the sharpened part of said lamellae and means for conveying the material to be separated between the upper and the lower poles.

1,072,362.—SAFETY CLUTCH FOR MINE CAGES. Brereton Burgess Roberts, Cimla, Neath, Wales.

An automatic safety device for mine-cages, lifts, and the like, comprising guide ropes, a movable plate, a pair of jaws mounted at each end thereof, and adapted to grip the guide ropes, slidable collars adapted to cause said jaws to grip said guide ropes, a spring adapted to impel said sliding collars, said spring being normally restrained by tension of the winding rope, a connection between said movable plate and the cage consisting of a rod projecting upward from the cage, and passing loosely through the said plate, a block through which said rod also passes, and rods connecting said block with the aforesaid collars, said rod having a shoulder at its upper end to retain said block.

1,071,891.—GOLD-SAVING MACHINE. Loyd C. Dibert, San Francisco, Cal.

The combination of a horizontally disposed screen shoe inclining in the direction of its length and having a discharge chute extending from end to end with an outlet substantially midway of the ends of the shoe and to the side thereof, a gold-saving table extending transversely relative to the shoe and of a width greater than the discharge outlet of the shoe and less than the length of the latter, the head of the table being directly beneath the discharge outlet and the table inclining from this point downwardly, yieldable supports for the shoe and the table, a rotatable shaft arranged at a point substantially between the shoe and table and extending transversely relative to the shoe, pitman rods, one for the shoe and the table each, having eccentric connections with said shaft and adapted to simultaneously impart shaking movements to the shoe and table in relative transverse directions about their yieldable supports.

Book Reviews

Economic Geology. By Charles H. Richardson. Pp. 320. Ill., index. McGraw-Hill Book Co., 1913. For sale by the *Mining and Scientific Press*. Price \$2.50.

This book makes an excellent first impression, being well printed and illustrated with fresh, up-to-date pictures. Unfortunately, this favorable impression is not strengthened by a study of the text. The latter does not show that intimate first-hand knowledge of the subject which alone permits wise choice from the bulk of material on ore deposits now available, and the English is so poor that it is charitable to assume that in places the reverse of what is stated was what the author intended to say. For example, the statement is made (p. 3): "If ore deposits are found in the sedimentary rocks as they sometimes are (with the exception of the lead and zinc deposits of Missouri), the minerals were associated with great rock masses whose detritus furnished the material for the new geological formation." In fact, of course, the lead and zinc deposits of Missouri are preëminent among deposits found in sedimentary rocks. The illustrations, while attractive, are used with little discrimination. For example (p. 112), a figure (71) typical of the 'flats and pitches' of Wisconsin, is used as follows: "In Missouri, galenite occurs filling large cavities as chamber deposits and as gash veins; also it occurs in what is known as flats and pitches." In fact, both gash veins and 'flats and pitches' are typical of Wisconsin. The latter do not occur in Missouri with the possible exception of some rare and far from typical instances. The discussion of zinc smelting is entirely out of focus. The 'calcination process' which is discussed first (p. 265) and at more length than distillation, is of no present large commercial importance. The gain of the Kansas zinc smelters over those at La Salle, Peru, and other points where "Joplin ores were formerly treated" (p. 267) has long since been reversed; the common method of making zinc oxide is not "by burning metallic zinc," but by treatment of ore; and in other details the discussion gives a false impression. The whole book is 'off centre.' It is a pity so much good effort should have gone to waste.

RUSSIAN MINING REGULATIONS. By J. Harper. P. 144. *The Mining Magazine*, London. For sale by the *Mining and Scientific Press*. Price \$2.

The difficulties attendant upon mining operations in Russia have been said to be principally those due to politic, racial, and economic conditions, and the mining law is by no means a small obstacle in the path of the uninitiated foreigner beginning operations on Russian soil; he being constantly told that he cannot do this or that thing according to his own designs as it is contrary to the government regulations. It is therefore important that every mining engineer contemplating going to Russia be conversant with the mining laws of that country and that every company operating in Russia should supply their managers with a copy of the laws governing mining. A knowledge of the law is a protection to the engineer, in that it stands between him and almost any eventuality that is likely to arise in the conduct of mining operations. In special cases not provided for in the regulations, it is usually possible to get permission to proceed by simply furnishing the authorities with plans and descriptions of the proposed undertaking. This has been found necessary in the sinking of inclined shafts, which are not provided for in the regulations, the use of locked coil hoisting ropes and other instances. In that this edition is the only English translation of the general regulations pertaining to metal mining, every engineer interested in Russian mines should include in his library a copy.

The Chicago Portable Mine Hoist

Portable mine hoists are one of the recent improvements that are decreasing costs and lightening the work and worries of underground managers. The Chicago Pneumatic Tool Co. has perfected a hoist of this type that has a number of novel features sure to commend it. The weight is 300 lb., so that the hoist may be handled as easily as a drill. It may be mounted or dismounted in a few minutes and is so small as to be easily stowed out of the way. It may be mounted on a column bar or set as a stationary hoist. It is described by the makers as below.

The Chicago portable mine hoist operates by a reversible two-cylinder pneumatic motor through a chain of gears cut out from solid steel and hardened. This gearing is so designed that a brake is unnecessary. It instantly and positively locks, whether in raising or lowering the load, the moment the motor stops, and it is impossible for the load to slip even though the air is cut off for a whole day. The hoist will coil 200 ft. of $\frac{3}{16}$ in. wire rope and hoist 650 lb. at a rope speed of 90 ft. per minute. This it is guaranteed to do with 80 lb. air-pressure, but as a matter of fact is tested with much heavier loads. The hoist is so designed that the rope cannot possibly run off the drum. The gears are incased in a closed gear box, which not only protects the teeth, but also insures the careless operator against personal injury and permits of automatic lubrication. The motor consists of two double-acting oscillating cylinders set at right angles in a closed case. There is no movable valve mechanism, as the oscillation of the cylinders opens and closes the ports. A quantity of oil is kept in the case, so that the crank in revolving lubricates itself and dashes the oil on the cylinder seats, from which the air carries it through the inlet ports in sufficient quantities to thoroughly lubricate the pistons. The air is controlled by a slide valve, which closes when in the central position and starts or reverses the motor as it may be thrown to the right or left. The valve is thrown by a lever. When this lever is released by the operator the valve is self-closing. This automatic action of the valve positively eliminates all danger of the hoist creeping and doing damage due to a slight displacement of the valve, since it is necessary to hold the valve open in order to admit any air to the cylinder. The cylinders are bored true, and automatically adjustable to their valve-seats, the adjustment being simple and made from the outside of the motor case. The piston rods are ground. The stuffing boxes are ample and contain sufficient packing for long wear. All bearings are bronze bushed.

The Younger Generation of Rock-Drills

*One of the most useful additions to the rock-drill family in recent years is the perfected hand hammer-drill, known in various mining districts by different terms of endearment such as 'Plugger' drill, 'Jap' drill, or 'Jackhammer.' This general type of drill is now extensively employed for such purposes as sinking shafts, digging trenches, in road work, trimming tunnels, breaking up boulders, quarry work, stripping coal land, picking coal bands, tearing up pavements, foundation work, 'glory-hole' mining, and similar operations.

The hand hammer-drill is essentially a one-man machine, its weight being 20 to 50 lb., and this has brought the type into general popularity. This is aside from the fact that the hand hammer-drill may be used in restricted quarters and more drills may be employed per unit of space, due to the absence of mounting and the elimination of helpers. The adoption of such unmounted drills has been accomplished without any sacrifice of speed. On the contrary, they have proved a material aid in securing results greater than could

*Furnished by Charles A. Hershberg of the Ingersoll-Rand Company.

be obtained with other types, and this is leaving out of consideration certain other advantages inherent in the hand type. It must be kept in mind, however, that this article applies only to work for which the hand hammer type is adapted. There are certain limitations to the possibilities of the type which will be referred to later.

The time factor in drilling may be considered as made



AUTOMATICALLY ROTATED HAND DRILL.

up of the following elements: Setting up the drill; drilling the hole; shifting position; removal.

The hand hammer-drill is used without mounting. Hence the time for setting up is eliminated. The time consumed in drilling the hole may be said to depend upon the size of the hole to be drilled, the method of applying the power to the bit, the facility with which steels may be changed, and the manner in which the drill-hole is kept clean of cuttings. With the types of mounted drills in which steel reciprocates with a piston, it is necessary to employ steels of large diameter, with correspondingly large bits, owing to the heavy crushing done by every blow and the severe shocks to which the steel is subjected. Moreover, a certain amount of power is consumed in the rubbing of the bit against the walls of the hole, which results in very rapid wear of the bit unless sufficient metal is provided.

In contrast to this, the hand hammer-drill under discussion employs the hammer principle for delivering the blow. The steel is not reciprocated with the piston, but rests loosely in the chuck and is struck a great many light blows by a

rapidly moving piston; the bit end of the steel being at all times against the rock. It will be evident that the lateral movement of the steel is very slight (the rebound only) as compared to the reciprocating of several inches with the mounted type. With the hand type, the great reduction in rubbing of the bit against the walls of the hole reduces the wear on the wings of the bit, so that bits of smaller gauge variations may be employed. In other words, to obtain a given size of hole at the bottom, a smaller size of starter bit may be employed than would be advisable with the mounted type of drill. In the one type the steel is rigidly clamped to the piston rod; in the other it rests loosely in the chuck and is prevented from going too far into the cylinder by a collar on the shank of the steel or by means of an anvil-block interposed between the end of the steel and the piston. The latter constructions mean less time consumed while changing steels and in removing steels so as to clean the hole. Of course, with types of drills having automatic hole-cleaning features the time consumed in cleaning the hole may be practically eliminated from consideration. The time required for removing the steel from the hole is still further reduced when a steel holder is employed, especially if it is of a type that can be slipped into place quickly.

In the mounted type the steel is invariably automatically rotated. In the hand type there are two methods of rotation, by hand and automatically. The drill runner must constantly rotate the drill back and forth through an angle of about 45° or the hole will become rifled, with consequent sticking of the steel and delay in removing it. A drill embodying automatic rotation will produce a more uniform hole and will relieve the operator of the most irksome part of his work, thus permitting him to work faster and with little or no necessity for periods of rest.

The time required for mounting and for the various operations of shifting mounted types of drills is often greater than the actual time of cutting, whereas with the hand hammer drill this element is practically eliminated, it requiring but a few seconds to shift.

When it comes to removing the equipment preparatory to blasting, the absence of mounting, aside from the great disparity in weight (about 250 lb. as against 40 lb.) is an important item in favor of the newer type of drill.

Of course, this type of drill has its limitations, principal among which is the depth of hole that may be drilled economically. This varies, depending solely upon the nature of the ground to be drilled. In extremely hard rock the drilling range has been as low as 5 or 6 ft., in medium ground around 12 ft., and in favorable ground about 20 feet.



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EDITORIAL

THE more careful methods of mining in foreign countries, as well as the stricter regulations and supervision, result in much lower fatality rates abroad than in the United States. The statistics for the year 1911 show that the fatality rates in Australasia varied from 0.68 to 2.33 per thousand. In Great Britain the rate was 1.48; in Japan, 1.76; and in Spain, 1.49 per thousand. In the Transvaal the high fatality rate (4.14) is probably accounted for by the enormous number of native laborers employed in the mines.

COLUMBIA UNIVERSITY students, according to the report of the director of the University employment office, earned \$56,705 during their summer vacation. The vocations of the 460 students who worked during the summer were both numerous and varied, including all the arts and trades from boot-black, plasterer, caddie, and baker, to fakir at the country fairs. With such a variety of talent being yearly moulded into doctors, lawyers, and engineers, we can but realize what an important position our great universities hold in the shaping of the youthful mind and giving direction to its efforts.

IS Wall Street the barometer of business conditions in the United States? No doubt this is generally thought to be the case, yet we venture to question it. One of our contributors has succinctly remarked that "the eastern investor is a speculator in stocks and not a buyer of mining claims." According to newspaper headlines we are informed that Wall Street was hard hit by the poor trade in 1913, and that the past year was almost a calamitous one in business circles generally. Yet on another page of the same paper we read that the year's exports were the largest in the history of the United States, and that the balance of trade in favor of this country exceeded the records of any previous year. Incidentally we note that the importation of diamonds and other gems broke all records, the value being about \$46,000,000, or more than half that of the total gold production of the country. The recent depression in Wall Street seems to be less indicative of poor business conditions than of a tendency on the part of the public to cease speculating, both in Wall Street and in mining claims, and to use their money for personal adornment.

Discovery Versus a Permit System

Discovery, as the proper basis for title to mineral lands, is discussed in detail and with great clearness in this issue by Mr. W. E. Colby, whose knowledge of the facts and the law in the case, as well as his disposition to be constructive rather than merely a 'standpatter,' lends great weight to what he says. Probably few have realized how ancient and how widely recognized the right of discovery is, and it is true, as is urged, that a rule found good for so many years and by so many different peoples, must have merit. It is also true that in legal matters it is wise to build on to an existing system rather than to be too ready to start with a clean slate. All this may be admitted without materially weakening the position of those who urge that the time has come for radical changes. We are confronted by certain stubborn facts, and out of them demand for revision has arisen.

In the first place, there are the withdrawn lands. Initially only coal lands were withheld from entry "pending classification." Later oil land, phosphate lands, potash lands, were added to the category, and now—and we understand that of this Mr. Colby approves—even presumed copper-bearing lands have been withdrawn in certain areas where there are no surface showings of the orebodies assumed to be present at depth. Furthermore, it seems entirely probable that there will be more classes of lands withdrawn in the future than the reverse. In the second place, the public domain is passing under private ownership with great rapidity. Figures need not be quoted, as the fact is one patent to all who live in the Western states. The bulk of the land is being acquired as non-mineral land, even in regions where there would seem to be a good presumption of mineral. Unless some measure be enacted and some step taken, there will soon be little land left for "free exploration and discovery." Finally, it is generally admitted by those who have watched the search for ores that the opportunities for making discoveries of ore-shoots at the surface, by the simple methods of prospecting hitherto in vogue, are becoming extremely rare. To find additional orebodies, we must, in general, adopt newer and more expensive methods of exploration. These require longer time, and as they involve more expense they warrant granting larger areas to the one undertaking the venture. Also, they warrant giving such explorer, during the period prior to discovery, more than a shadowy and constructive right to undisturbed possession of the ground that he is trying to prove to be mineral in character. In fact, under the present law such an explorer is put to needless anxiety and useless expense. Take as a case a secondary copper deposit similar to that at Miami. What good purpose is served by covering such ground with 'quartz locations'—each with a theoretical extralateral right—and either requiring or allowing the proverbial \$100 worth of work per claim during a tentative period:

especially if this work take the form of 10-foot pits in a capping 200 feet thick?

For the case of the rare 'true fissure lode,' with a shoot outcropping at the surface, the old system was excellent; but for the search for mineral in the western part of the United States as it is conducted in 1914 and must be from now on, these simple laws of our forefathers are clumsy, crude, and unnecessarily vexatious and expensive. Discovery may properly be made a condition to the giving of final title; but a form of temporary permit, coupled with withdrawal of any presumably non-mineral land from any other form of entry, or the reservation of mineral rights in all lands taken under non-mineral title in certain defined areas, may be added to the present system, we believe, with great benefit to the industry.

Gold Placers of the Marañon

New York and eastern investors are being asked to subscribe for the shares of Peru Gold Placers, Incorporated, a company formed to work certain ancient placers on the Marañon river in eastern Peru. The Company is well officered and the directorate includes Messrs. Alexis I. Du Pont and John J. Raskob of the Du Pont de Nemours Powder company; Henry H. Bowman of the Springfield National Bank; David T. Marvel, former judge of the Delaware Supreme Court; Charles S. Miller and O. R. Hartman of the Ascot Tobacco Works; and William B. Bassett of Bassett & Company, New York. It is capitalized at \$20,000,000 in \$5 shares. Of the total, 1,200,000 shares have been set aside for the benefit of the treasury and 150,000 are now being offered at \$2 per share. Subscriptions are said to have come in rapidly and it was at one time announced that the entire allotment had been taken. We understand that this was premature but that the issue has been underwritten by responsible men. The concern is being floated upon public faith in the directors and an engineer's report made by Mr. Raymond McCune. The placers are in the territory east of the Andes in which gold undoubtedly occurs and from which stories of enormous wealth to be won by mining have been coming for years. Our readers will recall the articles by Mr. Pierre Bourey and by Messrs. C. S. Haley and C. A. Rodegerdts that we have printed within the year. These gave definite conceptions of the character of the country and of the difficulties to be faced in mining or prospecting. These general impressions warrant an extremely critical attitude toward any project that appeals to the public for funds and that is capitalized at \$20,000,000. This disposition to scrutinize the matter closely is all the more warranted in the face of claims that gravel to the value of \$106,106,482 has been found as a result of one season's work in sinking test pits. It is not the first time that the 'placers of the Incas' have been reported to have been found, nor is it the first time that stories of fabulous wealth have come from the Andes.

Mr. Raymond McCune, who is general manager for the Company and at the same time makes the report upon which stock is offered the public, is a son of Mr. A. W. McCune, at one time of Salt Lake City and well known as an able railroad builder in the countries along the West Coast of South America. Mr. Raymond McCune is not, as is stated in advertising literature circulated for the Company, a graduate of Columbia. He left the school in fact without graduating and with numerous conditions. This would by no means prevent his later becoming a good engineer. It is, however, to his discredit that advertising literature is allowed to be circulated claiming for him graduation when this is not in accord with the facts. Mr. McCune has had extensive experience in connection with his father's railroad projects and may be safely assumed to be entirely familiar with the country in which it is proposed to mine, and with the conduct of expeditions through, and business enterprises in, such a country. From that point of view his experience has been excellent. His ability to test placer ground is less certain and must be judged by the report to which he has put his name. Here, as it seems to us, the evidence is inadequate to sustain the conclusions drawn. The deposit is taken at 22,966 yards long, 317 yards wide, and 18 yards deep, and the resulting 131,150,840 cubic yards is assumed to have an average value of 80.9 cents per yard. This average value was obtained by combining the results of 185 test pits. There are several doubtful points, among which we may call attention to the fact that Mr. McCune has assumed an average depth of 18 yards. Only two of his test pits were put down to bedrock. There may or may not be a depth of 18 yards of gravel present. Another doubtful point is the method of mining that is proposed. It is obvious from the report, together with the photographs and maps, that the usual simple method of hydraulicking would be absolutely impossible of application on this property. The conditions are quite unlike those at California placers, where the gravel in high banks can be washed down into sluices by means of giants. It should be evident to anyone that this easy and inexpensive method would be quite inapplicable to the Marañon placers, where nearly all of the gravel lies below the level of the river. The question of dump room and disposal of tailing is a vital one that has not been adequately discussed in the report. We find no estimate for hydraulic elevators; and provision for a 3000-foot diversion canal only, although the total length of the claims is said to be about twenty miles. The internal evidence obtained from a careful reading of the report convinces us that the testing and sampling of these placers was not done by thoroughly experienced men, however painstaking and careful they may have been. No engineer qualified in the testing of alluvial deposits would attempt to estimate more than a hundred million cubic yards of gravel when only one or two pits had been sunk to bedrock; nor would he sink test-pits in the irregular and unsystematic manner that is described in this case. In

placers of this type it is necessary to sink series of closely spaced shafts or drill-holes to bedrock along lines drawn at right angles to the course of the river, these lines or sections being spaced at regular intervals throughout the entire length of the valley to be sampled. In this way only can accurate data be obtained concerning the distribution of the gold and the average value of the profitable gravel areas. Mr. McCune reports that he collected the black sand obtained from the samples of gravel, had this assayed, and then added the value of the gold from this source to that of the free gold obtained by panning. This practice is misleading and erroneous, inasmuch as rockers and pans will save all of the gold that can be caught in the sluices in actual practice. In addition he fails to give the depths of any of the test-pits; and gives arithmetical averages of the gold values, instead of averages correctly weighted according to the depth of the shafts and their spacing.

It is also to be remembered, with all due respect to the engineer who signs his name to this document, that this is a vendor's report; and studying the plan of capitalization it becomes evident that the 'insiders' are to have the large share of any potential profits. If all the 1,200,000 shares set aside to finance the property are needed, the insiders' share will still amount to nearly three-quarters. If, as is hoped, part of these treasury shares can be cancelled, the promoters' share will be larger. There is just one other point that may fairly be recalled in this connection. The McCune-Haggin interests were last year interested in the Ambo placers on the Huallaga river, not in the same district, and were prepared to spend considerable money upon their development when it was discovered that the samples upon which their faith was centred had been salted. We are unable to say whether Mr. Raymond McCune was a member of the syndicate that came to grief in this way or not, but the fact that responsible officers of the leading American mining company in Peru were deceived in such a matter is another reason for caution in this case. We have been among those who have faith in eventual development of important gold mines on the east side of the Andes, but repeated failures suggest that no larger expenditures be undertaken except after complete verification of the first glowing reports, and we respectfully urge the men who are serving as directors of this new enterprise to take the time necessary to check the reports that they now have before inviting the general public into such a venture.

Mr. McCune has given us an interesting and picturesque account of his journey into the jungle with a small army of retainers, and a glowing account of what he discovered. While there is no suggestion of the use of gum-drops to inspire his native workmen, we are critical enough to recall that events proved the wisdom of suspending judgment in the case of the account of the far wanderings of another eminent explorer.

Revision of the Mining Law—Discovery

By WILLIAM E. COLBY*

Much has been written of late regarding the proposed revision of the United States Mining Statutes. There seems to be a strong current running in the direction of such revision and the probabilities are that Congress will, in the near future, be urged to radically amend the existing law, if not to adopt an entirely new system.

Difficulty of Revision

It is, therefore, of the utmost importance that such action should be taken only after mature deliberation. The proposed changes and the reasons underlying such changes, should be subjected to the most searching scrutiny while the probable effect on the mining industry of the laws to be substituted in their stead should receive the most careful and critical consideration. That the general excellence of the existing law has been a material factor in the wonderful development of our mineral resources must be generally conceded. The results have abundantly justified the sagacity of the framers of the act, and for this reason, if we have outgrown the system or if some of its provisions require amendment, it would seem that the burden is on the critics to establish beyond a reasonable doubt that what they offer as a substitute will accomplish the results claimed. Unless they can practically guarantee that what they offer will materially improve existing conditions, the move will be a dangerous one and may have a disastrous effect on mining in general. Most of the criticism aimed at the existing law is of a superficial character and throws but little light on actual conditions.

Extralateral Rights and Discovery

The object of this comment is to call specific attention to some of the important details which, so far as the writer is aware, have not been satisfactorily treated by the advocates of revision. The two most radical changes proposed are the abolishment of the extralateral right and doing away with the necessity of making a discovery. Those who advocate the first change are consistent in recommending the second. If the right to follow a vein down on its dip underneath adjoining ground is denied, and vertical side boundaries are to control, then obviously discovery on claims overlying the dip of the vein and situated several hundred feet from the apex would only be possible after great expenditure of time and labor. A shaft would have to be sunk from the surface of such

outlying claims to intersect the vein in depth if the requirement of discovery on each separate claim be retained.

Is Revision Wise?

Is it wise that we should wipe out this existing discovery requirement? Let us examine the underlying reasons and anticipate if possible the consequences which must inevitably result from its abolishment. Some uninformed critics of the present law have referred to its discovery requirements as being 'an impossibility of mining law originating in America.' No one at all conversant with the origin of the discovery requirement in the mining laws of the world could possibly stand sponsor for such a statement. As Judge Lindley, in his classic work on the 'Law of Mines,' has said:

Sec. 335. DISCOVERY THE SOURCE OF THE MINER'S TITLE.—Discovery in all ages and all countries has been regarded as conferring rights or claims to reward. Gamboa, who represented the general thought of his age on this subject, was of the opinion that the discoverer of mines was even more worthy of reward than the inventor of a useful art. Hence, in the mining laws of all civilized countries the great consideration for granting mines to individuals is *discovery*.

Antiquity of Rights of Discovery

The right of a discoverer of a mine to have the preference in the concession is recognized in the mining law of nearly every country of continental Europe. In Germany in the Middle Ages, in the famous mining district of Joachimsthal, free prospectors' licenses (*Frei Schurfen*) were granted, but they gave rise to so much quarreling that they were finally abolished. Thereafter it was declared that:

"The mining regions shall be free to every miner, who shall have the right to prospect therein according to his opportunity, without the necessity of securing previous permission. Whoever, thro' the grace of God first discovers a vein shall be termed 'the first discoverer' and he shall have the first discoverer's right, viz: a *Fundgrube* (discoverer's claim). * * The Mining Director shall grant the location to no one else. * *"

Locators of claims (*maassen*) adjoining the discoverer's claim had 14 days within which to discover and expose a vein in such adjoining locations.¹ These regulations are typical of those which governed in other mining regions of Germany and Austria.

In more modern times in Germany the discovery of a vein must be followed by its regular denunciation. The actual discoverer has, for one week after his discovery, the prior claim. As in our American law,

*AUTHOR'S NOTE.—A portion of the material used in this article has been prepared for and permission to publish given by the Carnegie Institution of Research, Washington, D. C. The author is also indebted to his wife, Rachel Vrooman Colby, for valuable aid in translation of foreign authorities on mining law.

¹The foregoing information is found in 'Speculum Juris Metallici,' by Sebastian Span. It is one of the most comprehensive treatises on mining law of the early Germanic period and was published in 1698.

the discovery point must lie within the claim as laid out.²

European Practice

The French and Belgian law of mines, while not giving the discoverer an absolute preference to the concession of a mine, placed him in the list of preferred applicants. The Spanish and Mexican laws were still more liberal, for they secured to the discoverer an absolute right of property in the mine which he discovered and denounced, and no one could have any preference over him. Other persons who came after the first discoverer were entitled to take up claims "as they shall discover ore." They could not set up stakes unless they had first discovered ore. In Prussia and Sweden, he who first discovered a vein, layer, mass or bed of ore, had a right to receive the concession in preference to any third party.³ In England in the lead-mining districts of Derbyshire, where the right of free mining existed, the discoverer of a mine was entitled as a matter of right to have his claim allotted him by the Barmaster, but this could not be done "till Ore be gotten in the same ground to free it withal."⁴

It may seem strange that countries like Spain and France should have requirements in their mining codes so similar to those of Germany. Germany was the birthplace of free mining, and one would naturally expect the Roman and civil law to have had greater influence in moulding the mining institutions of these other countries bordering on the Mediterranean. This is not the fact, however. The German States had made such a success of mining, and developed the art to such a high degree, that all of the other European countries were compelled to look to it for enlightenment. In doing so they also assimilated some of the ideas of free mining which had there attained so vigorous a growth. Gamboa, in his famous 'Commentaries on the Mining Ordinances of Spain,' states that the King of Spain appointed a commission to examine the mining laws of the world with the idea of selecting those best suited to the development of the provinces in the New World, and that after exhaustive consideration, those of Germany, with their right of free mining, were found best adapted.⁵

Extensive research confirms the conclusions of the foregoing authorities. Discovery, as we are familiar with it, sprang into existence contemporaneously with the assertion of the free miner's right. This was an

early Germanic institution, similar in its origin to other examples of an exercise of free and independent personal privilege as opposed to the restraint of despotic sovereignty which have been handed down to us and become a part of our own institutions. The free miner's right involved the privilege of going out on land, usually wild and uncultivated, even though owned by some prince or royal owner (this being the equivalent of our public domain), and discovering and locating a mining claim without the express permission of such owner. This right became so general and so well established, that the royal owners were finally forced to recognize it as a valid custom, and thereby yielded up one of their prerogatives of ownership. In short, the free miner decided for himself what land he would locate, and the ostensible owner of the land had very little or nothing to say about who should be allowed to work his mineral lands. A discovery was essential in order to identify the land claimed, stamp it with mineral character, and segregate it from the great bulk of surrounding land. This free miner's right was confined to mineral land, and the burden of establishing it to be mineral devolved on the free miner, and hence the necessity of discovery which furnished his proof. It was the simplest and most practical test. This same institution of free mining, somewhat modified by circumstances, can be traced into the lead district of Derbyshire, England, and it was accompanied by the same requirement of discovery founded on the same necessities.

Origin of American Mining Law

While it is impossible to state that the so-called American mining law which sprang up in the West following the discovery of gold, was directly patterned after the Germanic or Derbyshire prototypes, it is certain that our law in its genesis owes much to the spirit and reason underlying these other systems of mining law with their free miner's right. Here in the West, in the early days, the miners exercised the same free right to go out on the public domain to discover and locate mining claims. The sovereign power did not undertake to assert its prerogative, as it might have done, by designating those who should be permitted to work its mineral lands, but it gave full sway to the choice of the individual locators and passively allowed them to make their own rules and regulations. This free miner's right, first embodied in the rules and customs of the mining districts, was later crystallized and codified into the federal statutes. For the same reasons which have existed ever since the free miner's right was first exercised, the principle of discovery was thus recognized and incorporated into the American mining law. It was necessary for the individual exercising this free right to himself stamp as mineral in character the land he sought to select, and the only feasible way in which he could do this was to make a discovery of mineral. This served a double purpose, for it furnished evidence of

²'Modern German Codes,' by Raymond, 'Mineral Resources,' 1869.

³Hoover's translation of Agricola, pp. 81, 82, note; Halleck's 'De Fooz on the Law of Mines'; Delebecque, 'Legislation des Mines'; Blavier, 'Jurisprudence des Mines'; and Gamboa, 'Ordenanzas de Minas,' are authority for the foregoing statements.

⁴'The Compleat Miner,' Houghton, 1681; Bainbridge, 'Mines and Minerals' (5th. ed.), pp. 150-151.

⁵Gamboa, 'Commentarios a las Ordenanzas de Minas' (1761), p. 6. As to the influence of German mining law on that of France, see 'Das Französische Bergrecht,' Achenbach, pp. 28-29.

good faith on his part in claiming the land as mineral, and also segregated it from the public domain and prevented its acquisition by others who might seek to acquire it under the agricultural laws. As the law now stands, the miner is given the preference, and he can ordinarily defeat any agricultural claimant even up to the time of entry for patent by making a valid discovery of mineral on the land in controversy. By doing away with the necessity of discovery, what will result? No longer is the mineral claimant afforded a convenient test as to the character of the land, which it is now within his power to make, but he must look elsewhere for the determination of the controversy. Who shall decide whether the land is mineral or agricultural in character, and how? Those who advocate the abolishment of this test overlook the fact that an agricultural claimant may file on the same land. They must offer some substitute which will not only work as well as the test which they seek to supplant, but to justify the change they should offer a better test. It may be that they have such a test in mind, though it is impossible that they can have one which has withstood the wear and tear of centuries as has the one they would discard—one which was created by the miners themselves.

Classification by Government

It has been suggested that the Government shall determine whether any particular tract of land is mineral or non-mineral. This means an intensive classification of the millions of acres comprising the 'public domain.' While this land is being classified, what is to be the status of mineral filings? And after it has been classified, what likelihood is there that in innumerable instances the actual character will be properly determined? Prospecting will then have become a 'lost art.' With the greatest respect and admiration for the splendid work that has been and will be accomplished by the government geologists, the writer feels that they would be the last to claim that they could perform such miracles. But it may be urged that the determination shall be made by the Government after the claim is filed on by the mineral claimant. One can imagine the delay and intervening uncertainty of title which would result if some prospector in a remote part of the public domain had to notify a government inspector of his desire to acquire title to a claim and had to await the arrival and inspection and confirmation of report of the government agent. The writer has personal knowledge of a case where the applicant had to wait two years for the government inspector's report on a patent application for a lode mine existing in a remote and mountainous region of California. This instance is not cited by way of complaint, but merely as evidence of what will inevitably be the condition if the burden of classifying the character of the land is shifted from the prospector to the Government. It means abandoning the right of the miner to deter-

mine for himself by discovery the character of the land he seeks to acquire and compelling the Government to assume the burden. And who is to pay the expense of such government inspection and determination? When the government inspector arrives on the ground will he not, in all probability, in the great majority of cases, base his determination of the character of the land on the same evidences that the prospector and miner himself ordinarily accepts as a sufficient discovery?

Legal Protection of Discoverer

Under the present law the prospector knows that as soon as he has made his discovery he is entitled to his ground and can enforce his right in the courts, where the long line of well considered decisions on the question of discovery will be followed. When discovery has been abolished, however, he can have no such assurance. The protection of the courts based on long established precedent is no longer his. The determination of the character of the land will rest elsewhere, and the miner will have sacrificed one of his strongest safeguards, founded on centuries of mining experience.

The element of discovery is firmly established in our system of mining law, as is evident from the following expressions of opinion by the Supreme Court of the United States:

"Discovery is the all-important fact upon which title to mines depends." (Lawson v. United States M. Co., 207 U. S. 1, 13.)

"The whole scope of the chapter (Chap. 6 of Title 32, Rev. Stat.) is the acquisition of title from the United States to mines and mineral lands, the discovery of the mineral being, as stated, the initial fact. Without that no rights can be acquired." (Creede and Cripple Creek M. & M. Co. v. United T. M. & T. Co., 196 U. S., 337, 345.)

"In all legislation, whether of Congress or of the State or Territory, and by all mining regulations and rules, discovery and appropriation are recognized as the sources of title to mining claims, and development, by working, as the condition of continued ownership, until a patent is obtained. And whenever preliminary work is required to define and describe the claim located, the first discoverer must be protected in the possession of the claim until sufficient excavations and development can be made, so as to disclose whether a vein or deposit of such richness exists as to justify work to extract the metal. Otherwise, the whole purpose of allowing the free exploration of the public lands for the precious metals would in such cases be defeated, and force and violence in the struggle for possession, instead of previous discovery, would determine the rights of claimants." (Erhardt v. Board, 113 U. S., 527-535.)

The foregoing is sufficient to indicate that discovery has played an important part in the history of mining law of the world and is the most vital requisite of the law as it exists in the United States today. Not only is this fundamental requirement incorporated in the federal statutes, but practically every mining state in the West has enacted this provision into its supplementary statutes. If discovery be abolished, not only must the federal statutes be amended, but each

state will be compelled to alter its own statutes to harmonize.

The Law Now Well Understood

More important than all else, the mining laws with relation to each other, and with relation to all of our public-land laws, have, during the years of their existence, been interpreted by the courts; and we have now built up on these laws a superstructure consisting of a long line of decisions worked out after years of painstaking effort, harmonizing and correlating and unifying not only the mining laws themselves, but also these laws in their relation to the non-mineral public-land laws. Decisions involving the effect of discovery of mineral exist with relation to homesteads, town-sites, desert lands, timber lands, railroad lands, state lands, national forests, etc., and almost every imaginable problem that can arise where discovery is involved has sooner or later been presented and decided. This judicial interpretation of the effect of these laws with relation to one another is as important in its way as is the organic law itself which it interprets. It is more important in one sense, for the fundamental law may be enacted 'over night,' as it were, while the judicial interpretation and harmonizing of these laws is a matter of a great many years of laborious development.

The law as it exists is now well understood all through the mining regions. Rights innumerable have become vested and are being exercised, and to make a radical change will materially unsettle conditions for years to come. To wipe out at one stroke all of these statutes and all of this superstructure of judicial interpretation will be a most serious mistake unless something materially better is offered in its stead. The burden rests heavily on the proponents of revision to establish this, for we are giving up the result of years of labor and cannot afford to take in exchange some substitute that somebody or other thinks will improve conditions, unless it is quite certain that it actually will have the beneficial effect claimed. We must have some valid reasons that cannot be satisfactorily covered by amendment to the existing law.

A Way Out

No one conversant with the facts can, however, fail to recognize that the existing mining law is deficient in many respects and has been stretched to cover conditions it was never intended to govern. This is particularly true in the case of a discovery requirement as applied to deep-lying oil-bearing strata, zones of secondary enrichment constituting the so-called 'copper porphyries,' and gold placers of Alaska where the 'pay streak' can only be reached by sinking through many feet of frozen overburden. To such deposits the rigid discovery requirements should not apply. But, on the other hand, because the law as to discovery has imperfections is no reason for abolishing it *in toto* unless its shortcomings are incurable by amendment.

This entire condition can be remedied very simply by

applying to such exceptional cases the following equitable doctrine which has already been announced many times by the Supreme Court of California:

"If a qualified person peaceably enters upon public lands of the United States for the purpose of discovering oil or other valuable mineral deposits therein, and such land is at the time unoccupied, and there is at the time no valid mineral location or lawful entry thereon, under the land laws of the United States, such person has the right to continue in possession so long as he continues to occupy the same to the exclusion of others, and diligently and in good faith prosecutes thereon the work of endeavoring to discover such mineral therein." (Smith v. Union Oil Co., 135 Pacific Reporter, 966-967, and cases cited.)

The citation from *Erhardt v. Boaro*, already quoted, is also an announcement of the same doctrine by the Supreme Court of the United States. It is true that some courts have limited the locator's right prior to discovery to his *pedis possessio*, or ground that he actually has in his physical possession," but it would seem that this is taking too narrow a view of the situation where the locator is using due diligence in perfecting a discovery. The United States, through its mining statutes, has extended to him a tacit invitation by declaring that all of its mineral lands are "free and open to exploration and purchase." When he enters upon such lands in good faith, intending to demonstrate their mineral character by making a discovery with reasonable diligence, the Government should protect him to the extent of his located boundaries of lawful size and thereby prevent acts of violence and unseemly contests in a struggle for possession.

The California doctrine is clearly the equitable one, and if there is any uncertainty about its being the law, it can readily be codified by Congress as an amendment to the mining statutes. This will overcome many of the objections to the rigid discovery requirement.

Mineral Versus Agricultural Lands

There is another objection which has been raised against the existing law by reason of the possibility of agricultural filings being made on such lands containing deep-lying mineral before the mineral claimant has had a chance to make a discovery. The remedy for such cases is clearly one which has already been utilized in the oilfields and in the case of 'copper porphyries.'

Where such areas have been satisfactorily demonstrated by adjacent indications or discoveries of mineral to contain, in all probability, the continuation of such deposits, the land department can withdraw them from agricultural entry for a sufficient period of time to enable prospective mineral claimants to demonstrate the actual presence of mineral by discovery. Under existing law the Government can in this way extend every protection to the miner. The pos-

"Hanson v. Craig, 170 Fed., 62; Gemmel v. Swain (Mont.), 72 Pac., 662.

"34th Ann. Rep., Director U. S. Geol. Surv., p. 154; also, Bulletin 537, U. S. Geol. Surv., pp. 40-41.

sibility of serious difficulty from an agricultural claimant prior to discovery is rather remote even in the absence of a withdrawal from agricultural entry. The agricultural claimant must file his application under the land laws in the land office, and the miner has every opportunity of calling the land department's attention to the probable mineral character of the land by protest. The department has in several instances already decided that it is not necessary that there be an actual discovery of mineral on the land in order to cause it to deny the agricultural application or withhold determination pending discovery work by the mineral claimant. Adjoining indications of mineral are sufficient to justify the department in taking such action.⁸

The experience of 'scrippers,' homesteaders, and other pseudo-agricultural claimants in the oilfields is evidence of the fact that the Government will not permit land with mineral indications to be patented under the non-mineral laws. If this protective action has not been exercised widely enough, it is possible to extend it simply by convincing the land department of an existing necessity. The miner's status can be further strengthened, if deemed necessary, by appropriate legislation.

It will appear from the foregoing discussion that to do away with the necessity of discovery is to amend our mining law fundamentally. It shifts the power of establishing the character of the land in the first instance from the miner himself to the Government. Whereas the miner has in the past been given the preference, wherever he could establish a valid discovery, any alteration in the law such as proposed gives rise to new and unfathomed complications. Where agricultural claimants assert title to the same land, and where national forests are involved, the miner is not likely to profit by doing away with discovery. Under a new law placing the determination of the question of mineral character in the hands of others, he may awaken to the fact that he has "sold his birthright for a mess of pottage."

It may be that the difficulties pointed out can be overcome and that some one can suggest an alteration of our mining code, fitted to our conditions, which will not work a hardship on the miner. But the old adage must be kept in mind that it is easier to tear down than to build up. The proposal of abolishing the extralateral right also deserves careful consideration, but the subject is too large to be dealt with in this article.

To guard against sudden invasions of rebel bands at the El Favor Mining Co.'s properties in Mexico, the principal buildings were surrounded by a high wall and towers from which a defense could be made. A little tact with the 'insurrectos' has at the same time been of great benefit to the management.

⁸Skinner v. Fisher, 40 L. D., 112, 116; also, see an unreported decision appearing in the *Mining and Scientific Press* of July 27, 1907, p. 123.

Bisulphite Zinc Process

The Metals Extraction Corporation, Ltd., has been conducting experiments with a process designed to treat mixed sulphide and tin ores. A 25-ton plant has been in operation at Swansea, and experimental work has also been under way in Wales, Tasmania, and Sweden. At the company meeting held in London, December 29, H. T. Durant gave the following particulars.

"If one traces from its inception the bisulphite process, we find that its evolution has been strikingly similar to, and by no means slower than that of other metallurgical discoveries. The bisulphite process has always appealed strongly to all metallurgists after the briefest explanation of its claims and objects, for the reason that nothing but water and power is required for its operation, and its chemistry is simple and does not admit of discussion. Briefly, the process consists in roasting ores containing, among other valuable metals, zinc. During the actual roasting there is given off certain impure acid gases; these latter are dissolved in water, and the acid water thus produced is used to dissolve the zinc out of some of the already roasted ore, producing, on the one hand, ore free from zinc and, therefore, now of value for its other contents (for example, lead and silver), and, on the other hand, solution containing zinc, which zinc is recovered as zinc oxide by the agency of heat. The work naturally divides itself into three distinct sections, namely: (a) roasting the ore; (b) dissolving the zinc out of the roasted ore by means of the acid gases given off during the roasting, and thereby producing ore free from zinc and also zinc solution; and (c) recovering zinc oxide from the above-mentioned solution.

"None of the standard types of furnaces met our requirements until we had succeeded in evolving a furnace of our own, simpler than any of the standard roasting furnaces and free from royalties or other encumbrances. We had to provide for roasting complex ores under certain well defined conditions; such complex ores (because, to a great extent, a drug in the market) had not previously been commercially roasted. The first means employed was to obtain the pure acid out of the acid gases given off during the roasting of the ore, then to stir the ore in closed vessels with water, and pump the acid into it, thereby dissolving the zinc. This procedure was abandoned for several reasons; it is sufficient to state one, namely, that up to the present it is not possible to make a pump which will pump the acid gas. The next method tried was an improvement in that no pumps for acid gas were required; this method succeeded metallurgically, but we had to abandon it because the smell of the acid solutions was such that it was impossible for men to work on the plant. Here we succeeded metallurgically, but failed from a humane point of view. Now, by certain plant modifications, involving none of the previous disabilities, we have succeeded in putting the process to work on a commercial scale."



Tin Mining in Bolivia

By G. W. WEPFER

The following notes are extracted from studies, and observations made in Bolivia together with information which I have taken from the work of Sr. Pedro Aniceto Blanco, entitled 'Monografie de la Industria Minera en Bolivia,' published in La Paz, 1910.

Pedro de la Gasca founded the city of La Paz in 1548 and this date may be taken as the beginning of the mining industry in Bolivia, the 'Peru alto,' of the Spaniards. They had undisputed sway until 1781, when the Indians rose in revolt from Cuzco, Peru, to Tucuman now in the Argentine Republic. In 1805 a new Spanish army returned to Bolivia to reconquer the lost provinces, but after twenty-four years had to give up the attempt. During this period mining was being intermittently conducted in different parts of the country.

The Spaniards were not seeking tin; they wanted only silver and gold. They found tin in many of their silver mines, tin veins frequently running parallel with the silver veins, sometimes being intertwined with veins of silver in such condition they could not be mined separately. As far as possible, the early Spanish miners avoided the tin ore, but now the conditions are reversed and in the same mines the silver ore is left in place and the tin is mined.

Where the tin ore is in the form of oxide as cassiterite SnO_2 , it is crushed, concentrated, sacked, and shipped. Where it is in form of sulphide, as franckeite, $\text{Pb}_5\text{Sn}_2\text{Sb}_2\text{S}_{12}$ or $2\text{PbSnS}_8 \cdot \text{Pb}_3\text{Sb}_2\text{S}_8$, it is crushed dry, roasted and leached with hyposulphite of calcium and the tailing is concentrated. The hyposulphite solution is precipitated and this silver precipitate is washed, dried, and sacked. The tailing is classified by spitzkasten, the spigot discharge goes to jigs, the overflow is again classified into sand and slime and treated on sand and slime tables. The jig middlings are reground, separated by spitzkasten again into sand and slime and run over sand and slime tables. According to the ores, separate concentrates can be obtained of tin, gold, copper, lead, and antimony.

I have the detailed records of 115 tin mines, and there may be as many as 25 more tin prospects. These 115 tin mines may be divided into three classes, viz: 44 are good mines, some of which requiring more capital to operate; 27 are financially embarrassed and able to do but little development work on their tin veins; and 44 are prospects. Bolivia has nine departments, but only in four departments, namely, La Paz, Cochabamba, Oruro and Potosi are tin mines to be found. To afford a general idea as to the condition of tin mining in Bolivia, I give herewith the detailed operations of a number of the better and larger tin mining companies.

Department of La Paz

The Sociedad Anónima de las Minas Huaina-Potosi y Milluni has 653 hectares of mineral land (1 hectare=10,000 square metres=2,471 acres) on which are about 20 veins of tin and bismuth with an average content of 5 per cent tin. The monthly production amounts to 1000 Spanish quintals, (1 Spanish quintal=101.4 lb.) of concentrate of 55 to 60 per cent tin. The Company employs 200 men at a daily wage of 1.20 Bolivianos to 2 Bolivianos (\$0.60 to \$0.80). Bolivia has an agreement with the Bank of England whereby the bank accepts $12\frac{1}{2}$ Bolivianos for £1; 1 Boliviano equals about \$0.40. The Company has a good concentrator, also good houses for officers, and miners. The property is $12\frac{1}{2}$ miles by a good wagon road from La Paz.

The Mina Kala-uyu property consists of 450 hectares in the mountains of the Autajahua and Pacolla, Cercado province. The veins contain 10 per cent tin. The ore is stannite= $\text{Cu}_2\text{S} \cdot \text{FeS} \cdot \text{SnS}_2$. The production amounts to 800 quintals of concentrate per month of 60 per cent tin. The Company employs 20 men, who work by contract and receive 16 Bolivianos (\$6.40) per quintal. The Company has a good future, but will need \$50,000 to open a tunnel and build a concentrator, (at present the concentration is done by hand sorting by Bolivian women) and an aerial rope way to convey

the ore from the mine. The property is $9\frac{1}{2}$ miles from the railway from La Paz to Guaqui.

The Empresa Providencia property consists in 300 hectares upon the mountains of Chilaya and Chunchumany. This property has 40 veins which average 10 per cent in tin. The production varies between 150 and 200 Spanish quintals of concentrate of 68 to 72 per cent tin; employs 30 men at a daily wage of Bs. 1.20 to Bs. 2.50 (\$0.48 to \$1.00), and has a small concentrator,

wide and of an average content of 8 per cent. At the intersection of veins, the ore assays from 40 to 50 per cent of tin and contains many fine large specimens of cassiterite. There are 20 veins of uniform size and grade in the property. On the property are lakes Guallatani and Kasiri. Lake Guallatani is 4920 ft. long by 1640 ft. wide and at an elevation of 16,138 ft. above the sea. This water will be used for power purposes. It has a fall of 1476 ft. and could develop power for many mines in the locality.

The mineral area of this Company consists of 214 hectares. This Company is new and has not yet completed its equipment. The reserve of 13 per cent tin ore in sight amounts to 200,000 tons. The capital of the Company is £280,000.

The Concordia property was first known as the Andes Tin Company and was organized in Boston, Mass., with strong capital. The property comprises 477 hectares of mineral ground in the vicinity of Santa Vela Cruz. The ores contain from 3 to 19 per cent tin and the production averages about 200 Spanish quintals from the veins and from old dumps, but it is expected to be greater as soon as the new installations are completed. The concentrator includes a stamp battery, Chilean mills, jigs, and Wilfley tables. The Company has a hydro-electric power-plant and about 70 men at present occupied in road making. The Company has warehouses at the railway station 'Eucalipto,' as well as at 'Caluyo,' which serve as deposits for material in transit to the mine.



and houses for staff and workmen. The Empresa de Estaño en Araca has 502 $\frac{1}{4}$ hectares at Viloco. There are two large veins each two metres wide which carry from 12 to 19 per cent of tin, and produce 2000 to 2500 quintals of 60 to 65 per cent concentrate of tin per month. These veins produce the beautiful large specimens of cassiterite, the finest in the world, which can be seen in the National Museum at La Paz. This company employs 225 men. A branch railway to the Viacha-Oruro railway would greatly benefit this Company and with additional capital the mines could have a much greater production.

The Monte Blanco property is in the valley of Guallatani of the Cordillera Quimza-Cruz at an altitude of 17,984 feet. The veins are as much as two metres

Department of Cochabamba

The Minas de Tucsumuma is an Argentine enterprise which controls 64 hectares mineral ground upon the mountains of Tucsumuma and Jatum-Kaka in the mountain range of Colcha. One vein is a metre wide containing 3 to 4 per cent tin. The main tunnel 'Escorial' is lined with hewn stone and affords access to all the interior workings. The production is 500 quintals of concentrate of 65 per cent tin. The mine employs 140 men who receive Bs. 2 (\$0.80) per day. There is a mill on the property, but for better work a wagon road, from the mine to Colcha, connecting with the railway from Oruro to Cochabamba, and more capital is required. The Santa Rosa Company has 35



50-TON TIN CONCENTRATOR, ANDES TIN CO., LA PAZ, BOLIVIA.

hectares upon the mountains of Huallacocohi and Tuesuhuma in the Canton of Colcha. There are two veins, 3 metres wide, containing 8 per cent tin. The property is in a state of development at present with a short tunnel 200 ft. long, and is expected to produce 500 quintals per month. The Company would be benefited by a concentrator and a wagon-road about 6 miles long from Tuesuhuma to Colcha.

The Berenguela Tin Mines, Ltd., own 50 hectares in the Berenguela mountains in the Canton of Colcha. Within this area are 2 veins in tin, each 3 metres wide, carrying from 3 to 4 per cent of tin. The actual production per month is 700 quintals of 64 per cent tin concentrate. There are 73 men employed with a total monthly expense of Bs. 1200. The work is restricted on account of the scarcity of water for the mill. Without this difficulty the Company could easily produce 1000 quintals per month.

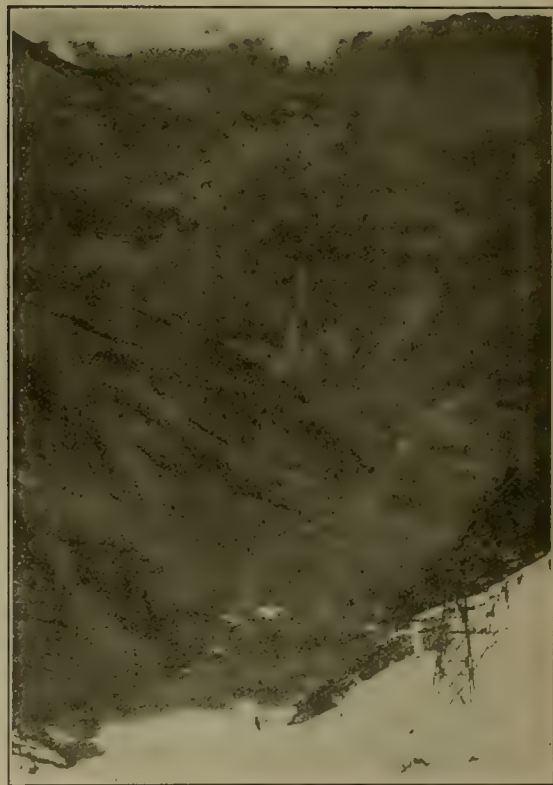
Department of Oruro

Empresa del Socavón de Oruro y Dependencias is also known under the old name Compañía Minera de Oruro. It belongs to the Bank of Chile in Santiago and comprises 252 hectares. There are 10 principal veins of an average content of 6 per cent tin and 12 marcos silver per cajon. The tin occurs as sulphides and oxides. The monthly production consists in 1121 metric tons of 10 marcos silver per cajon and 7 per cent tin; the oxides of 336 metric tons with equal con-

tent of silver and tin. The Company employs 770 men with a daily wage of Bs. 0.80 to Bs. 4 (\$0.32 to \$1.60). The various mines have commodious buildings for offices for the staff and men at Oruro and the mine. The property is two and a half miles by wagon-road from the city of Oruro. All the minerals are conveyed to the concentrator at Machamarca, which is 18 miles from Oruro by a branch railway. The sulphides are roasted and leached, and the tailings are concentrated. In the concentrator, 290 men are employed with wages between Bs. 1 and Bs. 4.50 (\$0.40 to \$1.80) per day.

The Compañía Minera de San Jose has 87 hectares of mineral lands northeast of Oruro at a distance of only two and a half miles from that city. The yearly production amounts to 4500 marcos silver, of 100 marcos per cajon and 4500 Spanish quintals of 55 per cent tin concentrate. The Company employs 500 men with average daily wages of Bs. 2 (\$0.80). The ores are sent to the Alantaña mill in the province of Poopo on the Antofagasta Oruro railway.

The Empresa Huanuni de Penny and Duncan operates 193 hectares upon Pozoconi mountain. There are two companies at work, namely: the English company, Harrison & Co. and the Empresa Penny & Duncan. The ore averages 8 per cent tin and the monthly production is 2583 Spanish quintals of 70 per cent concentrate. The Company employs 768 men at an average wage of Bs. 60 (\$24) per month. This



VIEW FROM LOADING TERMINAL, BUILT BY TRENTON IRON COMPANY.

Company has a large concentrating plant. There are also in the town of Huanuni for the different mines of this Company buildings for offices, the staff and the men. This Company has working arrangements with the English company.

The Compañía Minera el Balcón is an English company which operates 16 different important veins on Pozoconi mountain, Canton Huanuni, Cercado province. The ore averages 8 per cent tin. The production is 3570 quintals per month of 65 per cent of concentrate. The Company has 400 men who receive an average wage of Bs. 1.80 to Bs. 4.50 (\$0.72 to \$1.80) per day. This enterprise is one of the best in the department of Oruro and has the best of equipment. The first-class ore is hand sorted to a grade of 55 per cent and sent to Europe for sale. The low grade is sent to the El Balcón mill where a 65 per cent concentrate of tin is produced. The transport of the ore from the Cataricagua mine is effected by an aerial ropeway with a capacity of 3550 quintals per hour, to El Balcón mill. A branch railway from Huanuni connects with the railway station Machamarea, which is of great service to this Company and others in that locality.

The Compañía de Estañó de Anteguerra property comprises 227 hectares with two principal veins and many branch veins. The Esperanza group is on the Chunchu mountain and produces 500 quintals of 70 per cent concentrate. The Company employs 150 men who receive an average wage of Bs. 2.50 to Bs. 3.45 (\$1 to \$1.38) per day, and 12 men with a monthly salary of Bs. 200 (\$80). The Empresa Avicaya is a company operating a property in the mountain Chuallagrande in the province of Paria, 65 miles from Oruro with a 6-mile wagon road to the station of Pazna. The holdings of the Company cover an area of 300 hectares and the ore assays as high as 40 per cent, but the average is about 17 per cent tin. The monthly production is 3500 quintals of 70 per cent concentrate. The mine shaft is 656 ft. deep. An aerial ropeway 8200 ft. long brings the ore from the mine to the mill. There are between 500 and 600 men employed. Near by are other companies with equally good prospects, but they are doing nothing on account of lack of funds.

The Empresa Magariños property consists of 110 hectares on Villacollo and Sillacollo mountains with an average of 20 per cent of tin, and at the intersection of veins as high as 30 per cent. The production is comparatively small and irregular on account of lack of funds, but 500 quintals of 65 per cent concentrate per month could easily be produced.

Department of Potosi

The Empresa Soux Hernández, on Mount Potosi, has 10 tunnel mines employing 945 men who receive Bs. 1 to Bs. 2 (\$0.40 to \$0.80) per day. In the year 1909 this Company produced 385,350 quintals. Other properties of the Company which were worked by 187 men, produced 7700 quintals with an average content of 30 to 40 per cent tin. The Company has the large

modern mill Velarde and an aerial tramway to transport the ore from the mine to mill. Besides this mill the Company operates the Huailahuasi, Quintanilla, and Pampa mills which employ 1187 men, who receive an average of Bs. 1.50 (\$0.60) per day.

Production and Wages

The Bebin Hermanos are operating five mines with 570 men, who receive Bs. 1.50 to Bs. 1.60 (\$0.40 to \$0.64) per day. The mines produce silver and also about 2500 quintals of 50 per cent concentrate of tin per month. The Company has 10 other properties which are not being worked and the modern concentrating mills Huayra and Santa Rosa.

The house of Metting is working six mines and has five others in reserve. The production is 586 quintals per month of between 45 and 55 per cent tin. There are the two mills, the Candelaria and Alantaña employing 70 men who receive Bs. 1.40 (\$0.56) per day. These mines of Eduardo la Iglesia have a good future. These comprise seven properties, but only two, the Milagro and La Patria are being worked. In the Milagro 58 men are employed at an average wage of Bs. 0.80 to Bs. 1.60 (\$0.32 to \$0.64). The production amounts to 200 quintals per month. La Patria with 80 men and the same wages produces 400 quintals. The Patria has the Lagunacayo mill and the Milagro mine has the Milagro concentrating plant.

The Cosme Alurralde Co. is one of the best mining companies on Mount Potosi and has 11 mines, but work is only carried on for the present at the Rosario property. The production amounts to 417 quintals of concentrate per month of 50 per cent tin and some silver. The Company employs 340 men, who receive Bs. 1 to Bs. 2 (\$0.40 to \$0.80) per day. At present the ore is hand-sorted.

Vladislavichy y Cia. has two mines and three mills which produce 642 Spanish quintals of 50 to 55 per cent concentrate of tin per month with 95 men. This Company has a good future. Tomas Elio has four mines and the Escalante mill which produces 400 quintals of 57 per cent tin concentrate per month. Primitivo Calvimonte has two mines and the Golpeadero and San José mills. He is working 134 men and produces about 420 quintals of 60 per cent tin concentrate. Matias de Mendieta has the two mills Chaca and Esperanza at Rivera and with 93 men is producing 1000 quintals of 55 per cent tin concentrate per month. Roman Lopez owns the Victoria and San Felipe mines and employs 120 men. The property produces 420 quintals of 50 per cent tin concentrate.

La Salvadora which belongs to Sr. Simón I. Patiño, has four hectares on the Juan del Valle mountain in the canton of Uncia and a mill which is considered the best and most complete in Bolivia: the work throughout is conducted upon best practice by careful and efficient engineers. The content of the ore fluctuates from 1 to 75 per cent tin. The mine has a depth of more than 960 ft., all of which is being exploited, using

electric rock drills with good results. The ore is raised by electric hoists, the electric power is produced at the Mira-Flores mill. The ore is conveyed from the mine by an aerial tramway 12,344 ft. long to the mill and can deliver 1500 to 2000 quintals in 12 hours. The production is 17,000 quintals of 65 per cent tin concentrate, and 3000 quintals of ore which needs no concentration, as it assays 57 per cent tin. The mine is dry and the levels are well ventilated by electric fans. A gas engine of 350 horse-power is installed to produce the electric power at 2300 volts which is reduced by transformers to 500 volts for the hoist, and to 220 volts for the rock drills and fans. In mine and concentrator everything is done to promote the welfare and hygiene of the men. There is a hospital and a school for the children.

The Compañía de Unica has been acquired by Sr. Simón I. Patiño for the sum of £150,000 cash. This was an Irish company conducted by the well known engineer, Sr. Juan B. Minchin, situated in the Chaya-guena mountains of Unica and consists of the following groups: Carmen with 12 hectares, Industria with 15 hectares, San Antonio with 12 hectares, Pizarro with 7 hectares and San José with 12 hectares. Sr. Simón I. Patiño has now two large mines, namely, the 'La Salvadora' and the 'Compañía de Unica' and will soon be able to produce 25,000 quintals per month of 62 per cent concentrate, by means of the Victoria mill of La Salvadora.

The Compañía Estañífera de Llallagua is owned by Santiago interests. It has 212½ hectares in Llallagua mountains. The Company has two large veins, the La Blanca and the San Fermin. It is 2296 ft. from the portal of the Azul tunnel to the La Blanca vein and from thence 1476 ft. to the San Fermin vein. From this tunnel a winze is sunk about 100 ft. to the new Caneñiri tunnel and from the Azul tunnel a raise is driven for 400 ft. to the San José tunnel. The Caneñiri tunnel is the principal tunnel, through which all the ore is extracted. All three tunnels have electric current for light, electric traction, and electric rock drills. The ore trains are pulled by electric locomotives. An aerial ropeway conveys the ore from the mine to the Chile mill, a distance of 16,400 ft. The production is 600 quintals per month, with 600 men. The wages are Bs. 3 (\$1.20) per day.

The Aramayo Francke y Cia. Ltd. property is one of the largest enterprises in Bolivia with headquarters at Quechisla, North Chichas. The Company has 3524 hectares containing veins of tin, bismuth, wolfram, and silver in the districts of Chorolque, Chocaya, and Tasna. The average assay of tin ore is 18 per cent and there are ore-pockets of cassiterite assaying as high as 70 per cent of tin. The rich material is hand-sorted for shipment to Europe. The Santa Barbara, Sala-Sala, and Cotani mills treat the Chorolque ore. For this district, the Company employs between 600 and 800 men and produces about 5000 quintals of 60 to 65 per cent tin. The Santa Barbara mill has an altitude of 15,777 ft.; the Cotani mill 13,133 ft., and the mines an

altitude of 17,188 ft. The ore from the mines at Tasna containing tin, bismuth, and wolfram are treated in the Buen Retiro mill. The Chocaya property has the Asllani mill at an altitude of 13,123 ft. The property is equipped with an aerial ropeway 9842 ft. long to transport the ore from the mines to the mill. There are 600 men employed at this property, producing 6373 quintals per month of 55 to 60 per cent tin concentrate. The yearly production of this Company is about 71,700 quintals of tin concentrate. The wages vary between Bs. 1.20 and Bs. 5 (\$0.48 and \$2) per day. At Quechisla, the Company has a new installation for the smelting of ores of bismuth and copper, an electric power and light service and good buildings for the staff and the men.

Gaylussite and Its Possible Utilization

By E. E. FREE

*Previous to the discovery by the Railroad Valley Co., gaylussite has been a rare and little known mineral. Museum specimens came from a small lake near Merida, Venezuela, and from Soda lake, near Ragtown, Nevada, at both of which localities the gaylussite occurred as scattered crystals with trona and other soda minerals. The mineral has also been identified at Searles lake, California, and in Sweetwater valley, Wyoming. It can be produced artificially, and is occasionally an accidental and minor by-product in the manufacture of caustic soda. Previous to its discovery in Railroad valley, it had been found by the Railroad Valley Co. as crystals scattered through the clays underlying the Dixie salt marsh and the Columbus marsh, Nevada. Physically it is colorless and transparent when pure, but is usually rendered yellowish or grayish by included clay. Crystals from the buried bed in Railroad valley are the purest and most transparent yet obtained. The crystals belong to the monoclinic system. It is very brittle, has a specific gravity of nearly 2, and a hardness of 2 to 3. Chemically it is a hydrous double carbonate of calcium and sodium, having the formula $\text{Na}_2\text{CO}_3 \cdot \text{CaCO}_3 \cdot 5\text{H}_2\text{O}$. In percentage composition the pure mineral contains 35.81% of sodium carbonate, 33.78% of calcium carbonate, and 30.41% of water. It may be distinguished by brisk effervescence with dilute acid, and by the fact that when boiled with water it decomposes, giving a white powder and a strongly alkaline solution.

The practical interest of gaylussite lies in its content of sodium carbonate. Sodium carbonate, known commercially as soda or soda ash, is largely used in glass and soap making, in the paper and textile industries, in the manufacture of borax and in many other industries. At the present time nearly all the soda consumed is made from common salt by complicated and expensive processes, the industry of its preparation being one of the most important branches

*Abstract from report of the Railroad Valley Company.

of chemical manufacture. Commercial soda ash is commonly sold on the basis of 48%, referring to a content of 48% of the hypothetical sodium oxide, Na_2O . This 48% soda ash is now quoted in New York at \$13.50 to \$14.50 per ton of 2000 lb. Pure gaylussite contains the equivalent of 43.62% of commercial, 48% soda ash, and carries, at the present average price, a soda ash value of \$6.11 per ton.

Methods of Treatment

Since gaylussite in quantity is a recent discovery, it has never been used commercially for the manufacture of soda ash and no commercial methods have been worked out or tested. However, laboratory results indicate no probable difficulty in securing such methods. Two alternative processes at once suggest themselves, and both have been tested and found satisfactory on a laboratory scale. The first would calcine the gaylussite to drive off the water, leaving a mixture of sodium carbonate and calcium carbonate, from which the former could be extracted by leaching. The second would grind the gaylussite and boil it with water, when decomposition would occur, the soda would go into solution and the calcium carbonate fall as insoluble sludge. It is impossible to be sure that either of these methods would work satisfactorily on a large scale and in the simple form stated, but no general difficulty is to be anticipated, and it seems probable that all difficulties of detail can be worked out.

Since there is no experience, it is not possible to give accurate estimates of the cost of manufacturing soda ash from gaylussite. However, by making use of the cost data of similar processes now industrially employed, I have estimated the probable cost of extraction by the first method above outlined as not over \$3.50 per ton of 48% soda ash, assuming fuel oil at \$1.50 per bbl. and a plant of such size as will produce 100 tons of finished product per day. This estimate includes all plant expenses, depreciation, etc., but does not include general overhead taxes or charges for land. It is based on the assumption that the gaylussite supplied to the plant will contain not more than 5% of clay or other impurity. It is believed that this estimate is too high rather than too low. The second process above mentioned is probably cheaper than the first, and with either process various cheapening expedients suggest themselves, such, for instance, as preliminary part calcination of the gaylussite by exposure to sun and air. It is probable that soda ash can be made more cheaply from gaylussite than from any other known raw material, even the natural sodium carbonate known as trona. In this connection, however, it must be remembered that the utilization of the soda beds at Searles lake, California, now being undertaken by the American Trona Co., does not depend on the value of the soda alone. The Searles lake deposit contains potash and borax as well as soda, and while the chemical processes to be employed in working this deposit will be much more complicated and expensive

than the process of working gaylussite, this fact is more than offset by the obtaining of three valuable products instead of one. I do not consider it probable that soda produced from gaylussite could compete with soda produced from Searles lake, so long as production from the latter point is not in excess of the capacity of the market to absorb the potash and borax produced as well as soda. The only by-product in the manufacture of gaylussite from soda ash is the calcium carbonate sludge, and, while pure calcium carbonate has some sale as whiting, it will probably be impossible to produce from gaylussite a material pure enough for this except at a prohibitive manufacturing cost.

Practically, the crucial point of the gaylussite question is one not yet mentioned, the cost of mining the gaylussite. It is apparent that a high cost of delivery of the gaylussite to the extraction works would more than absorb the margin of profit already none too large. Whether or not there is hope of devising sufficiently cheap mining methods for the Railroad valley deposit it is impossible to say until cores have been taken of the gaylussite beds, and we know more of their nature and purity. It is obvious, also, that any utilization of the Railroad valley deposit is dependent upon cheap rail transportation, both outward for the product and inward for fuel. Unless a railroad is assured there is no hope of commercial value in the deposit.

Gaylussite-Bearing Clays

Of some interest in connection with the buried gaylussite, is the discovery of a stratum of gaylussite-bearing clay immediately underlying the surface of the west central portion of the Railroad valley mud flat. The material covers sections 33 and 34 of Township 8 north, Range 56 east, and sections 2, 3, 4, 5, 8, 9, 10, and 11 of Township 7 north, Range 56 East, with parts of the adjoining sections, about 12 square miles in all. The gaylussite-bearing clay lies from 4 to 8 in. under the surface and is from 12 to 18 in. thick. Samples taken from 41 holes over this area show an average content of 13.82% gaylussite. The gaylussite crystals are usually in skeleton form and somewhat less pure than those from the buried beds, but are otherwise identical with the latter. Assuming an average thickness of 14 in. for the gaylussite layer and an average gaylussite content of 13.82%, the surface deposit contains nearly two million tons of gaylussite. It is probable that it could be worked for soda ash easily and cheaply and it would probably be of value as an adjunct to any soda or potash industry which might be established on the flat. The surface deposit is not in itself of sufficient size to encourage railroad building or determine a soda industry.

During October two dredges of the Orsk Goldfields Ltd. in Siberia treated 86,900 cu. yd. of gravel, yielding gold valued at \$38,000. Both boats were shut down from November 1 to 14 on account of bad weather.

Cylindrical Wooden Ore-Passes

By ANDREW FAIRWEATHER

"Recognition of all the defects in the square-set and cribbed types of ore-passes made it desirable to secure a design that would require no repairs. After mature consideration, it was decided to adopt a cylindrical pass made of stringy bark eucalyptus boards standing on end, the thickness to be varied according to the conditions. There was no lack of prejudice and opposition against the novelty, and even those who were prepared to push the idea were skeptical about certain things. But as progress is made in knowledge of the arrangement, the more convinced I am of its superiority over any other design for practically all conditions of stoping.

Construction

Briefly, the chute is made of stringy-bark timber staves, cut with beveled edges, and fitted in the form of a tube, the grain of the timber running vertical. The staves are bound together by double hoops of fence wire, until the waste envelopes them.

At first, sections were cut in the longest possible length, but varied from 5 to 8 ft. Staves varied in thickness from 4 to 10 in. Internal diameters of chute were 3 ft., 3 ft. 6 in., and 4 ft. The combinations of all these lengths and sizes made a large number of different stocks, and experience has decided against them. Now there are four standard types of chute:

1. Chute 10 in. thick, 4 ft. internal diameter.
2. Chute 10 in. thick, 3 ft. internal diameter.
3. Chute 6 in. thick, 3 ft. internal diameter.
4. Chute 5 in. thick, 3 ft. internal diameter.

The length of the staves is now universally 4 feet.

It will thus be seen that the length of stave is a standard; there are but three thicknesses, and two diameters, for reasons that are obvious.

Types 1, 2, and 3 are used in open stopes, type 3 in square-set stopes, and type 4 for effecting repairs to old cribbed passes which have failed. The following tables show the manner of employment in the open stopes:

VERTICAL PASSES, OPEN STOPES

Height of chute.	100-ft. lift.	150-ft. lift.
0 to 35 ft.	Type 1	Type 1
35 to 70 ft.	Type 3	Type 2
70 to 120 ft.		Type 3

INCLINED PASSES, OPEN STOPES

Height of chute.	100-ft. lift.	150-ft. lift.
0 to 35 ft.	Type 1	Type 1
35 to 70 ft.	Type 2	Type 2
70 to 120 ft.	(modified)	Type 2 (modified)

In the square-set stopes the available space inside timber does not allow of any greater size than a 3-ft.

barrel, 6 in. thick. The type 2 (modified), mentioned in the table, for inclined passes, refers to a composite chute having a 10-in. bottom and a 6-in. top, and will be described later.

The staves to form the chutes are cut out of round or sawn stringy bark, of 10 by 5 in., 10 by 6 in., and 10 by 10 in. dimensions. The 10 by 10-in. piece is cut without waste, and to form the chute it is only necessary to reverse the ends of the two halves. Unfortunately, stringy bark shrinks considerably, so that if it is allowed to season at surface (and this is advisable if underground use has to follow), slightly different templates have to be used to form the true cylinder and to provide full bearing of the staves on one another. The shrinkage causes the use of an extra stave in the chute of 10 in. thickness, but only makes a slight alteration in size in the thinner sections.

It was recognized from the start that to obtain the best results the staves should be so placed that the rings of growth in the timber were parallel to the circumference of the chute. In a chute made of sawn timber this cannot be obtained, as in probably half the boards the grain would run parallel to the shorter side; consequently, an early attempt was made to use round logs. At first two cuts, inclined the proper amount toward one another, were made with the saw, and the outside and inside surfaces left rough.

As a guide to the timbermen, in assembling this type of chute, 4 dowel holes were bored in each stave, and $\frac{1}{2}$ -in. dowels used in the construction, as shown in Fig. 1. For the boring of these dowel holes a

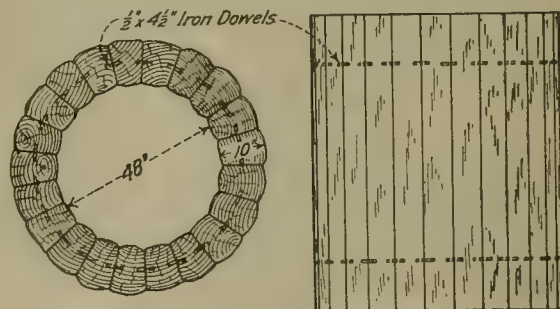


FIG. 1.

template was used, so that the irregularity of the different logs was kept outside rather than inside the chute. However, experience proved that the time required to 'stand' a section of this type was much greater than in the case of the sawn timber. The extra time was taken up in fitting dowels and closing up. As a consequence, the use of dowels was discontinued, and fencing wire was used to bind the logs, blocks being

*Excerpt from paper read before the Australasian Institute of Mining Engineers and based upon experience at the Broken Hill South mine.

used to fill up the irregularities. But this change meant that the timbermen had no guide for the correct placing of the logs.

The next move was to increase the number of the saw-cuts to three, that is, the two bevel cuts and one to form the inside face. This was an improvement, and gave the men a good opportunity to place the staves correctly, but as the rough, irregular surface outside effected no useful purpose, and gave some trouble in wiring, the saw-cuts were increased to four, and that method is now adhered to. The purpose of the sawing on both inside and outside faces is only to remove the irregularities and not necessarily to form definite angles with the other faces.

Advantage of Round Timbers

The advantage of the round timber is clear at once, apart from the fact that the correct position of the rings of growth, namely, that a smaller number of pieces go to form a ring than in the case of the sawn article; in the 3-ft. chute there is a reduction from 30 to 20 pieces, and in the 4-ft. chute from 38 to 24. A still greater advantage will be dealt with under the subject of costs.

The building of the chute in the stope is a simple and quick operation, although before it was attempted a good many had misgivings about it. The chutes on the South mine are formed of round logs, in cribbing form, for a height of about 13 ft. above the sill floor. On top of the round logs is placed a framed set consisting of four pieces of 10 by 10-in. Oregon pine, two of them dovetailed into the other two. On top of the framed set is placed a ring of 'chute blocks.' When fitted together the blocks form a foundation for the 4-ft. barrel, the outside of them being a polygon of eight sides, and the inside approximately a 4-ft. diameter circle. The blocks, in addition to being a foundation, are also a guide to the timbermen in the erection of the chute. They are spiked to the framed set.

Method of Building

The operation of building a section is as follows: One 4-ft. piece is stood on end, with its inside face flush with the inside of the chute block frame. One timberman holds it in position, while the other man gets another. The second piece is stood against the first, and the two are locked together by driving in a little timber dog. Both men then get to the job, one on one side and one on the other, standing other staves and working toward one another, using a dog to support each fresh stave to those already standing, and being guided in the approximate location of the staves by the chute blocks. When the ring is complete, two lengths of fence wire are cut, each length being a little more than twice the outside circumference. The wire is put twice around the chute, at a point 12 in. from the top, and the ends are connected by tying. This is also done at a point 12 in. from

the bottom. A fair amount of slack is allowed in each case. A hole $\frac{3}{4}$ in. diameter and 2 in. deep is bored in any stave, 12 in. from top, and a similar hole is bored 12 in. from bottom; into both holes a short waste piece of $\frac{3}{4}$ -in. round iron is driven, projecting about 3 in. The slack of the wires is caught up by a short drill, and twisted round the $\frac{3}{4}$ -in. pins. When both have tightened fairly well the chute dogs are withdrawn, and one timberman then goes round the chute hitting the staves on the outside with the back of his axe, while the other man puts the final strain on the wires by twisting. When the timbers have been closed up tight, the end loops of the wires are fixed in position by spikes driven into the stave. This prevents possible slackening. When the first section is finished, the second one is built on top in the same way, the lower barrel then forming a guide for the construction of the upper one. Of course, with all the staves being the same length, the surface of the top of the chute is flat. This lack of connection between two adjacent sections was thought at first to be a weak feature, but experience has shown that when the chute has been enclosed with filling there is no tendency to lateral movement.

Filling Around the Chute

An 8 or 9-ft. layer of filling is then distributed, particular care being exercised in spreading the waste evenly around the chute, and in not allowing it to build up high on one side only. This care is needed most with the thinner and, therefore, lighter sections: with the chute consisting of 10-in. timber, an advancing rill does not seem to have any effect in tilting.

As a rule, when the filling up is completed the tops of the chutes are found buried 12 in. under the surface. That is a desirable arrangement, as the stave ends are better protected from the effects of firing heavy holes in an open stope. There is also a better chance for sudden pressure, caused by a big fall of ground, to be distributed around the chute. As a further protection to the top section, two rings of bulk timber are sometimes placed around the top of the staves, the bottom ring flush with the top of the barrel, the upper ring flush with the surface of the filling.

As explained previously, at a point 30 to 40 ft. above the sill floor in an open stope a change is made from 4-ft. diameter to 3-ft. diameter chutes. To effect this change a framed set is used, measuring 3 ft. square within, and similar in construction to the larger one previously described. It rests on the lower barrel, and upon it is placed a ring of chute blocks, eight in number, the outside of them forming an 8-sided polygon, the inside approximating to a 3-ft. diameter circle. On top of this ring stands the 3-ft. chute, either 10 or 6 in. thick. Another method of making the connection between a 4-ft. chute and a 3-ft. chute is by means of a section 6 ft. long, and, in shape, a frustrum of a cone, with its staves so cut

that the bottom ends fit to form a 4-ft. ring and the upper ends fit to form a 3-ft. ring.

Inclined Passes

When the wooden cylinder was introduced, it was felt that repairs were a problem, if not an impossibility, and accordingly a rule was made that the barrels should only be reared vertical. This rule was found impracticable, and it has since been decided to use inclined chutes for the sake of economy and convenience, if possible, at the same grade as the dip of the walls enclosing the lode. As some of the chutes had failed at the point where the incline was commenced, the need of some special protection on the lower side of the pass was evident. The first suggestion put forward for the construction of the inclined pass was that it should be formed of round logs, of varying diameters, the large logs being placed in the lower half. This method has been used, and will be extended when certain alterations have been made in timber cutting and supply.

The existing method, however, consists in the insertion of $1\frac{1}{4}$ -in. mild steel plate, 9 in. deep, between staves 10 in. thick, on the underside of the barrel. The plates are held in position by dowels, passing through holes bored near the outside edge and connecting the staves; two dowels of $\frac{7}{8}$ -in. round to each plate.

The action of the ore is to cut out a trough, about 1 in. deep, between adjacent plates. After that the plate edges carry practically all the dirt, and thereby protect the timber. No alteration is made in the cutting of the staves, to allow room for the plates; such alteration would only lead to confusion in selecting pieces. The upper half of the chute is formed of 6-in. staves, without steel ribs, but resting on arch-bars, bent to a curve of slightly less than 18-in. radius, and provided with 6-in. lugs. The bars are of iron 4 in. wide and $\frac{5}{8}$ in. thick, and are placed at the contact of adjacent barrels.

To provide a seating for the lugs, recesses 6 by 4 by $\frac{3}{4}$ in. deep are chiselled out of the top staves of the lower half—before the upper half is commenced. Fig. 2 illustrates the arrangement.

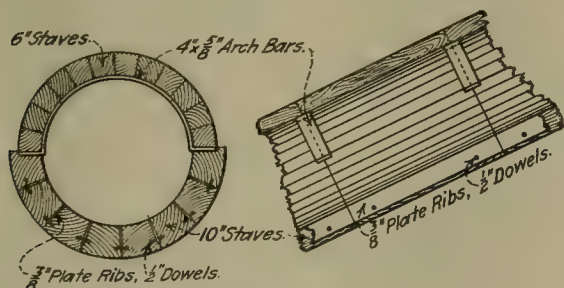


FIG. 2.

The purpose of these bars is twofold; they act as a guide and support for the upper timber during construction, and they strengthen the chute against possible failure through heavy falls of ore.

Wherever a chute is changed from vertical to inclined, a definite angle is arranged for, not a gradual sweep. As is well known, change in direction means excessive local wear, and with a gradual sweep it is more difficult to provide against such wear than when an abrupt change is made.

The sketches below, Fig. 3, show how a change of direction is made, and also illustrate the mode of protecting the timber that would be ordinarily exposed to 'beat.'

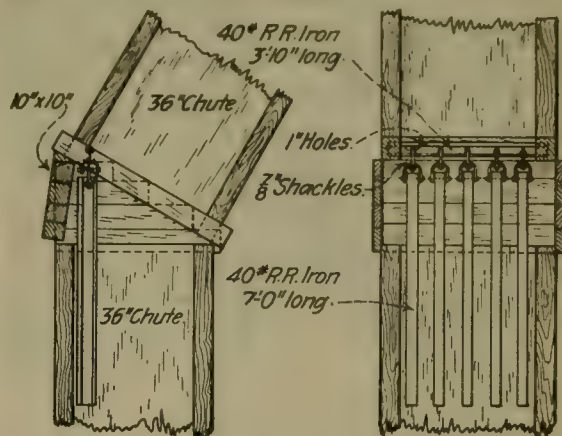


FIG. 3.

The inclined chute is given its correct inclination by resting on an ordinary framed set 3 ft. square within, which is blocked up on one side by 10 by 10-in., as shown. The side openings, between framed set and top of vertical barrel, are closed by 10 by 2-in. laths, spiked to the 10 by 10-in. blocking and the framed set. Stretching across the framed set near its high side, and parallel with the 10 by 10-in. blocking, is a piece of 40-lb. railway iron, 3 ft. 10 in. long, with its ends resting in recesses 5 in. deep, cut out of the framed set, on two sides. There are five holes in it, 1 in. diameter, spaced $6\frac{1}{2}$ in. apart, in each a $\frac{7}{8}$ -in. shackle hanging, supporting another $\frac{7}{8}$ -in. shackle, which in turn supports a 7-ft. length of 40-lb. rail. The ore, in falling down the incline, strikes the railway iron and is diverted into the vertical chute. This arrangement is called a 'curtain,' and has been found to operate very satisfactorily. The loosely hanging fingers of this curtain yield to every blow, give no trouble in support, and cause the ore to fall vertical after the impact.

Making Repairs

In repairing, suppose, for instance, that three staves only in a ring have failed. The old pieces are removed, and the filling behind them is worked away for an extra 6 in. or so to allow of the three new staves being placed in a position 6 in. behind their correct position, as shown in Fig. 4. These staves are cut 3 ft. 2 in. long, that is, 10 in. short, and each has a couple of spikes driven into it projecting toward the inside of the chute.

By pulling on the spikes in turn the three staves are drawn inward, the final tightening together is done by the timberman delivering blows with his hammer on the outside of the staves, operating his arm through the 10-in. space over the staves. When the closing-up process is completed, the space behind is filled with tailing and tightly rammed.

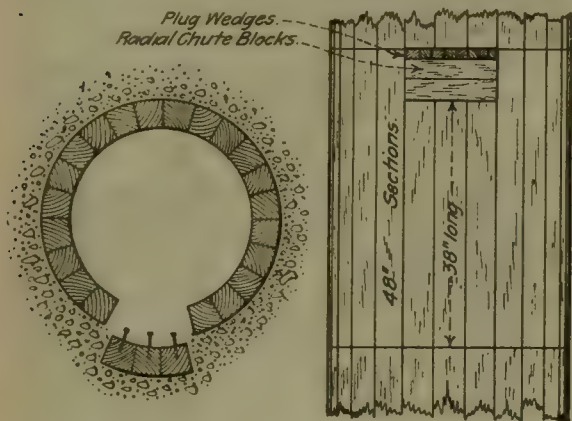


FIG. 4.

The description only covers a special case; sometimes the whole barrel has failed; in that case the complete ring is stood, except two staves, which are shortened and plugged on top, as shown. A closure has even been effected with one short stave only. If a number of sections have failed, naturally work commences on the lowest. The barrels are brought up as in the case of rearing them in an open stope, except that the final stave has to be dropped in. The only section giving trouble is the closing one, and that is dealt with in the manner just described.

Chutes in square-set stopes need scarcely any description, consisting merely of 6-in. barrels, 3 ft. diameter, reared in the set openings. They are constructed in a similar manner to those in open stopes, being bound with wire and packed around with filling. There is no blocking against the set frame and no outside lining to the set.

Minor Advantages of Chute

Apart from first cost, good wearing capabilities, and freedom from repairs, the cylindrical pass possesses the distinct advantage of being easily and rapidly withdrawn, after the stope is finished. This has been done in a large number of cases on the South mine. Generally through the pitching of the lodes, but sometimes by intrusions of waste, a chute has to be abandoned. An inspection of the interior will quickly show whether the timbers warrant removal. If so, a lump sum contract is set for taking out the timber and filling up the hole so formed. The *modus operandi* of recovering the timber is briefly to begin at the bottom, cut out the bottom section, fill up the height of it, remove the second section, fill up the hole again, remove the third

section and fill again, and so on till the stope above is reached.

The cylindrical chute has been found very serviceable and convenient on the South mine for the lining of winzes and waste passes.

Costs

The following table gives the cost of material and labor for the five types of cylindrical passes used, as well as for four other methods of construction used at various times on this field. Allowance has been made for bars, plates, fence wire, spikes, and nails, and timber has been reckoned at the following prices at present ruling in Broken Hill, namely:

				Per 100
				bd. ft.
Stringy bark (eucalyptus).....				\$5.64
Oregon pine, 10 by 10.....				4.56
Oregon pine, 10 by 2.....				4.80
				Cost per foot.
No.	Type of chute.	Material.	Labor.	Total.
1.	10-in. chute, 4 ft. diam.....	\$9.00	\$0.72	\$9.72
2.	10-in. chute, 3 ft. diam.....	7.08	0.72	7.80
3.	6-in. chute, 3 ft. diam.....	4.22	0.36	4.61
4.	5-in. chute, 3 ft. diam.....	3.60	0.36	3.96
5.	10 by 6-in. chute for inclines, 3 ft. diam.	8.28	0.96	9.24
6.	Square set, lined 10 by 4 S. B. inside and 10 by 2 Oregon outside.	7.68	0.96	8.64
7.	Solid Oregon, 10 in. thick, made of 10 by 10, halved at ends.....	11.40	0.19	11.60
8.	Bulk of 10 by 10 Oregon, spread with 10 by 2, and lined with 10 by 2 S. B.....	9.84	0.96	10.80
9.	10 by 10 Oregon, 2-in. joggle.....	9.12	0.19	9.30

Cost and consumption of supplies at the Mexican mill, Nevada, during the past year were:

	Cost per ton.	Pounds per ton.
Cyanide:		
Mexican ore	\$0.495	2.00
Monte Cristo ore	0.287	1.17
Lime:		
Mexican ore	0.034	4.62
Monte Cristo ore	0.039	5.26
Lead salts:		
Mexican ore	0.044	0.41
Monte Cristo ore	0.119	1.06
Zinc dust:		
Mexican ore	0.172	1.62
Monte Cristo ore	0.105	0.98
Shoes and dies	0.170	0.33
Chilean rings and dies	0.022	0.67
Chilean screens	0.011	...
Tube-mill liners	0.038	0.89
Pebbles	0.095	7.32
Fuel oil for heating	0.163	*3.69
*Gallons.		

The Hyderabad mint, India, produced during the four-year period ending in 1910, 27,526,895 rupees, 2,171,069 half-anna, 114,562,382 2-pie, and 6,876,334 1-pie copper coins (12 pies equal 1 anna, 16 annas 1 rupee, and in Indian currency 1 rupee equals in U. S. currency 32.44 cents).

Duty is imposed on exports of rubber, tin, and wolfram from the Federated Malay States.

Leading Copper Producing States

For 1913 Arizona, with a record production, continues in first place among the copper producing states. The production for 1913, according to the United States Geological Survey, will greatly exceed the 359,322,000 lb. produced in 1912, and may exceed 400,000,000 lb. The Bisbee district will show a large increase over the 140,000,000 lb. of blister copper produced in 1912, the output probably reaching nearly 160,000,000 lb. in 1913. The Morenci-Metcalf district will not equal the 79,900,000 lb. produced in 1912, but the 1913 output will doubtless exceed 70,000,000 lb. The Globe-Miami district will show an increase of several million pounds over the 61,600,000 lb. produced in 1912. The Mineral Creek or Ray district made a large increase, the output for 1913 being approximately 50,000,000 lb., compared with 35,000,000 lb. for 1912. The output of the Jerome district will probably exceed the 1912 production of 31,680,000 lb. by a few million pounds.

The production of copper by the mines of Alaska in 1913 has been estimated by the United States Geological Survey at 19,700,000 lb. The decrease from the production of 1912 is due to the reduced output from the Copper River district, caused by the part destruction of the plant of the Kennicott-Bonanza mine and the consequent interruption of production. The production of copper from California for 1913 changed but little from the 35,835,000 lb. produced in 1912. As in previous years the largest output was from the Shasta county region, with important production from the foothill belt. The Shasta county district will probably show a slight increase over the 26,000,000 lb. produced in 1912.

Copper production in Colorado is largely incidental to the production of other metals, and the output will probably not change greatly in 1913 from the 7,963,000 lb. produced in 1912. The production of copper from Idaho for 1913 will show some increase over the 7,182,000 lb. in 1912. As in 1912, the main output was derived from the Coeur d'Alene and Alder Creek districts. Owing to the serious labor troubles in the Lake Superior district during the later part of the year, the production of copper from Michigan for 1913 was the smallest in many years. The output for 1913 was approximately 152,000,000, compared with 231,112,000 lb. in 1912.

The output of copper from Montana decreased from the 1912 production of 308,770,000 lb. The production for 1913 will probably be about 280,000,000 lb. As in previous years, the copper was derived mainly from the deposits of the Butte district. The production of copper from Nevada in 1913 remained nearly the same as that for 1912, which amounted to 83,413,000 lb. As in 1912, the Ely and Yerington districts were the principal producers. In 1912 the Ely district produced 67,400,000 lb. of blister copper and the Yerington district 14,700,000 lb. Both districts will show approximately the same output for 1913.

The production of blister copper from New Mexico increased largely over that of 1912, owing to the increased production of the Chino Copper Co., of the Santa Rita district. The output of copper in concentrates by the Chino company for the first three-quarters of the year was over 39,000,000 lb., indicating a production for the year of over 50,000,000 lb. The production of copper from Tennessee will show little change from the 18,395,000 lb. produced in 1912. As in previous years, the output came from the Ducktown district. In 1913 Utah made a large increase in the production of blister copper over the 132,150,000 lb. produced in 1912. As in previous years, the Bingham district was the principal producer, though the Tintic district made a considerable production and the San Francisco and other districts also contributed.

Studying Mine Fires by Experiment

The Bureau of Mines has recently built at its Pittsburgh experiment station an underground chamber or furnace in which to carry on experiments relating to mine fires and spontaneous combustion as occurring in mines.

A section of steel tube, cylindrical in shape, 6½ ft. in diameter and 27 ft. long, was laid on its side in a deep trench, and after lining this shell with fire-brick and mineral wool, and stopping the ends with 13-in. brick walls, it was covered with two feet of earth. The chamber was constructed so as to be as nearly airtight as possible, and in such manner as to retain to the greatest degree practicable any heat generated within its walls. At one end a motor-driven fan will blow in air at a rate which can be accurately measured, and at the other a stack is provided which can be opened or closed as desired. Through the top of the chamber, at frequent intervals, pass small pipes for withdrawing samples of air or gases and for inserting pyrometers for temperature measurement in the interior.

The chamber will hold six to eight tons of coal when one-third full. It is expected that different kinds of coal or of the gob or waste material from mines will be placed in the chamber and a study made of spontaneous development of heat in them under various conditions. After an active fire has been started in the chamber either by this means or artificially, experiments will be made on controlling the fire by reducing the air supply or by sealing it off entirely.

Investigations have been made in other countries, and to some extent also in this country, of the gases produced in actual cases of mine fires both before and after sealing off a burning area. The Bureau is now making, however, probably the first attempt to investigate such problems in an experimental apparatus which permits careful control of conditions and yet is on a scale nearly commensurate with mining operations. These investigations are being carried on by Horace C. Porter, chemist, of the Bureau of Mines.

While the immediate tests are with a view to questions met in coal-mining, the data derived will be available for solving problems connected with underground fires of all kinds.

Income Tax Regulation

Engineers will be especially interested in the following among supplementary regulations regarding the income tax, issued by the Treasury Department:

Expense for medical attendance, store accounts, family supplies, wages of domestic servants, cost of board, room, or house rent for family or personal use, are not expenses that can be deducted from gross income. In case an individual owns his own residence he cannot deduct the estimated value of his rent, neither shall he be required to include such estimated rental of his home as income.

In calculating losses, only such losses as shall have been actually sustained and the amount of which has been definitely ascertained during the year covered by the return can be deducted.

Persons receiving fees or emoluments for professional or other services, as in the case of physicians or lawyers, should include all actual receipts for services rendered in the year for which the return is made, together with all unpaid accounts, charges for services or contingent income due for that year, if good and collectable.

Debts which were contracted during the year for which return is made, but found in said year to be worthless, may be deducted from gross income for said year, but such debts cannot be regarded as worthless until after legal proceedings to recover same have proved fruitless, or it clearly appears that the debtor is insolvent. If debts due to the taxpayer and contracted prior to the year for which return is made were included as income in return for year in which said debts were contracted, and such debts shall subsequently prove to be worthless, they may be deducted under the head of losses in the return for the year in which such debts were charged off as worthless.

Amounts due or accrued to the individual members of a partnership from the net earnings of the partnership, whether apportioned and distributed or not, shall be included in the annual return of the individual.

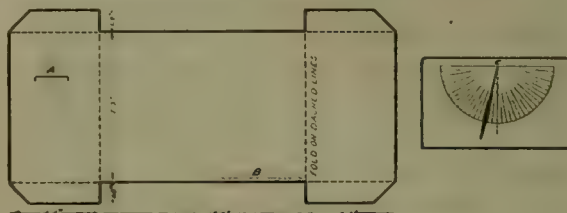
Estimated advance in value of real estate is not required to be reported as income, unless the increased value is taken up on the books of the individual as an increase of assets.

Costs of suits and other legal proceedings arising from ordinary business may be treated as an expense of such business, and may be deducted from gross income for the year in which such costs were paid.

An unmarried individual or a married individual not living with wife or husband shall be allowed an exemption of \$3000. When husband and wife live together they shall be allowed jointly a total exemption of only \$4000 on their aggregate income.

Cover for Engineers' Note-Books

Engineers who have acquired the habit of neatness are often sorely dismayed at the external appearance and condition of their note-books. These become soiled, worn, and ragged by contact with moisture, the sun's rays, and rough rocks and other objects, both when in use in the field and while being carried in the pocket or in a shoulder bag along with other articles. The cover here described has been found entirely satisfactory, and can be quickly removed from one book and slipped on another.



DIMENSIONS AND PLAN OF COVER.

The cover is cut out of heavy linen-back mounted map paper, and then glued together with Le Page's glue, the cloth side being turned outward. The drawing shows the pattern and gives the dimensions necessary for the No. 363 Mining Transit Book of the Keuffel & Esser Co., which has dimensions of $4\frac{1}{2}$ by $7\frac{1}{4}$ in. However, the best plan is to cut off a piece of the paper and fold it about the book, then dress down as necessary, and finally glue together.

A is a slit in the inside front cover for the insertion of an Eugene Dietzen Co.'s No. 1925 scale-protractor. This is a combined transparent rule, scale, and protractor costing 20 cents, and is a most valuable accessory in the field.

B is a strip of emery cloth, $\frac{1}{3}$ in. wide, which is glued to the bottom of the outside back cover of the book—a most convenient place—for pointing hard pencils.

The smaller drawing represents a diagram to be placed on the inside back cover for taking slope angle in geologic work. A large size sewing needle is suspended by a silk thread from C. The note-book is placed on or in the plane of the slope to be obtained. The back cover is opened to allow the needle to swing freely to the vertical, when the angle of slope can be read. These protractor diagrams are sometimes blueprinted, and pasted in the backs of note-books.

Another use for the linen-back mounted paper is to make durable covers for paper-covered bulletins, books, etc., and it is a good idea to save the large scraps remaining from maps for this purpose. The original cover of the bulletin is removed. The mounted paper is folded about the book, cut to the proper size, and glued on in the same way as the original cover. The title page of the original cover is then cut out and pasted on the new cover.

Discussion

Readers of the MINING AND SCIENTIFIC PRESS are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment. Devotion of any contribution is determined by its probable interest to the readers of this journal.

California Miners and the Exposition

The Editor:

Sir—What the Director of the mining exhibit says in the *Mining and Scientific Press* of January 3 concerning the character and importance of a suitable exhibit of the mineral industry will be universally commended by the mining public, and it is to be hoped that his appeal will meet an instant and favorable response. The opportunity is certainly unusual and not likely to be repeated within this generation, if ever. There has never been an adequate presentation of the state's mineral wealth. Great world's fairs are rare, and nothing short of one is likely to draw together the materials in sufficient variety. This being the case, we all ought to get to work to build up an exhibit worthy of the occasion and the country, in spite of the fact that there is no pecuniary reward in sight. While none besides promoters, stock-sellers, and private exhibitors are at all likely to make anything directly out of the fair, there should be sufficient incentive in state pride to bring about a united effort and creditable results. It would be a great pity if anything were left undone to insure a praiseworthy exhibition, both on the part of the mining fraternity and of the state.

From what has been said by Mr. van Barneveld, one may apprehend that a complete exhibit, if such could be had, would necessarily consist of two separate but closely related parts: namely, the display of ores and mineral products within the mining building, to be classified largely under county or local designations, and the other, a more systematic representation embracing processes and machinery as well as ores and products. The former will be splendidly housed, but in the nature of things the mill and cyanide apparatus, and matters of that sort, will have to be taken care of on otherwise vacant ground and amid less glorified surroundings. However, looks will hardly count. Space, and a methodical arrangement of processes and apparatus on a working scale, are much more to the purpose, and this view harmonizes with those of the Director. The presumed necessity of placing each collection under some geographical designation tends to lessen their effectiveness. Valuable historical and economic features are partly lost sight of unless the offerings are concentrated in the mass. This, probably, is unavoidable, but it would seem that the working part, if we may call it so, of the outside collections might be specially arranged from this point of view. This part of the exhibit must be

financed, it appears, by individuals, organizations, or districts.

The tentative program advanced by the exposition authorities looks to the installation of systematic exhibits far in advance of anything yet attempted at a world's fair, and if their project meets with the support it deserves, the result must remain unapproached for generations. Previous fairs, while not doing so much, have yet contributed good object-lessons, and their mineral displays have invariably been noteworthy. That of St. Louis was particularly so; but, like the rest, it lost much of its force and effect from the wide scattering of the exhibits, the better part of which was embraced within foreign collections necessarily shown as a whole. The best of these was the Japanese exhibit, in which were many noteworthy objects, arranged with exquisite taste. Among these may be mentioned the splendid relief map of the Ashio copper mine, which in itself was worth going to St. Louis to see. We have never produced anything to compare with the best foreign work, but there is no apparent reason why we should not, and as a beginning it might be well to try our prentice hands on a relief map of the Mother Lode region. Such a model would form a valuable addition to the fair, and might be presented by the five counties through which the famous lode runs, or by the property owners along its strike, who are numerous and prosperous enough to well afford it. This form of illustration lends itself very well to the surface features of extensive areas as well as confined ones, and furnishes an invaluable picture of the geological formations as well as the surface topography, and might be developed into an impressive exhibit of great scientific and economic significance. At the conclusion of the fair the work might be given over to some public institution, the State Mining Bureau, for instance.

The history of the mines of California is virtually the history of the state. Mining, therefore, has a great significance to the world, and its historical phase should by no means be neglected in preparing the exhibits. This state and neighboring states ought to be ransacked for historical objects. The ordinary tools of the old placer miners will, of course, be shown, and their cabins and places of employment and amusement ought also to be displayed. Antique arrastres and stamp batteries with wooden stems would find a place in such a collection. The educational side of such exhibits is measurably subserved by the ordinary glass-case displays, common everywhere. These serve well enough so far as they go, but it is important to complement them by systematic showings of metallurgical processes. If it could be managed to show visually how commercial metals are produced from the ore, the general public also would be instructed and impressed, as they cannot be by show-case exhibits of any size. There might be an attempt to show what we might call the evolution of the gold coin, for instance. This would naturally embrace a

mine, with men working; a hoisting works or tunnel; cars; a milling plant; cyaniding works or smelting works, or both; a refinery of some sort; and perhaps some minting process, all at work for so many hours per day or per week. With these would go, as the Director suggests, some piles of ore, and in descending ratio samples of the metal produced, by which the uninformed bystander could gather notions of the actual steps taken in mining and metallurgy when gold, silver, lead, or copper is won. This might not appeal to the miner or metallurgist, already educated to the saturation point in the details of his profession, but it would have an educational influence on laymen, whose ideas of mining need correction.

Efforts are being made to induce the different parts of the state to coöperate in their exhibits, instead of uselessly duplicating them. Groupings of the county exhibits may be advantageously made to this end, whose exhibits form a satisfactory unit. Thus the Mother Lode counties should unite in a first-class display, covering placer, quartz, and drift mining, together with the appropriate metallurgy. It should be practicable, also, to induce the copper-producing regions to combine likewise in a display of their peculiar arts. Very probably also, it might be found that the subsidiary or minor industries based on silver, mercury, chrome, magnesite, tungsten, etc., could make unit exhibits of merit. It is well worth trying. Pocket mining is another pursuit of much interest and its geology and practice might easily be shown graphically and instructively.

The proposal to put up and run a blast-furnace for smelting copper and lead ores is one of great importance beyond the ordinary and spectacular features of such work. It comes at an opportune time, since it will provide sulphur fumes for testing several promising devices for controlling or utilizing such products. The Cottrell, the Hall, the Thiogen or Young, the Field, and other processes might be tried exhaustively, to the no small advantage to the mining interests of the country.

HERBERT LANG.

Oakland, California, January 29.

Leaching Copper Ores

The Editor:

Sir—After reading the article in your journal of January 3, 1914, by Thomas T. Read, page 57, in which Mr. Read says "Hendryx agitator is to be displaced by Dorr classifiers when this plant is enlarged," I called up the office of the Bullwhacker Copper Co. and have been assured that they are well satisfied with the Hendryx acid-resisting agitator; that when the plant is enlarged more of the Hendryx agitators will be added, as they are giving perfect satisfaction, namely, ores ground to 30 mesh and containing from 2 to 4% copper, after 15 minutes agitation, 97 to 98% of the copper is in solution, and at 16 mesh 92 to 95%. I also notice on page 56, flow-sheet of Butte-Duluth plant

you show Hendryx agitator, and the flow-sheet of the Bullwhacker plant you left out the Hendryx agitator, which should be just the other way about. Such inaccuracies in a journal of your character are inexcusable, to say nothing of their unreliability and false impressions given to the reader.

Will you kindly, in your next issue, correct the same, in order to be fair to everyone, which I believe to be the policy of your paper.

WILBUR A. HENDRYX.

New York, January 19.

[The information to the effect that the agitator was to be displaced came to Mr. Read through a source of information that had always proved reliable, and the announcement was published in entire good faith. Titles to the two cuts were transposed in making up the number, and while the mistake is annoying, any comparison of the figure and text makes clear at once what happened.—EDITOR.]

Ore

The Editor:

Sir—May I suggest the following definition of the word 'ore' as one satisfactorily covering the subject and avoiding grounds for the criticisms leveled at Mr. Rickard's definition by several of your correspondents: *Ore is rock whose metal content entitles it to consideration for the commercial production of that metal.*

Cost of transportation, difficulty of extraction, and the like, may prevent the present exploitation of a metal-bearing rock, but if it justifies serious consideration for that purpose, it is none the less ore.

JEROME B. LANDFIELD.

San Francisco, California, January 24.

Mining Costs at Joplin

The following table presents a detailed account of mining costs at a representative Joplin property. The average cost per ton of ore mined in the district is slightly higher than the figures presented.

Labor	\$0.47900
Explosives	0.20400
Fuel	0.06870
Water	0.01455
Oil	0.00979
Hard iron	0.02478
Drill R. & S.	0.00802
Drill steel	0.00587
Power R. & S.	0.00441
Other expenses ..	0.01342
Casualty insurance	0.02037
Superintendence ..	0.02651
Management	0.02711
Total cost per ton	\$0.90753

Imports of copper into Germany during the period January to November, inclusive, were 212,458 tons, of which 182,931 tons came from the United States. The consumption was 203,802 tons.

Concentrates

Most of these are in reply to questions received by mail. Our readers are invited to ask questions and give information dealing with the practice of mining, milling and smelting.

Carnotite contains potassium, uranium, and vanadium.

Crude iodine is prepared along the sea coast of Japan in six prefectures. It is reduced from seaweed, and in 1912 the output was 22,772 pounds worth \$44,979.

Six holes drilled by the rotary process in search of potash deposits, for the Railroad Valley Co. of Nevada, cost \$3500 each. They were put down from 745 to 1204 ft. through sand, clay, gravel, mud, and crystalline gaylussite.

The Minerals Separation flotation machine is made in five sizes, as indicated by the diameter of the stirrers, which revolve at 282 r.p.m., with approximately the following capacities per 24 hours: 12-in. stirrer, 70 to 84 tons; 15-in. stirrer, 140 to 168 tons; 18-in. stirrer, 200 to 240 tons; 21-in. stirrer, 360 to 430 tons; and 24-in. stirrer, 500 to 600 tons.

Converting copper matte at the Old Dominion smelter, Arizona, is done in the basic type of converter. The first was blown in early in January 1913, and remained on the stand until the middle of July. During that time it produced 14,500,000 lb. of copper before requiring any patching. No. 2 converter is making a better record than the first one.

Sycee is the name given to shoe-shaped ingots of silver weighing between 50 and 60 oz. each. The sycee at Shanghai at the end of 1913 amounted to 50,300,000 oz. Silver passes current as money in this form throughout the greater part of China, and having been prepared for this purpose at extra cost, naturally ranks at a higher value than silver in the form of large bars, as imported into that country. Sycee is part of the currency of China, and figures really as bank reserves. Sycee has been shipped and sold to India, and also to London, but such transactions are exceptional.

Transport of copper ore from the Mother Lode mines at Kennecott, Alaska, to McCarthy creek is done by means of a Leschen aerial tramway. The line is 6980 ft. long with a fall of 2564 ft. in that distance. This allows of the system being worked by gravity. The cables carrying the fourteen 6-cu. ft. buckets are 1½ in. diameter on the loaded side, and ⅞ in. diameter on the empty side, are supported on 13 towers spaced 100 to 1500 ft. apart. The traction rope is ¾ in. diameter. The track ropes rest on saddles, and the traction rope is supported on sheaves or rollers attached at each end of intermediate supports. The whole sys-

tem is automatic in action, and only one man is required to supervise the line, which has a capacity of 50 tons of ore per 10 hr. day. An unusual feature of this tramway is that the towers on the upper part of the line are built upon solid ice that has become covered with broken rock. The anchorage at the upper terminal is also imbedded in ice which is said to be unusually clear. Another good use that is made of the system is the transport of supplies and mine equipment from McCarthy creek up to the mine.

Dredging in the Philippine Islands is on a fairly satisfactory basis. The boats are all worked by steam-engines. A crew of 1 white and 6 natives is employed each shift. Dredgemasters get \$150 per month, foremen \$4 per day, and natives 50c. gold per day. The Philippine Dredges, Ltd., is operating on the Paracale river. One boat is digging a considerable amount of mud and vegetation, and a shallow depth of gravel. The quartz cobbles from the boat are stacked on a barge, and then fed to a 5-stamp mill, which recovers about \$10 per ton by amalgamation.

Sizing tests of ore crushed through a 16-mesh screen at the Argonaut mine, Amador county, California, show the following result:

Mesb.	Per cent.
On 40.....	13.33
60.....	16.67
80.....	11.67
100.....	9.17
150.....	6.67
200.....	5.83
300.....	5.00
Through 300.....	31.66
	100.00

Discussing the treatment of tin ores in Cornwall, Edward T. McCarthy stated in the *Bulletin* of the Institution of Mining and Metallurgy that, bearing on the saving of tin, it has been clearly demonstrated in tin-dredging that where the black tin is crystalline and comparatively fine, it is fairly easy to save. The main factors governing the saving of the tin in this respect are: (1) plenty of area; (2) as low a gradient of the sluice-boxes as possible, compatible with keeping the material in suspense, and with the least possible amount of water almost to the point of allowing the material to bank; and (3) the saving surface to be of wood. A sample of black tin thus saved, and as sent to the smelters at Singapore from the Renong dredge in Asia, gave the following screening analyses:

Total weight, grams	525.7	
Screen:	Grams.	Per cent.
On 30	4.74	= 0.90
On 60	174.36	= 33.17
On 80	237.50	= 45.18
On 120	98.75	= 18.78
On 200	7.60	= 1.44
Through	0.95	= 0.18
	<u>523.90</u>	<u>99.65</u>

Special Correspondence

RENO, NEVADA

THE SAFETY FIRST CONFERENCE.—READING AND DISCUSSION OF VALUABLE PAPERS BY MINING, RAILROAD, AND ELECTRICAL WORKERS.—PRACTICAL DEMONSTRATIONS AND EXHIBITS.

One of the most unique and interesting meetings ever held in a Western state was the 'Safety First' Conference at Reno, on January 26 and 27. It was unique because it was probably the first instance in the country where a movement arousing such state-wide interest was started and carried to a successful conclusion by state officials. These included the State Industrial Commission of Nevada, and the Mechanical and Electrical Department and Engineers' Club of the University of Nevada. The meeting was interesting in that it brought together mine managers and miners, railroad officials and trainmen, power-plant superintendents and operators, members of the university faculty and students, state officials, labor representatives, engineers, and professional men. The total attendance was six hundred. It was productive of lasting benefit in that it focused the attention of the entire state on the Safety First movement, leaving as a record valuable papers and discussions.

The conference opened on January 26, in the University gymnasium, with W. E. Wallace, of the Brotherhood of Railroad Trainmen and state industrial commissioner, and James G. Scrugham as presiding officers. The following papers were presented at the afternoon session. 'The Safety First Movement in Nevada,' by John J. Mullin, secretary of the Nevada Industrial Commission. He described the organization of the commission, and dwelt on its future work, and the cooperation between employer and employee, that was necessary to make the movement a success. L. E. Abbott, safety commissioner of the Oregon Short Line, gave an interesting account of 'Safety First on the Oregon Short Line,' showing with what enthusiasm the work had been taken up, and what splendid results in the saving of life and limb had been accomplished on that railroad system. 'Safety First in Practice,' was discussed by Frank Ingram, secretary of the Brotherhood of Locomotive Firemen and Engineers. Mr. Ingram told of the safety precautions which had been suggested by the employees of the railroads in the state, dwelling principally on the law which the trainmen had succeeded in placing on the statutes of Nevada requiring locomotives to be equipped with 1500-cp. arc headlights. J. H. Linn, of Topeka, Kansas, gave a short description of the safety work on the Santa Fe system, and followed with an interesting paper on the student apprentice system of the Santa Fe, with which he is connected as assistant chief instructor. J. M. Guild, secretary of the Bureau of the Union Pacific, followed with a short description of the work on that road. H. P. Boardman, head of the Civil Engineering Department of the University of Nevada, made some interesting remarks on 'Safety in Civil Engineering.' He showed how necessary it was in designing structures to use proper safety factors, citing the Quebec bridge failure as an example where all the necessary precautions had not been taken. Two conclusions drawn from this failure were: (1) that a structure which might be satisfactory and safe on a small scale might not be safe when constructed in a similar manner on a much larger scale; and (2) that certain members of a structure may be subjected to greater strains during erection than after completion, thus necessitating corresponding greater strength. He also mentioned the necessity of automobile drivers exercising more Safety First precautions. A paper titled 'The Prevention of Accidents' by C. W. Price, safety engineer of the Wisconsin Industrial Commission, was read by the secretary, Mr. Price not being present. The paper

described some of the remarkable results that have been obtained among eastern corporations, and then gave in detail the necessary steps to be followed in introducing a Safety First movement in an industrial organization.

The evening session was devoted to a demonstration of wireless telegraphy, and of discharges of high potential electricity by the Department of Electrical Engineering and Physics of the University, followed by motion pictures of Safety First on the Union Pacific; The Manufacture of Steel, loaned by the U. S. Steel Corporation; University of Nevada Campus and Laboratory Views, and National Mine-Rescue Demonstrations, loaned by the U. S. Bureau of Mines.

Owing to the severe storm of the 25th and 26th, many of the delegates were delayed in reaching Reno, so the electrical



EXPLOSION OF COAL DUST AT EXPERIMENTAL MINE, BUREAU OF MINES, BRUCETOWN, PENNSYLVANIA, SEPTEMBER 23, 1913. ONE OF THE STUDIES THE GOVERNMENT IS MAKING IN THE INTEREST OF SAFETY IN MINES.

papers were held over until the 27th. On the morning of that day, an interesting meeting was held by railway apprentice instructors of the Southern Pacific, Santa Fe, Oregon Short Line, and Union Pacific. The meeting was presided over by Norman Collyer, executive secretary to the president of the Southern Pacific Railroad Co., and papers were presented by John Edwards Bray, Nevada State superintendent of Public Instruction, Thos. G. Gray of the Sacramento, and H. S. Gillette of the West Oakland shops of the Southern Pacific; Mr. Linn of the Santa Fe; and A. W. Preston, shop superintendent of the University of Nevada. On the preceding day, Mr. Collyer had addressed the engineering students of the university on the apprentice system for college men in operation on the Southern Pacific system. At the electrical section of the conference, on January 27, at which A. H. Babcock, electrical engineer for the Southern Pacific, presided, a discussion was held on 'Safety Regulations for Electric Power Companies,' the leading paper being by W. K. Freudenberger, chief engineer of the Nevada State Public Service Commission.

The principal session of the conference was the general meeting on the afternoon of the 27th, at which Governor Tasker L. Oddie presided. At this session, interest was mainly centred in the discussion on electric headlights, which was introduced in a valuable paper by J. G. Scrugham, professor of electrical and mechanical engineering at the University of

Nevada. Following the headlight discussion, after a demonstration of the talking arc, the following papers were presented: 'Safety First in Mining,' by Thomas M. Fagan, president of Tonopah Miners' Union. He discussed in an eloquent manner the relation of the employee who sells his labor to the employer and the state, dwelling particularly on features of the Nevada Insurance and Compensation Act. 'Safety First at Nevada Consolidated Copper Company's Plant,' by Lindsay Duncan, mechanical engineer of that Company, was read by title in the author's absence. Edward Ryan, state mine inspector, gave an interesting paper on 'Accident Prevention in Mining,' paying particular attention to the necessity of educating employees to their own dangers. At the close of his address, Mr. Ryan demonstrated the miner's oxygen helmet and rescue outfit, also the pulmotor, which is used by the U. S. Bureau of Mines. A. W. Hunsinger, of the Goldfield Miners' Union, spoke on accident prevention, and was followed by the Rev. Lloyd B. Thomas, Carson City, Nevada, who gave his impressions as a visitor at the Safety Conference held under the auspices of the American Museum of Safety in New York, December 10-12, 1913.

At the close of the meeting, a communication from secretary Cameron, of the National Council for Industrial Safety, urging the formation of a local council in Nevada to cooperate with the national body, was read by C. W. Whitney. On motion of John J. Mullin, secretary of the Nevada Industrial Commission, a resolution was passed by the convention to the effect that it was the opinion of the conference that an organization be formed to carry on the industrial safety work in Nevada, and that Governor Oddie appoint a committee of nine, of which he constitute the chairman, to arrange for and perfect such an organization. The conference proper closed with a banquet given by the Engineers' Club of the University to the delegates and guests. A. A. Codd, regent of the University, presided as toastmaster, and the speakers of the evening included Governor Oddie; W. S. Lunsford, city attorney; P. A. McCarran, justice Supreme Court; R. J. Clancy, assistant general manager Southern Pacific railroad; J. B. Brennan, representing the Blacksmiths' Union; J. H. Linn, of the Santa Fe; and J. E. Stubbs, president of the University of Nevada. Mr. Clancy's remarks were particularly interesting to the technical and railroad men present, as they covered a wide range of the Southern Pacific's activities, touching on the historical side and closing with the live subject of electric headlights. Of the exhibits at the conference, the principal one was that of the Southern Pacific Railroad Co., which reproduced the exhibit booth that was shown at the International Exposition of Safety and Sanitation, held in New York City in December, at which time the Company was awarded the Harriman medal for the best safety record of all railway companies in the United States during 1913. The exhibit was in charge of John C. Weigandt, assistant chief clerk to Julius Kruttschnitt, chairman of the executive committee of the Southern Pacific Railroad Co. Another interesting exhibit was an electrically operated working model of the block signal system used on the Southern Pacific. The University of Nevada exhibited a small locomotive, gas engine, and generator, constructed in the University shops, also a comprehensive display of safety first literature. Much of the credit for the success of the conference is due to J. G. Scrugham, who conceived the idea of the meeting and arranged practically all its details, carrying it through with honor to himself, the University, and the state.

The Nevada State Mine Owners' Association met at Reno on January 28. Members were present from all parts of the state. An election of officers resulted as follows: President, John G. Kirchen, of Tonopah; vice-presidents, Albert Burch, of Goldfield, and C. B. Lakenan, of Ely; and secretary and treasurer, W. B. Alexander, of Reno. The executive committee elected was as follows: John G. Kirchen, Albert Burch, C. B. Lakenan, W. A. Bradley, Frederick Bradshaw, L. G. Campbell, and W. H. Bradshaw. At the conclusion of the

annual meeting, there was a dinner given at which the following were present among others: John G. Kirchen, W. L. Alexander, George Wingfield, Fred J. Siebert, Frederick Bradshaw, Albert Burch, W. H. Blackburn, Arthur Lowry, L. G. Campbell, Hugh H. Brown, and C. V. Jenkins.

LONDON

PHOENIX AND EAST POOL MINES.—LABOR TROUBLES IN CORNWALL, AND MINERS' OBJECTIONS TO NEW SYSTEMS.

A few weeks ago I mentioned that the Duchy of Cornwall had been trying to exact onerous terms for a renewal of the lease of the Levant tin and copper mine near Land's End. I explained that the Duchy of Cornwall was in by-gone days the private property of the King of England, but nowadays a government department. The treatment of the Phoenix tin mine, north of Liskeard in East Cornwall, has apparently been different. It was stated at the meeting of shareholders last week that the Duchy office had agreed to subscribe £7500 on mortgage, provided the directors found a similar sum. This money is required for further development. Royalty has a particular interest in the Phoenix mine, for did not the present King and Queen, when Prince and Princess of Wales, pay a visit to it for the express purpose of formally starting operations in connection with the sinking of the new shaft? At the most recent reorganization of affairs, in September, 1912, Bewick, Moreing & Co. were made managers. When they assumed control at Phoenix, they arranged for £50,000 new capital, for the purpose of paying off the debentures and liabilities, and providing funds for further development. It is evident that this amount has not been sufficient, otherwise new debentures would not now be issued. The property has afforded another example of the miner-like fashion in which the old Cornishmen conducted their operations, for it has been proved by the present managers that no ore worth extracting was left in the old workings. It has therefore become necessary to launch out into a vigorous scheme of development at a number of places in virgin ground, in the hope of finding sufficient ore to keep a mill going. The directors and managers are keeping rather quiet about the performance and prospects at this mine. The yearly report was not circulated to the press, and the meeting of shareholders was held privately. It was only accidentally that I heard that the report had been issued and the meeting held.

The same firm, Bewick, Moreing & Co., also has the East Pool mine, near Camborne in hand, and will have an equally difficult job there. For years the mine yielded handsome profits, and in recent times the crushing and concentration departments led Cornwall in the treatment of low-grade complex ore. But the yield per ton gradually fell, and in order to reduce costs development underground was neglected. Finally the provision of additional capital became imperative in order to conduct a new campaign of development. This, Bewick, Moreing & Co. undertook to do a year ago. Their efforts have given disappointing results so far. One of the objectives at depth was the finding of the Great lode. A lode, which is apparently that sought, has been cut, but it is low grade. At this mine, Bewick, Moreing & Co. have also had labor troubles, owing to their desire to keep track of costs more closely, and to abolish what is known as the contract system of pay, which is in general use in Cornwall. The men refused to go underground on the new terms and in the end, the regulations were withdrawn. Under the contract system, the 'taker' of the 'pare' or gang is paid the whole of the amount earned by the 'pare', and he distributes the money among the men and boys constituting it in such proportions as he may previously have agreed with them. The boys he usually pays \$12 to \$14.40 per month, and he justifies this low wage by a claim that he is teaching them their work, or in other words, they are serving a sort of apprenticeship for which he claims a part of the value of their services, as a payment for supervision and in-

struction. The manager of the mine has no control of the members of the 'pare', so far as wages paid or time worked is concerned, and frequently shifts are missed by one or other member without penalty. This is an unsatisfactory state of affairs, for the standing charges of the mine continue the same whatever the output, and it is necessary to get a maximum of shifts worked. The management of any mine is entitled to, and indeed ought to, know the rate of pay of all employees per shift, and how many shifts they work. The older men were opposed to any change that involved payment for actual shifts worked at a fixed rate, as their share for so-called supervision would vanish, and they were able to persuade the younger men to follow their lead. It is always difficult in Cornwall to abolish old customs; but it is hoped for the sake of the industry that the attempt will be made again, after it has been clearly demonstrated that the genuine worker would not be a loser by the adoption of the shift system of payment. Another difference with the men was the proposal to close all contracts on the 15th day, and at the end of each month. This would have resulted in two pays per calendar month, the Company only holding three days pay in hand instead of two weeks pay as at present, and would have replaced the existing four-weekly pay, with subsist at the end of the second week. The change was necessary to enable the general managers to figure their costs, etc., per calendar month. The opposition of the men was based on the opinion that this change would result in their only having 12 instead of 13 pays, an absurd contention in view of the fact that the men were to be paid on shifts actually worked.

NEW YORK

THE GUGGENHEIM EXPLORATION CO. AND ITS 'FRIENDS.'—AMERICAN SMELTING & REFINING CO.'S COPPER TRANSACTIONS.—TRUST INVESTIGATIONS.—COPPER STATISTICS QUESTIONED.—BRITISH COLUMBIA COPPER COMPANY.

Whatever the Guggenheims do is of burning interest to a great many people, and in the advertising they get by their 'loving' friends, not a little is ascribed to them which is more surprising to them than to anyone else. Whenever negotiations for a mining property are started anywhere, it is sure to be whispered, to the accompaniment of mysterious winks, that "the Guggenheims are back of it." The latest of these interesting canards is a despatch from Denver stating that the Guggenheim Exploration Co. is about to take over pretty near the whole Rico district of Colorado, involving a \$4,500,000 deal. Just how this could be brought about without the officials of the Company knowing anything about it is not clear, but it seems to offer no difficulties to the reporter. What the Department of Justice is going to do to the American Smelting & Refining Co. is another matter of much interest, in this case to business men in general. The hearings in the dissolution suit against the United States Steel Corporation still drag along, but do not even get space on the financial page any more, and it is clear that the public has lost all interest in the matter, being pretty well convinced now that the 'Steel Trust' is, at the worst, a beneficent ogre. The International Agricultural Implement Co. is also under scrutiny; but the worst charge that can be truthfully brought against these two big organizations is that they have combined a number of competing plants into one organization. So many intelligent men now believe that unrestricted competition is harmful to the public interest, that it seems doubtful whether any public support for the dissolution of the organization on that score alone can be evoked. What the Department of Justice has against the American Smelting & Refining Co. has not been made public, but must be much the same as the two others. Meanwhile the Company has been 'getting in wrong' to a further extent, for the statistics of 1913 show that it advanced to the leading position in the copper producing and selling business, a

position which it has long held in lead production. The Company sold nearly 500,000,000 lb. of copper in 1913, as compared with 442,000,000 lb. by its nearest competitor, the Amalgamated sales agency. The difference is really greater than this, for Braden copper goes directly to Europe, not appearing in the figures, while the Amalgamated agency sells much more copper for outside companies than the American Smelting & Refining Co. does. Whether this fresh proof of villainy on the part of the 'smelter trust' will add fresh fuel to the flames of governmental wrath remains to be seen. As a matter of fact, were it not for President Wilson's anti-monopoly policy, all three matters would probably be quietly dropped.

I have several times referred to the suspicion with which American copper statistics are regarded abroad, while consumers here similarly allege that the European figures are not to be trusted. The most vigorous attack on American statistics is one published in the *Ironmonger*, of London, which says: "American news is now entirely discredited after the last returns issued by the Copper Producers' Association, which are regarded by most as having been manipulated. If these present figures correctly represent the position, then it is held in many quarters that the preceding figures have not done so. Under the circumstances, the copper market took the returns calmly, although they were bad enough to have precipitated a panic, and the fact that prices did not sustain any greater deterioration than was actually the case, is probably due to the extent of the depreciation already sustained and to there being no bull account open worth consideration. The attitude of producers has not been such as to inspire any confidence in the trade, for there has been a continued weak appearance about prices and a decided tendency toward competition between producing and dealing interests, all of whom seemed to want to book business. Whether the chief producers have much metal on hand awaiting sale is not clear, but they are quite ready to sell, and are in a position to give early shipment copper whenever required, a somewhat unusual circumstance, in the light of the experience of the greater part of last year." Consumers here freely intimate that large quantities of copper have gone to Europe on consignment and do not appear in the statistics there. Pascal once said that we know truth not only by the reason, but also by the heart. In this case a good many people seem to be somewhat affected in both organs.

The British Columbia Copper Co. has been extending its operations for some time and has been busy exploring and optioning properties. It has done so well in this regard that Hayden, Stone & Co. have underwritten a new bond issue of \$1,000,000 in 6% convertible bonds, and it is reported that the \$3,000,000 company will be reorganized as one with \$5,000,000 capital. The refinancing plan will be announced during the current week. As a result of this activity, British Columbia shares advanced from \$2 to \$4 last week. The new smelter of the Granby at Anyox will not be blown in until after February 1, there having been some delay in the construction of a dam. The Mason Valley has had its converter department in operation for several weeks, two 12-ft. converters being in use. In addition to making a saving of about ½c. per pound over shipping the matte to Garfield, the converters enable the Company to utilize 50 to 60 tons per day of silicious custom ore, of which there is an abundant supply. The Mason Valley should make a better showing this year. The suit of the United Zinc Co. of Maine against Sydney Harwood and others to recover \$1,000,000 excessive profits alleged to have been made by them when they were directors of the United Zinc & Lead Co. of New Jersey, has been dismissed by the Massachusetts Supreme Court. The fraud alleged was in the sale of Missouri lands to the New Jersey company, which was afterward merged into the Maine company. The Court held this merger was never authorized and the Maine company had no right to bring the suit.

General Mining News

ALASKA

CIRCLE

Clarence Barry has contracted with the Union Construction Co., of San Francisco, for a 3½-cu. ft. close-connected bucket-dredge, to dig 15 ft. below water-level. This dredge will be erected on Mastodon creek, near Circle City. Probably the most important feature in its design was the question of economy of power production. After making an exhaustive study of the problem both east and west, it was decided to install two R. Wolf locomobiles. These engines give a high economy in fuel consumption, delivering 1 b.h.p. per hour from 1.06 lb. of coal. The engines use superheated steam and are mounted directly on the boiler. The dredge will have a revolving screen, to remove the oversize material, the fine passing through the screen, directly into either of two sluices. The bucket-lines of both dredges will be made of cast nickel chrome steel with manganese steel lips.

FAIRBANKS

Since quartz mining started here in 1909, the total gold produced is approximately \$1,000,000, of which the Rhoads-Hall mine has yielded \$400,000. It is estimated that the 1914 out-



RHOADS-HALL MINE.

put of the district will be nearly as much as the total previous production. During December the Newsboy mill was cleaned-up for \$2500, which is an equal amount short of all expenses at the mine and mill. Leslie M. Drury is manager. Good ore is now being mined. Gravel worth \$1.75 per foot has been uncovered by Johnson brothers and Johnson on 22A Goldstream. They have a 35-hp. plant on the claim, and will take out a large winter dump.

NOME

John Brower, Charles Mitchell, and J. J. Cole, of Nome, have contracted with the Union Construction Co. of San Francisco, to build a 3½-cu. ft. close-connected bucket dredge, to dig 35 ft. below water-level. It will be erected on Bangor creek on the Seward Peninsula. It will be operated by distillate engines and will have the standard equipment of winches, screen, stacker, and gold-saving tables. The distributor will be of the Company's special design, by means of which the fine material is spread equally over all the tables. This is a feature which has been neglected in most of the California dredges, resulting in about 90% of the gold being caught in the upper part of the first two or three tables.

SHUSHANA

Little work is being done on the claims just now, but about 400 cabins have been erected. Food is plentiful, including wild meat at 10c. per pound. Flour, beans, sugar, and rice are 50c. per pound. Several large outfits are on the way to the camp. A moving-picture outfit is in charge of Frank L.

Johnson. He is equipped to take and show pictures. G. P. Sprout, who has studied the different routes to Shushana, stated at Fairbanks that the Tanana river route is the best one under present conditions.

VALDEZ

The Cameron-Johnson Gold Mining Co. is to install an aerial tramway to convey ore from its Treasury Note claim to the mill built last summer. The Company has 26 claims on the right limit of Shoup glacier. Three adits have been driven in the Treasury Note, the veins being 18, 30, and 48 in. wide, respectively, worth \$185 per ton. Rich ore has also been opened in the Montezuma claim.

ARIZONA

COCHISE COUNTY

On January 22, excavating was started for foundations of the first unit of the Copper Queen concentrating plant. The site is just below the Sacramento shaft. This unit will be of 25-ton capacity to check laboratory work. Concreting the Junction 5-compartment shaft from 1800 ft. to the surface is practically finished. The first work was from 1500 ft. up, and then from 1800 to 1500 ft. It is likely that development will be resumed at the Denn. Water has been an obstacle in this mine. Better ore is being mined by the Higgins Leasing Co. Ore shipments are being sent regularly from claims at Tombstone, the State of Maine being the largest producer. Results of the examination of the Tombstone Consolidated mines by engineers of the Phelps-Dodge company have not been published yet. The Commonwealth Extension, at Pearce, has been sold to Bisbee mining men.

A 'Safety First' smoker was held last week at Bisbee, at which over 700 men attended. Besides serious discussions on the subject, a good program was submitted for the audience.

GILA COUNTY

(Special Correspondence.)—For the International smelting plant, the American Bridge Co. will supply about 6000 tons of steel, and work must be started within 90 days. At the Inspiration, during the past week, two carloads of iron gates for draining the ore-storage bins have been received and are now being put in place of the bins, which will require 140 of the gates. The General Electric Co. has shipped three of the large transformers and they should soon be in Miami. The transformers, which are shipped from Pittsfield, Massachusetts, weigh 5000 lb. each. One of the large Pacific Electric No. 4 air-compressors has been received and unloaded near the main shafts. Bad weather has interfered with construction work and train service. Ore-bins are being erected at the main shafts, and work is to be soon started on the head-frame. The United States Reclamation Service force now has towers of the transmission line erected up to the main east and west shafts and is continuing the work toward Superior.

Miami, January 31.

Assessment and development work is being done on 75 claims of the Troy-Arizona Copper Co., at Troy, south of Globe. An option has been taken on the Renfro group of 40 claims adjoining, the price being \$25,000. Leo Von Rosenberg has 25 men on the various claims.

PINAL COUNTY

At the Ray Consolidated mine, the company is starting a 'safety first' movement. Employees who offer suggestions for lessening risks are given cash prizes; a course of lectures in first aid is provided; pulmotors are installed for emergencies, and a helmet practice is given every month.

YUMA COUNTY

The Swansea Consolidated Gold & Copper Co., operating the Swansea mine and smelter in the northern part of the county, has been pronounced bankrupt. The Farmers' Exchange of Phoenix is the principal creditor.

CALIFORNIA

AMADOR COUNTY

A Spaniard, on being refused work at the Kennedy mine, attacked the foreman, Alex. Ross, with a razor. He was finally overpowered and arrested. Mr. Ross was not seriously hurt. A miner at the Keystone, Amador City, is suing the company for \$5071 for injuries alleged to have been received while attending to a machine-drill.

BUTTE COUNTY

Floods in the Feather river interfered with power for the three dredges of the Oroville Dredging Co., and the gold output was only \$3289 during the week ended January 3.

ELDORADO COUNTY

J. J. Meyers and J. J. Dunn, of Georgetown, have sold a third interest in the Emma group of mines, on the Georgetown divide, to W. T. Russell, of Fresno. The mine will be developed and a 5-stamp mill will be erected at once.

MARIPOSA COUNTY

The Exchequer dam, a concrete structure across the Merced river at Exchequer, was destroyed by the recent floods. It was built about eight years ago by the Exchequer Mining & Power Co., to supply power for several mines near Hornitos. These included the Mount Gaines, Ruth Pierce, and No. 5. In 1911, floods in the river damaged the power-plant, which was only supplying the Mount Gaines at that time. Since then the dam was not used for any purpose, but may have been useful at a later period. Its dimensions were 56 ft. high, 10 ft. thick at the top, 40 ft. at the bottom, and 175 ft. long, and cost \$42,000. It is stated that the Bad Spur dredge, two miles above the dam, has been washed out. The town of Snelling, in Merced county, was partly flooded, but apparently the Yosemite Dredging Co.'s boat was not damaged.

NEVADA COUNTY

Moore's Flat, an abandoned hydraulicking district, is now active through lode mining at the Black Bear, Metropolitan, Nellie V, Golden Shipper, and Bawder's properties. The new 10-stamp mill at the Golden Center of Grass Valley mine has started work.

PLACER COUNTY

A good ore-shoot was recently opened in the east end of the Gold Blossom mine at Ophir. The main shaft is down 480 ft. Ore averaging \$7.50 in free gold and 75c. per ton in concentrate has produced over \$500,000 from this mine. Various causes have prevented its being operated of late years, but J. H. Toler, one of the heirs of the Reed estate, estimates that instead of mining and crushing 43 tons per day at a cost of \$3.75 per ton, a modern plant and methods will reduce the cost to \$1.16 per ton. Ore reserves are estimated at 53,384 tons, worth \$160,019, and a profit of \$79,943. A rearrangement of plant will cost about \$6940. A. C. Lowell, executor of the Reed estate, is interesting Nevada people in the Gold Blossom.

SACRAMENTO COUNTY

The Natomas Consolidated of California reports the result of its gold-dredging operations during December as follows:

	Gross.	Cost.	Net.
Natoma field	\$176,974	\$108,809	\$ 68,165
Feather River field.....	49,073	24,738	24,334
Total	\$226,048	\$133,547	\$ 92,500
Crushed rock	24,087	14,571	9,515
Water	2,139	1,399	740
Miscellaneous income	25,958	7,971	17,986
Total	\$278,233	\$157,490	\$120,742
Bond interest		81,103	81,103
Net	\$278,233	\$238,594	\$ 39,638

SIERRA COUNTY

Work has been resumed at the Independence mine on Wolf creek, below the Plumbago.

COLORADO

For the mining convention to be held on February 19, Denver has been chosen as the meeting place. Twenty-six counties have selected delegates, and about 150 representative mining men will be present.

DOLORES COUNTY

The annual meeting of the Rico-Wellington Mining Co. was held at Provo, Utah, on January 29. The old board of directors was reelected, including Jesse Knight as president. Large shipments of copper and some zinc ore were made in 1913, and at present 20 tons of copper ore is being shipped daily to Salt Lake smelters. The Company's indebtedness is now \$51,000, \$50,000 having been paid off during the term.

GILPIN COUNTY

This county is said to be quite active in spite of the winter, and numerous small claims are being developed. Deeper work is to be done at the Bates mine in Chase gulch. Ore shipments to the Polar and Iron City mills have yielded high gold returns. The Castle Rock is also producing good ore. Shipments from the Pittsburg, in Russell gulch, have yielded 2.16 to 10.54 oz. gold, 3.84 to 10.20 oz. silver, and 4.8 to 19% copper. Development at the Homer, Columbia adit, Cecil lode, and East Notaway is producing satisfactory results.

LAKE COUNTY (LEADVILLE)

A large tonnage of iron ore has been opened in the Henriette mine, Carbonate hill, and shipments are being made. The daily output of iron, lead, and carbonate of zinc ores is 50 tons, but this is to be increased. Development in the Eureka, Lackawanna gulch, is excellent, several hundred feet of ore being opened in the main adit. Lessees at the Little Johnnie, Breece hill, are getting satisfactory results. The Walker adit, at South Evans, is being driven 400 ft., the present rate in hard ground is only 2 ft. per day. This place is at a high altitude, and miners do not stay long. The District mill, lower California gulch, is working full time. A tube-milling oil-flotation process is being tried on the zinc tailing from the Horriggan lease on the Maid of Erin dump. W. H. Campbell, of the Jolly Leasing & Milling Co., states that there should be a change in the smelter charges on iron ores. At present the smelters demand 40% excess in all iron oxide ores. Most of the large iron orebodies in the district contain 3 to 4 oz. silver per ton, and a good deal of silica, and he considers that on a basis of 35% iron there would be a revival in mining at Carbonate and Fryer hills. The Denver City shaft, Yankee hill, is completed, and properly equipped for work. The Mt. Champion mill, Half Moon gulch, is being overhauled. A wide vein has been opened in the Siwatch adit.

OURAY COUNTY

A snowstorm of four days' duration shut down every mine in the county for some time during the last week of January. A flume and transmission wires of the Ames power-plant in San Miguel county were carried away, and power was cut off. A snowslide knocked over a tower of the Atlas tramway, and part of a shed at the Camp Bird, while a considerable amount of minor damage was done.

SAN MIGUEL COUNTY

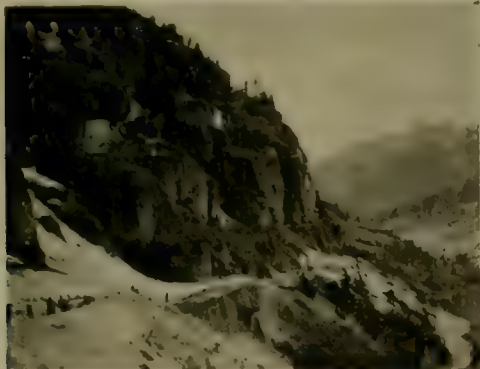
The Liberty Bell Gold Mining Co. has recently acquired, under lease and bond, some property in the East Mill Creek district, the purchase price being \$10,000. The claims contain gold-bearing veins, and will be prospected by an adit in Cornet Creek basin.

A fierce storm throughout the county did little damage to mining plants, which operated practically the whole time.

The Idaho and Butterfly snowslides carried away power lines and flumes of the Western Colorado Power Co. The Pandora slide started off with the Bob Tail slide and destroyed two towers of the Tombow tramway and some cables. These slides rushed to within 300 ft. of the Pandora mill of the Smuggler Union company, and damaged the Pennsylvania snowsheds and tramway.

TELLER COUNTY (CHITTLE CREEK)

On No. 11 level of the Gold Coin shaft of the Granite company, the main Granite vein has been opened over 100 ft. so far, and yields rich ore. Dan McCarthy is superintendent. Dividends amounting to \$45,000 and \$26,185, respectively, have



SNOWSLIDE IN CANYON CREEK, OURAY COUNTY.

been paid by the Vindicator and Mary McKinney companies during the last week of January. Lessees at the Isabella mines are satisfied with their conditions, and have published a statement to that effect.

The January gold output of the district was \$1,285,536, from 86,213 tons of ore.

IDAHO

LEMHI COUNTY

A car of rich gold ore has been sent to Salt Lake City from the Allie mine at Gilmore. The vein is 2½ ft. wide, and has been driven on 40 ft., and a raise driven 50 ft. The face gives high assays at present. This is an old silver-lead district, which was almost abandoned except for several prospectors, mainly on account of transport arrangements over 80 miles of road. Three years ago the Pittsburg-Gilmore railroad was constructed to the district, and it became active as a silver-lead ore producer, according to Robert Bell, inspector of mines. The principal work has been done at the Pittsburg-Idaho, Latest Out, and Allie mines. The formation of the district is ancient limestone underlain by Cambrian quartzite. E. C. Ross is manager of the Allie mine.

SHOSHONE COUNTY

The Idora mill, near Sunset, and 1600 ft. below the mine, has resumed work after a temporary shut-down for overhaul. The mill has a capacity of 100 tons per 24 hours, and is connected with the mine by aerial tramway. Concentrate from the mill is hauled 9 miles to Prichard. The mine is looking well, as is also the Tuscumbia, which is under option to the company. M. D. Winder is manager. John Mocine has been appointed manager of the National Copper Mining Co. at Mullan, in place of Charles McKinnis, who is in bad health. At a depth of 400 ft., the cross-cut from the bottom of the Sunset mine shaft has cut the vein. The ore contains lead and zinc. This property is owned by W. A. Clark, of Montana.

On February 4 the Bunker Hill & Sullivan Mining & Concentrating Co. paid dividend No. 197, of \$81,750. This makes the total amount of dividends paid \$14,892,750.

There has been further litigation with the Stewart Mining

Co. This was the suit of this Company against Jonathan Bourne, Jr., owner of the Ontario property, for the purpose of getting title to orebodies in the Ontario lode claim the apex of which was claimed by the Stewart company. It was admitted that the same vein was in the Ontario and Stewart, but in the latter it was faulted. The question for the court to decide was whether the particular fault to which reference was made by parties to the suit constituted a part of the apex of the vein which extended across both the Stewart and Ontario properties, or whether it was only a side or edge of the vein. In his decision, Judge E. S. Dietrich held that it was no part of the apex, and the complaint was dismissed. Both properties contain high-grade ore, and the case was one of the most bitterly contested ever tried in the Coeur d'Alene district.

The American Smelting & Refining Co. has secured control of the Stewart Mining Co. by buying 471,000 shares of the latter's stock. The former Company is also negotiating for another 68,000 shares.

MICHIGAN

HOUGHTON COUNTY

'Rock' shipments from different Calumet mines during the third week in January were as follows: Calumet & Hecla, 8790 tons; Osceola, old mine, 960; South Kearsarge, 1200; North Kearsarge, 920; total for Osceola Consolidated, 3080; Ahmeek, 1480; Mohawk, 1400; Wolverine, 1400; Centennial, 440; and Allouez, 840 tons. At the Ahmeek stamp-mill, two heads are working three shifts, crushing 1700 tons of rock per day. Four heads at the Osceola are crushing 2800 tons. The Mohawk is employing 200 men, and the one-man drill is used exclusively.

The past week has seen a number of additional mines enter the list of the normal producers. Those mines which are now working full handed and producing copper at the rate before the strike are as follows: Superior, Calumet & Hecla, South Kearsarge, Osceola, North Kearsarge, Allouez, Winona, Centennial, and Victoria. The mines which are working normal forces, but which are not producers of copper, are as follows: White Pine, Mayflower, Old Colony, Keweenaw, New Arcadian, New Baltic, Oneco, Hancock Consolidated, Naumkeag, South Lake, North Lake, Indiana, Wyandot, La Salle, Houghton Copper, and St. Louis. The mines which are operating over 75% normal rock output and expect to be in normal condition again within a few weeks are the Baltic, Trimountain, Champion of the Copper Range Consolidated, the Quincy, nearly normal, Ahmeek, and Wolverine. Mohawk is about half of normal in rock production now. The influx of new men to the district continues. Quite a few of the men from the iron mines are coming to the copper district, feeling that the Finnish socialists there will attempt to strike in the near future.

MISSOURI

GREENE COUNTY

Ore has been found at a shallow depth near Springfield, and the district is quite busy. The first shaft has been sunk south of the James river. The Gumbo district is producing ore, which is sent to smelters in Kansas and Illinois.

JASPER COUNTY

The Napoleon mine is producing from 50 to 60 tons of zinc ore per week, and is one of the steadiest properties at Joplin. Last year a large tonnage of zinc and lead ore was produced. Work is carried on at a depth of 150 ft. Drilling at the south part of the lease showed rich ground at 115 to 125 ft., and down to 155 ft. The Napoleon Lead & Zinc Co. is composed of Joplin men. It has a lease on 40 acres of the Nap Perry land. A modern concentrating plant is at work. Of the 4745 tons of zinc ore from the Missouri-Kansas-Oklahoma district during the past week, 1570 tons was from

the Webb City-Carterville sheet-ground area. It also sent out 486 tons of lead ore. Despite low prices, the operators are keeping their mills running. The Galena-Joplin Lead & Zinc Co. has its shaft down 167 ft., but continuous pumping is necessary. Drilling has proved ore under limestone over a good area. W. C. Kramer has secured a lease on the Bonanza land, and will probably start drilling shortly. A new 250-ton mill is being erected by C. C. Yoder and associates. Large pumps are now at work in the Dallas mine. About \$5000 was spent last fall on the Symmes mine plant.

MONTANA

MADISON COUNTY

It is stated that a new company has taken options on 20,000 acres of ground in Ruby valley, near Twin Bridges, for dredging purposes. The options are for the current year only. Prospecting is to start soon, according to H. F. Jackson, representative of the company. Charles F. Helman, of the El Oro Dredging Co. of Oroville, California, has authorized this work to commence. He spent some time in this district last summer and fall.

SILVERBOW COUNTY

Development of the Edith May vein at 2600 ft., in the North Butte, is very promising for further discoveries. At 2000 ft. the Butte-Alex Scott drift has cut the vein. A shoot of 4 to 5% copper was recently cut in the Alex Scott. The property is producing 150 tons of ore per day from the 1900-ft. level. Seventy men are employed. The Butte-Ballaklava shipped 2300 tons of ore in December. The largest ore-shoot is at 1400 ft., where it is 10 ft. wide, against 5 ft. at 1200 ft. and 10 ft. at 800 ft. It is intended to cross-cut from the 1600-ft. station. Last week the miners entered the old 1200-ft. level stopes which were filled with waste, the result of litigation with the Anaconda company. The Butte Ballaklava is working a southeast extension of the North Butte's Jessie vein. Forty-five men are employed. The large flow of water in the Butte & Zenith, six miles west of Butte hill, is now under control, enabling further sinking to be done. Cross-cutting is under way at 2400 ft. in the Tuolumne, and the Jessie vein will be cut about February 23. About 100 tons of ore per day is being mined from a wide shoot at 800 ft. A station is to be cut at 2200 ft. in the Pilot-Butte, and cross-cutting done to cut a 2½-ft. shoot opened at 1800 ft. The Anaconda company's suit against the Pilot-Butte is set for March. The former claims ownership of the South vein, which is alleged to apex in its Emily ground, adjoining the Pilot-Butte.

NEVADA

CHURCHILL COUNTY

It is stated that at the Goldbanks Quicksilver Mines Co.'s property, 35 miles south of Winnemucca, in Pleasant valley, an area of 1000 by 3500 ft. contains cinnabar. A gravity tramway to a 12-ton retort is nearly finished, the furnace now being heated up. The annual meeting of the Nevada Hills Mining Co. was recently held at Reno. Development in the mine at Fairview covered 6243 ft. during the past year. The mill treated 41,919 tons of ore averaging \$13.77 per ton. The net yield was \$510,414. The total expenditure was \$333,448, equal to \$7.95 per ton. The profit was \$176,966. E. A. Julian is general manager.

ELKO COUNTY

The Eureka & Palisade Railroad Co. will construct a line to the mining camp of Bullion. It will be 14 miles long with 2 and 4% grades. There is a large tonnage of profitable ore opened in the various claims.

ESMERALDA COUNTY

The Goldfield Consolidated Mines Co. reports as follows for January: Ore treated, 30,249 tons; gold recovered, \$336,000; operating expenses, \$180,000; and net realization, \$156,000.

NYE COUNTY

Work is to be resumed at the Manhattan Consolidated mine. Water is being taken out by a Cameron pump. The ore from this property is rather refractory, and the California Extraction Co., of Oakland, is experimenting with it. It is said that the Clancy process is being installed at the Associated mill. Good ore has been opened in the Wittenberg-Mushett lease on the Manhattan-Dexter property, at 300 ft. A winze is being sunk to prove the extent of the shoot. A heavy snowstorm visited Manhattan during the last week in January. The West End will pay a dividend of 10c. per share in March, equal to \$178,848. The ore production of Tonopah mines last week was 11,005 tons, valued at \$265,210. A reduction in power and light rates will be effective in the district on March 5. The last quarterly report of the Tonopah Mining Co. shows the following: Gross value of mill products, \$667,747; net earnings, \$358,694; sundry income and dividend (\$54,220) from Tonopah & Goldfield railroad made a total of \$436,678; exploration, \$19,425; and defense of Brown process litigation, \$6592, leaving net income of \$410,660. Dividends of \$250,000 each were paid on October 21, 1913, and January 21, 1914. The company has organized the Tonopah Placers Co., with a capital of \$1,000,000, to work the dredging areas acquired at Breckenridge, Colorado.

STOREY COUNTY

The 2700-ft. level at the Comstock has been drained, the water being 5 ft. below the station. This is the first time for 30 years that anybody has been to that depth. The drift leading from the station to the Ophir, Mexican, Union, and Sierra Nevada mines is in good condition. Great hopes are held for satisfactory development at 2700 ft. The Starrett pumps have done excellent work in unwatering the area. A. M. Walsh and Leon M. Hall are superintendent and engineer respectively of the United Comstock Pumping Association.

UTAH

SUMMIT COUNTY

Three feet of shipping ore has been opened on the 1550-ft. level of the Silver King Consolidated, at Park City. This makes three faces at this depth where ore is being mined. The Thompson-Quincy mine is being worked as usual in spite of the fire at the Daly West in December. Good ore is being mined.

SALT LAKE COUNTY

The old Yosemite mine at Bingham is again active, and a carload of lead ore has been extracted from the 500-ft. level. The mine, down to 2000 ft., has been drained by the Mascotte adit. A settlement of 37 tons of ore from the City Rocks workings of the Michigan-Utah gave the following result: gold, 65c.; silver, \$25.76; copper, \$1.47; and lead, \$11.22; a total of \$39.10 per ton. Twenty-five men are employed at the property.

WASHINGTON

STEVENS COUNTY

The eighth annual meeting of the United Copper Mining Co. was held at Spokane on January 28. Conrad Wolfe is president. He stated that \$67,000 was spent last year in development, installing electric equipment and enlarging the mill. The lower adit was driven 3700 ft. during 1913. A two-compartment shaft is below the 600-ft. level, and will be sunk 400 ft. farther. Both the adit and shaft should be finished in about 60 days. Generally the mine is in good condition. Statements of ore production and metal output will be published shortly by the Company.

SPOKANE COUNTY

(Special Correspondence.)—The Reata Mining & Milling Co. has been organized by Spokane men, with a capital of \$1,500,000. The mining claims to be developed are near the

Dear Creek mines, 4½ miles northwest of Spokane. About 2000 ft. of work has already been done, and 10,000 tons of ore is ready for shipment. The Providence claim has produced ore worth \$50,000. Silver predominates in the ore, the lowest grade being 10 oz. per ton.

Spokane, January 28.

CANADA

BRITISH COLUMBIA

Shipments of ore from Rossland mines to the Trail smelter for the week ended January 21, also for the year to that date, are as follows: Centre Star, week 3710 tons, year 10,565 tons; Le Roi, week 795, year 3551; Josie (Le Roi No. 2), week 212, year 1330. During the last week 477 tons of ore from the Ben Hur mine, Republic, has passed through Rossland, also 53 tons consigned from the First National Bank at Colville, Washington.

The Second Relief mine at Erie has been sold to Minneapolis people for \$300,000. A. H. Elftman is the principal holder in the new concern, and Litchfield & Hanson were the former owners. Spokane people are interested. The present gold output is between \$10,000 and \$12,000 per month. The British Columbia Copper Co.'s gross earnings in 1913 were \$1,240,000. New holdings, costing \$275,000, were acquired during the past year, and a new concentrating plant will be erected to treat the ores from these properties. The Greenwood smelter can handle the extra product. A bond issue of \$1,000,000 will be used to pay for new works.

ONTARIO

During December the Hudson Bay mill treated 1945 tons of ore averaging 23.6 oz. per ton, with 88.7% recovery, the residue containing 2.8 oz. per ton. The output was 49,721 oz. silver. Thirty feet of ore, worth from 3000 to 4000 oz. per ton and 2 in. wide, has been opened in a branch stringer from the Fleming vein on the 150-ft. level of the Crown Reserve mine. It is consistent in the few feet opened to date. The new development is from the workings driven shortly after the draining of Kerr lake.

During 1913 development at the Wettlaufer Lorrain mine covered 1390 ft., and 982 ft. of diamond-drilling; but results were disappointing. Ore produced yielded 252,864 oz. silver, and the reserves contain only a few thousand ounces. The year's profit was \$38,042, against \$320,249 in 1912.

Thirty-one mines were on the shipping list at Cobalt in 1913, against 27 in 1912. The amount sent out last year was 20,916 tons, and a total of 179,934.31 tons since 1904. During December the Buffalo mill treated 7199 tons of ore averaging 23.27 oz. per ton. Silver recovered was 128,997 oz. A vein has been cut at 280 ft. in the Bailey, and it is figured to be the No. 1 vein, but contains low-grade ore at present.

The Hunton, Horne & Stevenson claims at Kirkland Lake have been acquired by English people, headed by H. Cecil. The Hunton claims include two 40-acre properties about ¾ mile south of the Teck-Hughes. The deal, on a cash and share basis, will amount to about £200,000. English capital is flowing freely into the Kirkland Lake district of late.

It is proposed to amalgamate all the mines at Pearl Lake under one company. These include the McIntyre, which is treating ore, and the Pearl Lake, Jupiter, Plenaurum, Schumacher, and Vipond, which are not being operated. Central equipment will be an advantage to the group. The Foster Leasing Co. is preparing to develop its ground under Glen lake. Nearly half of its 40 acres is situated there.

The International Exploration Co., of Buffalo, has an option for \$160,000 on the Le Blanc property at Keniwisek, near Hurricanaw, and probably this will be completed. On account of proper bridges to the mine, development is temporarily held up. At 46 ft. depth in the Clark claims, 40 in. of quartz assays \$5126, and 30 in. of quartz and schist averages \$32.87 per ton. On the hanging wall is porphyry assaying \$3.31 per ton.

Personal

J. C. PYD is down from Butte.

W. C. RALSTON is in New York City.

E. H. NUTTER has returned from Butte.

E. H. LESLIE is at Bartlesville, Oklahoma.

C. G. TAILFUR is now at Dayton, Nevada.

EDWARD J. O'CONNELL is in San Francisco.

F. L. SIZER is in San Francisco for a few days.

L. D. RICKETTS was in Salt Lake City this week.

A. CHESTER BEATTY has sailed for the Mediterranean.

F. R. MANN has moved from Globe to Superior, Arizona.

ALBION S. HOWE is expected in San Francisco from Costa Rica.

R. NOBLETT has gone from Bisbee to Pilaes de Nacozari, Sonora.

CLEMENT A. FOSTER, of Halleybury, sailed from New York for London.

LESTER A. GREENE is expected from New York and Chicago next Thursday.

D'ARCY WEATHERBE passed through New York last week on his way to Cobalt.

E. T. STANNARD has returned from Chile and is atinghamton, New York.

W. G. ANDERSON left San Francisco on February 1 to inspect mines in eastern Ontario.

E. C. CONVERSE was married to Miss EDITH M. DUNSHEE in New York on January 30.

WILLIAM J. PRIESTLY, Jr., who has been in Latouche, Alaska, is now at Seattle, Washington.

R. S. McCaffery has been appointed professor of metallurgy in the University of Wisconsin.

ASKIN NICHOLAS is manager of the Block 14 wolfram mine, at Torrington, New South Wales.

DAVID MCCLURE has left San Francisco for a trip through the mining regions of South America.

J. M. KURIE formerly at Philadelphia, is now at 625 I. W. Hellman Bdg., Los Angeles, California.

F. G. COTTBRELL has been in Butte in connection with the Bureau of Mines work on smelter fume.

HARRY NELSON has resigned as superintendent for the Golden Cycle and will be succeeded by JASPER T. ROBERTSON.

A. G. BURROWS gave a lecture at Porcupine, Ontario, January 29, on the prevailing rock formation in Canada.

P. A. ROBBINS will sail from New York for the Mediterranean, and will spend three months in Europe and northern Africa.

C. M. EYE has just completed a 200-ton mill for the Imperial Reduction Co., near Ogilby, California, where he has charge of the mining property.

M. J. STAFFORD, field engineer with the construction department of the Inspiration Consolidated Copper Co., has resigned and will leave for the Pacific coast.

FORBES RICKARD has been examining mines in the Pioneer district, Nevada. He will visit Pasadena, Catalina, and the Grand Canyon before returning to Denver.

V. A. STOUT has returned from a trip East and will be in San Francisco, where he will be the Pacific coast representative for the New York Engineering Co. and the Hardinge Conical Mill Company.

B. M. SNYDER, of Los Angeles, ALEX. WISE, and DONALD CAMERON, of San Francisco, have been assisting R. E. CRANSTON in making an examination of the Zeila mine, at Jackson, California.

DORSEY LYON and R. M. KEENEY, of the U. S. Bureau of Mines, have been detailed to take charge of the metallurgical research station at Salt Lake City established in cooperation with the University of Utah.

Company Reports

CONSOLIDATED MINING & SMELTING COMPANY OF CANADA, LTD.

This Company operates about 15 different mines, and a smelter at Trail, British Columbia, and the report covers the 15 months ended September 30, 1913. R. H. Stewart, general manager, states that the Ottawa at Slocan City, the Silver King at Nelson, the Lucky Thought at Silverton, and some properties on the coast were under development during the period, these being new additions to the existing work. There was 38,741 ft. of 'narrow' work, and 35,288 ft. of diamond-drilling done in the following mines: Centre Star, Le Roi, St. Eugene, Sullivan, Molly Gibson, Silver King, Number One, Highland, Maestro, Libby, Tiger, Richmond Eureka, Ottawa, Lucky Thought, and Silver Dollar. The total development to date in the various properties operated is 418,052 feet.

The Company's mines in Rossland show an encouraging increase in the amount of ore developed, a considerable part of this increase being due to tonnage developed in the Le Roi. Development in depth from the War Eagle mine continues to prove encouraging, a large body of ore, of good grade, having been opened on No. 14 level. A cross-cut from the Centre Star shaft is now being driven to reach this vein at a depth of 300 ft. below this level, and should reach the vein early in 1914. Development in the Le Roi mine has been satisfactory in finding new ore. A dispute regarding the rights to mine certain veins apexing near the north boundary of the Le Roi, where it adjoins the property of the Le Roi No. 2, was settled by an agreement between the two companies, involving an exchange of certain parts of the properties of both companies and the substitution of definite planes for extralateral rights. This agreement should do away with any cause for disputes of this nature with the Le Roi No. 2 company in the future. At Kimberley, development of the Sullivan group has been satisfactory in opening new ore, and the mine should continue to produce for a good many years to come. At Moyie a small tonnage has been shipped from the St. Eugene mine, but no large bodies of new ore have been discovered. The Molly Gibson mine was closed down for about six months last winter, owing to snowslides, which carried away a considerable part of the tramway. The tramway has been repaired and development is proceeding satisfactorily. The cross-cut tunnel mentioned in last year's report has opened considerable new ore, much of it of good grade, and the mine looks better than ever before. Owing to its situation, development is necessarily slow, but the mine should, in time, be a producer of considerable profit. At Sandon there have been no new developments in the Richmond Eureka group, which still continues to produce a small tonnage. At Ainsworth, the Number One mine has been producing ore comparatively steadily, and developing with favorable results. The Highland group is also being developed with fairly satisfactory results. This mine has also commenced producing. The Maestro, Libby, Banker, and Tiger

properties adjoining or close to the Highland and Number One groups, and which the Company has under option, have developed to a small extent and some ore has been produced under lease. Labor troubles prevented full work at the Silver Dollar at Salmo. At Boundary Falls the Number Seven supplied silicious ore for the smelter part of the time. In the Phoenix camp no work was done. Mining activity increased in the Kootenay district, ore shipments to the smelter being 97,823 tons against 47,257 tons in the previous term.

Operations at the smelter for the term were as follows:

Ore from all mines, tons	407,124
Gold, ounces	186,017
Silver, ounces	3,224,408
Lead, pounds	48,325,252
Copper, pounds	3,454,814
Gross value	\$8,335,668

Covering the period of 1894 to 1913, inclusive, results were:

Ore smelted, tons	3,551,051
Gold, ounces	1,332,929
Silver, ounces	23,449,031
Lead, pounds	299,295,896
Copper, pounds	54,244,797
Gross value	\$60,502,672
Revenue from all sources in 1912-13.....	\$ 9,148,714
Ore, lead, and bullion purchased.....	3,151,325
Development	598,240
Mining, smelting, and general expenses.....	3,110,794
Freight on Company's ore	71,046
Ore and smelter products	868,112
Development, written off	146,019
Depreciation	193,256
Directors and sundries	11,554
Profit	998,367
Dividends (3, equal to 8%).....	464,352
Credit of profit and loss.....	1,717,650

At the Le Roi experimental mill, tests have been carried



TRAIL SMELTER, BRITISH COLUMBIA.

out on concentration. The head-frame at the War Eagle was burned, but did not stop ore supplies. At Ainsworth was installed an aerial tramway 9000 ft. long, from Number One mine to the lake. Several improvements were made at the Highland and Kimberley mines. At the Trail smelter one of the copper furnaces was lengthened to 35 ft., preparation was made for installing a new lead furnace, and for rebuilding the lead furnaces.

New York Metal Market Review

All of the important metals finished 1913 with considerable activity. January opened quiet, but with a better feeling, which grew in force as the month progressed. Copper was affected only temporarily by the unfavorable statement for December, issued January 8 by the Copper Producers' Association, and toward the third quarter of the month electrolytic advanced under a good demand. Lake was nominal throughout January. In spelter, there was an excellent buying movement, following greater activity at the sheet mills. Lead quotations were between 4.10 and 4.15c. per pound, New York, from January 1 to 28, and the heaviest buying was in the third quarter of the month. Antimony was uninteresting, although there was an effort to force sales. In tin, there was some heavy purchasing, under which prices advanced. Quotations for aluminum showed no variations in January, and on the whole the metal was quiet. The feeling in all lines is that a betterment in business conditions is on the way, but that it will come slowly.

COPPER

The review of December covered the market to December 23, on which date there was no indication of impending activity, and it was thought that 1913 would finish with the dullness that had so long prevailed. On December 26, 27, and 28, however, buying was heavy, and millions of pounds were sold, about 75% being for export, according to report. One result was that electrolytic, which had been quoted at 14.37½c. cash prior to the movement, went to 14.87½c. on January 2. Lake was nominal on that day at 15.12½c. cash. The Waterbury average for December was 15c. Total exports in December were 30,503 tons. Total exports for 1913 were 382,660 tons. Immediately after the subsidence of buying in the last days of 1913, dullness set in again, and while prices held for the first week of 1914, they were nominal. On January 8 the market suffered a hard blow when the Copper Producers' statement for December appeared. It was a great disappointment to the trade, inasmuch as while it was not expected to be favorable, no one figured that domestic deliveries would be as low as 21,938,570 lb., or that surplus stock would rise to 91,438,867 lb., an increase of 43,509,438 lb., the largest increase in the history of the records. In the face of the statistical showing and the lack of demand, electrolytic dropped to 14c. cash, New York, by the middle of the month, with Lake nominal at 14.50c. The last prior sale of Lake was at 15.12½c., and then it was to be had only from one or two producers. At around 14c. some activity started in electrolytic with Europe again figuring in the bulk of sales, though domestic consumers took more than they had for some weeks previously. Prices advanced under the demand, and by January 21 electrolytic was quoted at 14.37½c. cash and Lake was nominal at 14.75c. cash. With the better buying referred to came an improved feeling which survived the activity and lasted to the end of January. It was justified, as in the third week of the month came another buying movement which, while not heavy, was fair, with Europe again the largest purchaser. Quotations advanced until on January 28 electrolytic stood at 14.50c. cash, New York, with Lake at 15c., although in the latter there had been little or no action. Few resale or speculative lots of electrolytic were in evidence at this time, holders of such metal evidently believing that they could obtain full prices by not pressing sales, despite the dullness then prevailing. The exports up to and including January 30 were heavy, amounting to 33,690 tons. The quotation on January 30 for electrolytic was 14.62½c. cash, delivered, New York.

SPELTER

This metal took on added strength under the stimulus

of better inquiry and improved buying at the very end of 1913, as did copper, and quotations advanced to 4.15c. New York and 5.20c. St. Louis, on December 29. These new prices caused the base price of sheet zinc in carload lots to be advanced 25c. per 100 lb., to \$7.50 per 100 lb. less 8% discount, f.o.b. cars Peru, Illinois. Later in the month this advance was lost. In most of January there was little doing, and by the end of the second week quotations had dropped to 5.25c. New York and 5.10c. St. Louis. After January 15, however, the market became firm again, and with the reports of increased production of sheets there came an excellent demand with buying good on January 22, 23, and 24. Prices moved upward again, and by January 27 the New York quotation was back to 5.35c., although buying had eased off. The quotation on January 30 was 5.40c. New York.

LEAD

In lead, also, there was an improvement in the final days of 1913, the American Smelting & Refining Co., on December 29, advancing its price 5 points to 4.15c. New York. At the low price which had been prevailing, the big interest had been taking most of the business and probably more than it wanted to at these figures. Meanwhile the western quotation eased off until January 9, when the New York price was again made 4.10c. New York by the American Smelting & Refining Co. This drop was a surprise to the New York trade, as it was generally believed that an advance was in order. The St. Louis price on January 15 was 3.97½c. About this time good inquiry appeared, some of it from abroad, although the New York price, 4.10c., was not low enough to permit of profitable sales for export. Metal could have been shipped at 3.95c. f.o.b. New York, but the price at this port, as noted, was 15 points higher. The margin was rather close, but it excited no uneasiness for the reason that producers have shown little desire to export their metal. Between January 21 and 28, the market was exceedingly active at 4.10c. New York level, and under the demand the St. Louis price crept up to 4.02½c., and all the indications were that the eastern price would advance accordingly. In the good buying referred to, both consumers and dealers took metal. Quotations in London had sagged toward the end of the month, but this did not disturb the American market. The quotations on January 30 were 4.10c. New York and 4.02½c. St. Louis, with independent producers asking a few points more.

ANTIMONY

The market was unsatisfactory throughout January, as it had been for several months. At the end of 1913 the situation was easier, because of a disposition to give concessions to induce buying. Little success was met in the endeavor. January opened with Hallett's at 7 to 7.25c., Cookson's at 7.45 to 7.60c., and Chinese and Hungarian grades at 6 to 6.50c. On January 30, Hallett's was practically unchanged, but Cookson's had dropped to 7.25 to 7.35c. Other brands were still 6 to 6.50c. Government statistics showed that importations had fallen off heavily in the latter part of 1913, but there was a large stock on hand, and conditions indicated a desire to liquidate the accumulated metal. Much of this stock had been landed prior to the new tariff becoming operative.

The annual report of the Mary McKinney Mining Co. shows the following:

Development, feet	2,901
Stoping, cubic feet	58,277
Company's ore sales	\$293,434
Lessees' ore sales	52,662
Total earnings	348,092
Total expenses	235,902
Net profit	112,190
Dividends	104,740

The Metal Markets

LOCAL METAL PRICES

San Francisco is not a primary market for the common metals except quicksilver. The prices quoted below therefore represent sales of small lots and are not such as an ore producer could expect to realize. Ore contracts usually call for settlement on the basis of Eastern prices, less freight and treatment charges. The prices quoted are in cents per pound, except in the case of quicksilver, which is quoted in dollars per flask of 75 pounds.

San Francisco, February 5.

Antimony	9	—3½c
Electrolytic copper	15½	—15½c
Pig lead	4.40	—5.35
Quicksilver (flask)		\$39.00
Tin	41	—42½c
Spelter	6½	—6¾c

Zinc dust, 100 kg. zinc-lined cases, 7½ to 8c. per pound.

EASTERN METAL MARKET

(By wire from New York.)

New York, February 4.—The past week has shown a steady increase in copper prices from 14.50 to 14.70c. per lb. Present demand is strong, and prices are advancing. The Copper Producers' report is due on February 9, and an increase of between 1,000,000 and 20,000,000 lb. in stocks is expected. January copper returns are as follows: Anaconda, 21,409,000 lb.; Chino, 6,131,840 lb.; and Copper Range subsidiaries, 3,276,000 pounds. German consumers have bought copper at 14.70 cents. Lead and spelter are firm at 4.15 and 5.25c. respectively. In London, tin is strong at £187 10s. for spot. Large speculation in various stocks is still being indulged in in London, and markets are buoyant.

SILVER

Below are given the average New York quotations in cents per ounce, of fine silver.

Date	Average week ending
Jan. 29.....	57.50
" 30.....	57.25
" 31.....	57.25
Feb. 1 Sunday.....	
" 2.....	57.75
" 3.....	57.62
" 4.....	57.37

Monthly averages.

	1913.	1914.		1913.	1914.
Jan.	63.01	57.58	July	58.70	.....
Feb.	61.25	.....	Aug.	59.32	.....
Mch.	57.87	.....	Sept.	60.53	.....
Apr.	59.26	.....	Oct.	60.88	.....
May	60.21	.....	Nov.	58.76	.....
June	59.03	.....	Dec.	57.73	.....

Throughout the week ended January 15, according to Pixley and Abell, some Indian covering has been going on, and, in addition, about £100,000 has been bought for this week's steamer. As some shipments have also gone to the Continent, stocks in London are still about £1,500,000. The China banks have been quiet, but gave some support to the market earlier in the week. In view of the Chinese New Year, which commences on January 26 and lasts until the 29th, inclusive, it is doubtful whether China can prove a great source of strength to this market at present. In spite of this, however, Bombay will probably want more silver for the settlement steamer, leaving next week, and there are still some bears to be covered. As American sales are falling off, possibly owing to large purchases for the United States Mint, and also to the Mexican troubles, and as stocks in London are largely under control, the general appearance is not unhealthy.

COPPER

Quotations on copper as published in this column represent average wholesale transactions on the New York market and refer to electrolytic copper. Lake copper commands normally 1-5 to 1-4c. per lb. more. Prices are in cents per pound.

Date	Average week ending
Jan. 29.....	14.50
" 30.....	14.50
" 31.....	14.55
Feb. 1 Sunday.....	
" 2.....	14.65
" 3.....	14.65
" 4.....	14.79

Monthly averages.

	1913.	1914.		1913.	1914.
Jan.	16.74	14.21	July	14.21	.....
Feb.	14.93	.....	Aug.	15.42	.....
Mch.	14.72	.....	Sept.	16.23	.....
Apr.	15.22	.....	Oct.	16.31	.....
May	15.42	.....	Nov.	15.98	.....
June	14.71	.....	Dec.	14.25	.....

The copper market strengthened considerably last week, though without large sales. On Monday orders were few and on Tuesday some dealers did a good business, while others did not. On Wednesday, January 28, word came that the London agencies were asking the equivalent of 14½c. for 30 days' copper and doing fair business. The same price was asked in New York the next day, but sales were small and also on January 30. Some Calumet & Hecla and Quincy copper sold at 15c. Exports of copper for the week ended January 29 totaled 8473 tons; since January 1, 33,690 tons; same period last year, 23,048 tons.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date	Average week ending
Jan. 29.....	4.15
" 30.....	4.15
" 31.....	4.15
Feb. 1 Sunday.....	
" 2.....	4.15
" 3.....	4.15
" 4.....	4.15

Monthly averages.

	1913.	1914.		1913.	1914.
Jan.	4.28	4.11	July	4.35	.....
Feb.	4.33	.....	Aug.	4.60	.....
Mch.	4.32	.....	Sept.	4.70	.....
Apr.	4.36	.....	Oct.	4.37	.....
May	4.34	.....	Nov.	4.16	.....
June	4.33	.....	Dec.	4.02	.....

QUICKSILVER

The primary market for quicksilver is San Francisco, California, being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending	Jan. 22.....	39.00
Jan. 8.....	39.50	.....
" 15.....	39.50	.....
Feb. 5.....	39.00	.....

Monthly averages.

	1913.	1914.		1913.	1914.
Jan.	39.37	39.25	July	41.00	.....
Feb.	41.00	.....	Aug.	40.50	.....
Mch.	40.20	.....	Sept.	39.70	.....
Apr.	41.00	.....	Oct.	39.37	.....
May	40.25	.....	Nov.	39.40	.....
June	41.00	.....	Dec.	40.00	.....

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date	Average week ending
Jan. 29.....	5.25
" 30.....	5.25
" 31.....	5.25
Feb. 1 Sunday.....	
" 2.....	5.25
" 3.....	5.25
" 4.....	5.25

Monthly averages.

	1913.	1914.		1913.	1914.
Jan.	6.88	5.11	July	5.11	.....
Feb.	6.12	.....	Aug.	5.51	.....
Mch.	5.94	.....	Sept.	5.55	.....
Apr.	5.52	.....	Oct.	5.22	.....
May	5.23	.....	Nov.	5.09	.....
June	5.00	.....	Dec.	5.07	.....

TIN

New York prices control in the American market for tin, since the metal is almost entirely imported. San Francisco quotations average about 5c. per lb. higher. Below are given average monthly New York quotations, in cents per pound:

Monthly averages.

	1913.	1914.		1913.	1914.
Jan.	50.45	37.85	July	40.70	.....
Feb.	49.07	.....	Aug.	41.75	.....
Mch.	46.95	.....	Sept.	42.45	.....
Apr.	49.00	.....	Oct.	40.61	.....
May	49.10	.....	Nov.	39.77	.....
June	45.10	.....	Dec.	37.57	.....

ALUMINUM

Throughout January the market for aluminum was dull but steady at 18.50 to 19c. for both domestic and foreign, prompt delivery metal, 98 to 99% pure. This range of price applies to large purchases, smaller quantities running proportionately higher. Government statistics issued January 20 show that the imports of aluminum in November 1913 were only 1,055,869 lb., whereas in the same month of 1912 they were 3,743,210 lb. In the early months of 1913 the imports were large, and the total for the 11 months ending November 1913 were 21,830,972 lb., as against 18,956,168 lb. in the first 11 months of 1912. Near the close of the month 18.37½c. was bid for a large quantity, but was refused.

The Stock Markets

SAN FRANCISCO STOCKS AND BONDS (San Francisco Stock and Bond Exchange.)

BONDS

February 5.

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Amalgamated Oil Co.	97 1/2	98 1/2	Natomas (Consol. Co.)	25 1/2	—
Unlisted.			Pac. Port. Cement Co.	—	100 1/2
Am. Oil Co.	80	—	Santa Cruz Cement Co.	—	90
General Petroleum Co.	—	45			

STOCKS

Listed.	Bid	Ask	Listed.	Bid	Ask
Amalgamated Oil	83 1/2	84 1/2	Union Oil	62	—
Amalgamated Oil	41 1/2	42 1/2	Unlisted.		
E. I. du Pont pfd.	—	90	Noble Electric Steel	—	34
Giant	88	—	Natomas Consol.	14	—
Pac. (Nat. Borax, pfd.)	88 1/2	—	Riverside Cement	50	—
Pacific Crude Oil	—	35c	Santa Cruz Cement	—	49 1/2
Sterling O. & D.	14	14	Stand. Port. Cement	10	—

NEVADA STOCKS

(By courtesy of San Francisco Stock Exchange.)

February 5.

Atlanta	17	Mizpah Extension	45
Belcher	35	Montana-Tonopah	110
Belmont	7.75	Nevada Hills	39
Big Four	14	North Star	43
Con. Virginia	16	Ophir	18
Florence	58	Pittsburg Silver Peak	35
Goldfield Con.	1.60	Round Mountain	40
Goldfield Oro	11	Sierra Nevada	66
Hallfield	1.10	Tonopah Extension	1.90
Jim Butler	1.00	Tonopah Merger	69
Jumbo Extension	21	Tonopah of Nevada	7.00
MacNamara	11	Victor	30
Mexican	1.10	West End	1.40
Midway	42	Yellow Jacket	35

COPPER SHARES—BOSTON

(By courtesy of J. C. Wilson, Mills Building.)

February 5.

	Bid	Ask		Bid	Ask
Allouez	\$ 40 1/2	41	Mohawk	\$ 44 1/2	45
Ariz. Commercial	54	54 1/2	Nevada Con.	16 1/2	16 3/4
Butte & Superior	35 1/2	35 1/2	North Butte	30	30 1/2
Calumet & Arizona	68 1/2	69	Old Dominion	52	52 1/2
Calumet & Hecla	445	452	Osceola	83	83 1/2
Copper Range	40	40 1/2	Quincy	61	61 1/2
Daly West	2 1/2	3	Shannon	6 1/2	7
East Butte	12 1/2	12 1/2	Superior & Boston	2 1/2	2 3/4
Franklin	4 1/2	4 1/2	Tamarack	36 1/2	37
Granby	89 1/2	90	U. S. Smelting, com.	42 1/2	43 1/2
Greene Cananea	41	41 1/2	Utah Con.	10	10 1/2
Isle-Royale	22 1/2	23	Winona	4 1/2	4 3/4
Mass Copper	3	3 1/2	Wolverine	46	47

NEW YORK CURB QUOTATIONS

(By courtesy of E. F. Hutton & Co., Kohl Building.)

February 5.

	Bid.	Ask.		Bid.	Ask.
Braden Copper...	7½	7%	Mason Valley...	3½	4
Braden 6s	152	157	McKinley-Dar.	1%	1½
B. C. Copper.....	3¾	4¼	Mines Co. Am.....	3	3¾
Con. Cop. Mines...	2½	2%	Nipissing	7	7½
Davis-Daly	2½	2¾	Ohio Copper	¾	¾
Dolores	1	2	San Toy	17c.	20c.
Ely Con.	4	5	Stand. Oil of Cal.320		324
First National...	3¾	3¾	Tri Bullion	½	¾
Glroux	1¼	1½	Tuolumne	5%	7%
Hollinger	17	19	United Cop. com.	¾	¾
Iron Blossom....	1½	1¼	Wetlaufer	7c.	9c.
Kerr Lake	4%	5	Yukon Gold	2¼	2½
La Rose	1¾	2			

NEW YORK STOCK EXCHANGE

(By courtesy of J. C. Wilson, Mills Building.)

February 5.

	Bid	Ask		Bid	Ask
Amalgamated.....	8 77	77 1/2	Miami.....	8 23 1/2	23 3/4
Anaconda.....	37 1/2	37 3/4	Nevada Con.....	16 1/2	16 3/4
A. S. & R.....	69 1/2	69 3/4	Quicksilver, com.....	2 1/2	2 3/4
Calif. Pet.....	30	30 1/2	Ray Con.....	19 1/2	20
Chino.....	43	43 1/2	Tenn. Copper.....	35	35 1/2
Guggenheim Ex.....	51	51 1/2	U. S. Steel, pfd.....	110 1/2	111 1/2
Inspiration.....	17 1/2	18	U. S. Steel, com.....	65 1/2	65 3/4
Mexican Pet.....	62	63	Utah Copper.....	55 1/2	55 3/4

Tin in January

There was fair buying at the latter end of 1913, a final flurry which ceased when prices went up. December deliveries totaled 3100 tons. The total deliveries for 1913 were 43,900 tons, a decrease of 5600 tons compared with those of 1912. The total visible supply December 31, 1913, was 13,893 tons, which was 2916 tons above that of December 31, 1912. In stocks and landing, December 31, 1913, was 2199 tons. In the first week of 1914 there was only a moderate business, with the price on January 7 around 36.60c. In the next week, January 8 to 14, quotations hovered between 36 and 37c., but business was lacking. In the week of January 15 to 21 the market showed more life, both inquiries and sales becoming more frequent and with dealers doing some of the buying. Between January 15 and 21, quotations reached and exceeded 37c., the price on the latter date being \$37.85c. The price on January 30 was 40c. The arrivals in January were 2235 tons.

Current Prices for Ores and Minerals

(Corrected monthly by Atkins, Kroll & Co.)

The prices are approximate, subject to fluctuation, and to variation according to quantity, quality, and delivery required. They are quoted, except as noted, f.o.b. San Francisco. Buying prices marked *.

	Min.	Max.
Antimony ore, 50% $\frac{1}{2}$ ton	\$18.00	\$20.00
Arsenic, white, refined, $\frac{1}{2}$ lb	0.02 1/2	0.03 1/2
Arsenic, red, refined, $\frac{1}{2}$ lb	0.08	0.08 1/2
Asbestos, chrysotile	100.00	350.00
Asbestos, amphibole	5.00	10.00
Asphaltum, refined, $\frac{1}{2}$ ton	11.50	20.00
Barium carbonate, precipitated, $\frac{1}{2}$ ton	40.00	45.00
Barium chloride, commercial, $\frac{1}{2}$ ton	40.00	42.50
Barium sulphate (barytes), prepared, $\frac{1}{2}$ ton	20.00	30.00
Bismuth ore, 15% $\frac{1}{2}$ ton	*250.00	upward
Chrome ore, according to quality, $\frac{1}{2}$ ton	10.00	12.50
China clay, English, levigated, $\frac{1}{2}$ ton	15.00	20.00
Cobalt metal, refined, f. o. b. London, $\frac{1}{2}$ lb	2.50	
Coke, foundry, $\frac{1}{2}$ 2240 lb	15.00	20.00
Diamonds:		
Borts, according to size and quality, $\frac{1}{2}$ carat	2.00	15.00
Carbons, according to size and quality, $\frac{1}{2}$ carat	55.00	80.00
Feldspar, $\frac{1}{2}$ ton	5.00	25.00
Firebrick:		
Bauxite, $\frac{1}{2}$ M	175.00	
Magnesite, $\frac{1}{2}$ M	190.00	275.00
Silica, $\frac{1}{2}$ M	50.00	55.00
Flint pebbles for tube-mills, Danish, $\frac{1}{2}$ 2240 lb	21.00	22.50
Fluorspar, $\frac{1}{2}$ ton	10.00	15.00
Fuellers earth, according to quality, $\frac{1}{2}$ ton	20.00	30.00
Gilsonite, $\frac{1}{2}$ ton	35.00	40.00
Graphite:		
Amorphous, $\frac{1}{2}$ lb	0.01 1/2	0.02 1/2
Crystalline, $\frac{1}{2}$ lb	0.04	0.13
Gypsum, $\frac{1}{2}$ ton	7.50	10.00
Infusorial earth, $\frac{1}{2}$ ton	10.00	15.00
Iridium	55.00	
Magnesite, crude, $\frac{1}{2}$ ton	5.00	7.50
Magnesite, dead calcined, $\frac{1}{2}$ ton	20.00	25.00
Magnesite, brick (see firebrick).		
Manganese ore, oxide, crude, $\frac{1}{2}$ ton	10.00	15.00
Manganese, prepared, according to quality, $\frac{1}{2}$ ton	30.00	70.00
Mica, according to size and quality, $\frac{1}{2}$ lb	0.05	1.00
Molybdenite, 95% MoS_2 , $\frac{1}{2}$ ton	500.00	750.00
Monazite sand (5% thorium), $\frac{1}{2}$ ton	150.00	200.00
Nickel metal, refined, $\frac{1}{2}$ lb	0.45	0.60
Ochre, extra strength, levigated, $\frac{1}{2}$ 100 lb	2.00	2.50
Osmiridium, $\frac{1}{2}$ oz	25.00	
Platinum, native, crude, $\frac{1}{2}$ oz	30.00	45.00
Silex lining for tube-mills $\frac{1}{2}$ 2240 lb	35.50	37.50
Sulphur, crude, $\frac{1}{2}$ ton	20.00	25.00
Sulphur, powdered, $\frac{1}{2}$ ton	30.00	35.00
Sulphur, 80%, $\frac{1}{2}$ ton	16.50	18.50
Talc, prepared, according to quality, $\frac{1}{2}$ ton	20.00	50.00
Tin ore, 60%, $\frac{1}{2}$ ton	450.00	500.00
Tungsten ore, 65% $\frac{1}{2}$ ton	425.00	450.00
Uranium ore, 10% min.	25.00	per unit
Vanadium ore, 15% V_2O_5 , $\frac{1}{2}$ ton	150.00	180.00
Wolframite (see tungsten ore).		
Zinc ore, 50% $\frac{1}{2}$ up, $\frac{1}{2}$ ton	*15.00	20.00

Current Prices for Chemicals

(Corrected monthly by Braun-Knecht-Helmann Co.)

Prices quoted are for ordinary quantities in packages as specified. For round lots lower prices may be expected, while in smaller quantities advanced prices are ordinarily charged. Prices named are f.o.b. San Francisco and subject to fluctuation. Other conditions govern Mexican and foreign business.

	Min.	Max.
Acid, sulphuric, com'l, 66°, drums, $\frac{1}{2}$ 100 lb.....	\$0.85	\$1.10
Acid, sulphuric, com'l, 66°, carboy, $\frac{1}{2}$ 100 lb.....	1.25	1.75
Acid, sulphuric, C. P., 9-lb. bottle, bbl., $\frac{1}{2}$ lb.....	0.13	0.18
Acid, sulphuric, C. P., bulk, carboy, $\frac{1}{2}$ lb.....	0.094	0.12
Acid, muriatic, com'l, carboy, $\frac{1}{2}$ 100 lb.....	1.85	3.00
Acid, muriatic, C. P., 6-lb. bottle, bbl., $\frac{1}{2}$ lb.....	0.15	0.20
Acid, muriatic, C. P., bulk, carboy, $\frac{1}{2}$ lb.....	0.104	0.15
Acid, nitric, com'l, carboy, $\frac{1}{2}$ 100 lb.....	6.00	6.50
Acid, nitric, C. P., 7-lb. bottle, bbl., $\frac{1}{2}$ lb.....	0.16	0.22
Acid, nitric, C. P., bulk, carboy, $\frac{1}{2}$ lb.*.....	0.124	0.15
Argols, ground, bbl., $\frac{1}{2}$ lb.....	0.10	0.20
Borax, cryst. and conc., bags, $\frac{1}{2}$ 100 lb.....	3.00	4.35
Borax, powdered, bbl., $\frac{1}{2}$ 100 lb.....	3.38	4.50
Borax glass, gd. 30 mesh, cases, tin lined, $\frac{1}{2}$ 100 lb.....	10.50	13.50
Bone ash, 60 to 80 mesh, bbl., $\frac{1}{2}$ 100 lb.....	5.50	6.50
Bromine, 1-lb. bottle, $\frac{1}{2}$ lb.....	0.55	0.65
Candles, adamantite, 14 oz., 40 sets, $\frac{1}{2}$ case.....	4.60	4.80
Candles, adamantite, 14 oz., 60 sets, $\frac{1}{2}$ case.....	5.25	5.45
Candles, Stearic, 14 oz., 40 sets, $\frac{1}{2}$ case.....	5.00	5.20
Candles, Stearic, 14 oz., 60 sets, $\frac{1}{2}$ case.....	5.70	5.90
Clay, domestic fire, sack, $\frac{1}{2}$ 100 lb.....	1.50	2.00
Cyanide, 98 to 100%, 100-lb. case, $\frac{1}{2}$ lb.....	0.18	0.22
Cyanide, 98 to 100%, 200-lb. case, $\frac{1}{2}$ lb.....	0.18	0.22
Cyanide, 129%, 100-lb. case, $\frac{1}{2}$ lb.....	0.22	0.254
Cyanide, 129%, 200-lb. case, $\frac{1}{2}$ lb.....	0.22	0.25
Lead acetate, brown, broken casks, $\frac{1}{2}$ 100 lb.....	9.00	10.50
Lead acetate, white, broken casks, $\frac{1}{2}$ 100 lb.....	10.50	10.75
Lead acetate, white, crystals, $\frac{1}{2}$ 100 lb.....	12.50	13.25
Lead, C. P., test, gran., $\frac{1}{2}$ 100 lb.....	13.00	15.00
Lead, C. P., sheet, $\frac{1}{2}$ 100 lb.....	15.00	18.00
Litharge, C. P., silver free, $\frac{1}{2}$ 100 lb.....	11.50	13.50
Litharge, com'l, $\frac{1}{2}$ 100 lb.....	8.00	9.50
Manganese ox., blk., dom. in bags, $\frac{1}{2}$ ton.....	20.00	25.00
Manganese ox., blk., Caucasian, in casks, $\frac{1}{2}$ ton.....	33.00	50.00
(55% MnO ₂ —45% Fe)		
Nitre, double ref'd, small cryst., bbl., $\frac{1}{2}$ 100 lb.....	7.00	8.00
Nitre, double ref'd, granular, bbl., $\frac{1}{2}$ 100 lb.....	6.50	7.50
Nitre, double ref'd, powdered, bbl., $\frac{1}{2}$ 100 lb.....	7.25	8.00
Potassium bicarbonate, cryst., $\frac{1}{2}$ 100 lb.....	12.00	15.00
Potassium carbonate, calcined, $\frac{1}{2}$ 100 lb.....	7.50	9.00
Potassium permanganate, drum, $\frac{1}{2}$ lb.....	0.104	0.13
Silica, powdered, bags, $\frac{1}{2}$ lb.....	0.03	0.05
Soda, carbonate (ash), bbl., $\frac{1}{2}$ 100 lb.....	1.50	1.75
Soda, bicarbonate, bbl., $\frac{1}{2}$ 100 lb.....	2.00	2.50
Soda, caustic, ground, 98%, bbl., $\frac{1}{2}$ 100 lb.....	3.00	3.25
Soda, caustic, solid, 98%, drums, $\frac{1}{2}$ 100 lb.....	2.50	2.75
Zinc shavings, 850 fine, bbl., $\frac{1}{2}$ 100 lb.....	12.00	13.00
Zinc sheet, No. 9—18 by 84, drum, $\frac{1}{2}$ 100 lb.....	10.20	11.00

*Extra charge for packing nitric acid for shipment to conform to regulations.

A New Classifying Jig

A new machine is now being put on the market known as the 'Shields & Thielman combined classifier, jig, and slime separator.' It was originally developed at the Quincy mine, Hubbell, Michigan, by James W. Shields and in that mill has replaced all trommel screens, bull jigs, middling jigs, Hancock jigs, Woodbury jigs, and Richards pulsating classifiers. The exclusive manufacture of this machine is now in the hands of Chalmers & Williams and many separators are being placed in mills as a result of their efforts. The following information is supplied by that firm:

The separator is really a 16-compartment jig and has 4 sections, each being divided into 4 compartments and each compartment having its own independent plunger. Each of these 16 plungers, which are made of bronze and work in cast iron cylinders, can be adjusted separately so as to give the amount of throw best suited to the work. The compartments in which the plungers work are bored like cylinders, the lower ends of each being opened to the compartment under its respective screen. There are vertical screens be-

tween each compartment, which classify the material as it travels from the feed to the tail end of the machine. It will classify and jig a mixed feed direct from the crushers from a size of 1½ in. down to as fine as 100 mesh. The slime passes out from the tailing end of the machine, while classified concentrate, middling, and tailing are delivered from each section separately.

The machine occupies a floor space of 12 by 4 ft., a head room of less than 7 ft., and is handling successfully from 450 to 500 tons of ore for 24 hours. It will handle any ore that can be treated on jigs and requires but 4 hp. to operate. Above the bed is a system of chutes, which are adjustable, permitting the removal of concentrate, middling, and tailing above the screen as well as the hutch product below.

Commercial Paragraphs

DREDGING is becoming more popular in the Malay States tinfields. Following the success of Malayan Tin Dredging, Ltd., and the Kamunting company, the Ipoh Tin Dredging, Ltd., has ordered a bucket dredge. It will be a Werf Conrad boat and delivery was promised in six months, the price being £24,000.

UNITED STATES BUREAU OF MINES rescue cars carrying the helmet types of mine-rescue apparatus have just been re-equipped with the mouthpieces and corrugated tubes that are used with the Fleuss apparatus. The same change has been made on the Illinois rescue cars. This is an interesting confirmation of those who have maintained that the helmet itself was unnecessary and expensive and even, because of possible leakage around the face, a source of danger.

SYMONS BROS. Co. are manufacturing a pulsating screen which makes a radically new application of certain old principles. The three things essential to a screen are: (1) to keep the openings clean; (2) that the travel of the material over all the screen surface should be at the right pace; and (3) a simple, strong construction. The Symons pulsating screen is a horizontal, step screen, the body being carried on springs. As the screen is forced downward and backward the springs are compressed. They are then suddenly released, with the effect that the screen springs upward and forward, feeding the material evenly over the surface and giving a jig-like motion. The stone particles are partly thrown out of the screen openings and partly pass through. The travel is in a series of short, rapid jumps. The body is supported upon two shafts by hanger arms, and the whole construction is designed for rigidity and strength.

The Plumb pneumatic jig, now being introduced by the AMERICAN ZINC ORE SEPARATING Co., is the invention of A. M. Plumb, who has been engaged in treatment of complex zinc ores for twenty years. He was one of the engineers who helped develop the old Blake-Morsher machine into the present successful electrostatic separator. The Plumb jig uses the same principle as the Richards; that is, the introduction of a pulsating motion into a current, in this case air instead of water, by means of a rotating valve. This causes the crushed rock and mineral to dance on the screen as in an ordinary jig. The result is the building up of a bed of the heavy mineral on the screen and by suitable arrangement of outlets this automatically discharges as the weight of the column on the screen becomes more than that in the discharge. The machine is simple and compact and is reported to make remarkably clean concentrates.

THE RAILWAY operated by the El Oro Mining & Railway Co., Mexico, earned \$524,178 during the past fiscal year. The cost of operation was \$288,211, and the profit was \$235,967.

GOLD PRODUCTION in India in 1913 totaled 589,311 oz., averaging about \$18.50 per oz., against 584,838 oz. in 1912.

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EDITORIAL

AUSTRALIA is not content with the building of one transcontinental railroad, that now under construction from South Australia to the west coast, but has also undertaken a main north-south line. A piece of road 54 miles long in the Northern Territory, and ultimately to form a part of this second main line, has just been authorized. The total distance to be traversed is 1063 miles.

FREE COINAGE of silver has recently found an exponent in the person of Sr. Victoriano Huerta, who is trying to recoup the coin shortage which resulted from the heavy exportation of silver coin previous to that being forbidden by the Mexican government. Undoubtedly the results of this policy will be watched with great interest by its erstwhile champion of "cross of gold and crown of thorns" fame.

DIRECTORS of corporations are held to have large power in an opinion recently delivered by Mr. Justice Cardoza of the New York Supreme Court, in which he is quoted as saying: "The business of a corporation is to be conducted by its directors. They are not required to follow the recommendations of stockholders. Still less are they required—if, indeed, they are permitted—to abdicate their functions and surrender to a stockholders' committee the right to control their discretion." This raises the question as to just why there are stockholders. It is, unfortunately enough, common for minor stockholders to be ignored by those holding a major interest, but that directors "are not required to follow the recommendations of stockholders" appeals to us as novel.

MINOR STOCKHOLDERS in the Mining Science Publishing Company received short shrift at the final meeting of that corporation at Denver in December. Our Colorado contemporary had fallen on evil days in a business way, and, as debts were proving embarrassing and collections slow, the principal stockholders arranged to turn the property over to the Union Printing Company. Motions calling for a statement of receipts and disbursements and for the appointment of a committee to audit the books and accounts were promptly voted down and the original plan as promptly put through. We do not remember to have seen a more cynical exhibition of the art of freezing out minor stockholders, and now that it has been ac-

complished. *Mining Science* appears as usual, with no signs of being bankrupt. We cannot believe that the engineers whose names appear on the title page have read the minutes of the stockholders' meeting of December 17, and we suggest to our friends, Messrs. D. W. Brunton, J. W. Finch, Howland Bancroft, Cassius A. Fisher, Victor G. Hills, Thomas B. Stearns, and the others who are listed as members of the 'Editorial Counsel,' consideration of the philosophic comment of Old Daddy Do Funny's angle worm:

"I could stand de hook," says de angleworm,
 "An' a lily-brook wouldn't make me squirm,
 But I can't help wrigglin' ag'in' my fate—
 It breaks me all up to be used for bait."

Fostering Foreign Trade

From time to time we have frequently called attention to the many obvious ways in which the Department of Commerce and other governmental agencies could render more effective service in developing and building up the foreign trade of this country. It is with peculiar pleasure, therefore, that we record that one of the necessary steps has already been taken and another bids fair to quickly follow. The new banking act has been much discussed, but too little attention has been given to one of its most important features: the section permitting national banks to establish branches abroad. In the past, national banks have not been permitted to establish branch banks in other cities, apparently on the theory that such an arrangement would permit one community to draw away money from another.

An equally important matter is the need for commercial attachés to embassies for the purpose of scientifically studying the possibilities of foreign trade; a need to which we have frequently called attention. Even the smaller European countries have their attachés in every important commercial field, and, in a letter to the *London Times*, an Englishman not long ago urged the necessity of the British government increasing its commercial staff in China to three attachés and twenty subagents in order to keep its work upon a par with that which the effective German organization is now doing. We have not even one commercial agent in China, and yet some of us wonder why our trade there does not increase faster. A bill has recently been introduced into Congress with the support of Mr. William C. Redfield, Secretary of Commerce, providing for the appointment of fourteen commercial attachés, at a salary of \$4000 to \$5000 per year, to posts in the leading commercial nations. This somewhat tardy recognition of an obvious need deserves the instant and hearty support of everyone interested in foreign commerce and also the backing of those who have no foreign interests, for whatever benefits some of our people is not without its effect on the nation as a whole.

Whether any real benefit will be derived from the work of the attachés will entirely depend upon the considerations which govern their appointment.

Salted Placers of Santo Domingo

By J. W. LEDOUX

At frequent intervals during the past ten or more years there have been brought to the United States propositions for the investment in mines in Santo Domingo. The most lurid prospectuses and statements have been presented, representing that fabulous wealth exists principally in the shape of gold quartz veins and placer deposits. These placer deposits have been generally represented to exist in the red soils of the plains, or highlands, between the rivers at the foot-hills of the mountain ranges.

Many people of means have been induced to invest in leases and concessions, and several mining engineers of experience have been sent down to make investigations and verify the claims of the promoters. In nearly all cases the engineers have come back with more or less favorable reports, and findings averaging \$10 to \$20 per yard have been reported for areas covering thousands of acres. The accounts of these deposits have not always referred to the same locality, but the most advertised region is that in the vicinity and within 20 to 50 miles of the City of Santo Domingo, covering the mountainous region at the headwaters of the Nigua, Jaina, Isabella, and Ozama rivers.

There are no roads in this vicinity, simply mountain trails, and no mining operation on any considerable scale has as yet been started, but stories are told of fabulous wealth in gold extracted by the Spaniards several hundred years ago, and there are many evidences of their old workings, especially on the highlands; but reliable tests have been made at and in the vicinity of these workings, none of which has shown commercial gravel to exist. The fact that during all this time no one has had the faith or enterprise to install sufficient plant to mine on a large scale is fair evidence that nothing of material value has as yet been discovered. I was informed of a large stock flotation scheme, known as the 'A. L. Brown' episode, some years ago, when the most gigantic deception was practised by a Santo Domingo resident on many American investors, and the fraud was afterward discovered.

Another story that is current states that this same resident of Santo Domingo sent a sample of red soil to a firm in the United States with an inquiry as to its suitability for paint. This firm had their chemist analyze the soil, and he reported that it contained considerable gold. The firm then wrote to the man in Santo Domingo for a larger sample and inquired whether he had much of this same kind of soil. A second large sample was sent, and tested in the same way, and found to contain even more gold than the first. The firm then started negotiations with the Santo Domingo man which resulted in an option or agreement to purchase for a large sum of money and the payment down of a large sum. They then started operations and soon discovered that there was no gold

of any account where the material came from. They then sued the Santo Domingo man for fraud in the Dominican courts and were non-suited on the ground that he did not pretend that there was gold in the soil, and that his negotiations were carried on entirely on account of the possible prospective paint value.

About a year ago this Santo Domingo man and several associates interested some Philadelphia people in property along the Jaina river, and these people sent a reputable mining engineer down to examine the property. The engineer, on account of his general knowledge of the country and previous experience in similar formations, prior to making the examination, was extremely skeptical as to the presence of any gold gravel of value, and so advised his principals. Nevertheless, he made the investigation and found that several of the streams emptying into the Jaina river contained gold, for there were many natives, especially women, who made a business of panning gold on these streams. His investigations showed that the river bed was narrow and steep for miles, and suddenly widened out into a large deposit of gravel, which would afford excellent ground for dredging, providing it contained gold, and as it was close below the mouths of these gold-bearing streams, he thought it was worth a trial. He, therefore, obtained a drill capable of testing the ground, and when he commenced work had only 15 days to make the test, when it was necessary to make a considerable payment for the concession. He sank some half dozen holes, as well distributed as possible, to test the ground and found gravel averaging over 50c. per cubic yard for an average depth of about 30 ft., and on these findings took the chance of wiring his people to make the first payment. Soon afterward he started other drillings to test this gravel deposit completely, and eventually sank some 100 holes, 500 to 1000 ft. apart. The average value of the gravel amounted to over 30c. per yard. During this operation it was found necessary to purchase other concessions on account of conflicting claims and so as to secure entire right to the use of the river. The payments necessary to be made on these concessions covered a period of over a year, and, in all, these people paid some \$130,000 for the properties and spent about \$60,000 in tests and borings.

In order to make doubly sure of these results before installing the dredge, corroborative tests were made with test pits and independent drillings. This revealed the fact that the findings of the original tests were erroneous, and finally one of the workmen confessed that the native foreman on the work, the women panners, and others had persistently salted the samples from the beginning, the final outcome being a total loss of a large sum.

The man notorious in the paint episode induced some Philadelphia people to investigate a concession known as the Buena Ventura, which adjoins the Jaina river, and told them the gravel would average at least \$2 per yard for thousands of acres. One of these men

happened to have some 15 years' prospecting experience in South America, Nicaragua, and the western part of the United States, and was familiar with sluicing, panning, and all operations connected with placer gold. He was engaged to make the investigation in June 1913. During his first week on the property he was very favorably impressed, as he obtained results averaging some \$10 or more per cubic yard. Then he did some drilling and digging independently when the natives were not around, and was surprised to find that he got no gold. After this he tested some of the original drillings and found no gold, and after two or three weeks' work was convinced that his original work had been salted in every case. This he reported to his people in the United States, and as the alleged owner of the concession was in Philadelphia at the time, he was asked to pay back all the money that they had spent. On his refusal, he was arrested and the case brought before the Grand Jury, and before letting it go too far, he settled the case by paying the people what they demanded.

In the latter part of July 1913, some Philadelphia people, who formed a corporation known as the Jaina Mining & Improvement Co., employed me to go to Santo Domingo and investigate a concession known as the Pedro Bran, which adjoins the Buena Ventura, and is alleged to be owned by the same man. He had leased to this Company the portion of this concession adjoining the Jaina river on the basis of 25% royalty and a payment down of \$4000. One of the members of this Company had previously been to Santo Domingo in January 1913 and was thoroughly acquainted with the owner of the concession, and had made numerous borings and tests and found extremely high gold content, amounting to an average of \$30 or more per cubic yard. He had later reported this to his son, a man of over forty, who, being very skeptical, went down with his father to corroborate the tests of the former. The second tests, made some time in May, were even more favorable than the first ones. I went down in August in company with both of these men and another young man, a son of one of the members of the new company. During the first four days augur borings were made near the places which had been previously tested by this man and his son. The highest value was \$43.20 per cubic yard, and the average of the first ten holes, which covered a distance of about three miles, was over \$12 per cubic yard. I then continued the investigation alone with native employees, and sank some 80 holes, covering a territory four miles long and two miles wide, the average being over \$11 per cubic yard.

On account of a revolution being started at this time, and some other positive reasons which cannot be stated here, it was necessary to wind up the work before the investigation was satisfactorily completed, and for this reason I spent the last two days in making borings and panning the material without the aid of anyone. Although I had up to this time heard none

of the stories above outlined, I was extremely suspicious of the results, and these suspicions were confirmed when I failed to find any gold in my own pannings. I then went to the United States and made a complete report of the matter, and also stated my suspicions, and recommended that I be sent down again with one or more reliable men. My suggestions were adopted by the Company. I therefore took one reliable man and went down, thoroughly prepared to test the ground by means of an improved 'Long Tom,' which required a hose stream and the use of rakes to disintegrate the clay and concentrate the gravel, which was constantly passed through a sluice containing riffles. Two pumps were sent down, one to work by hand, requiring four men; the other to work by gasoline. The gasoline pump had a capacity of 125 gal. per minute against 25 ft. head, and the other was a diaphragm pressure pump, good for 75 gal. per minute under any pressure up to 50 lb. It was decided to make the preliminary tests by the hand pump.

In one of the original tests there were seven augur holes drilled to an average depth of about 6 ft. and covering a space of about 50 ft. in length. These showed over \$20 per cubic yard. The reason so many shallow holes were sunk here was that rock or boulders were encountered, and an attempt was being made to sink a deep hole. To verify these findings, a trench 3 ft. wide, 6 ft. deep, and covering the entire ground where the holes were dug, was excavated, and the material was hauled by means of an ox-cart to the 'Long Tom,' which was placed on a small stream about half a mile distant. Not a color of gold was found. In order to be certain that the apparatus was not losing gold, a given amount of fine lead filings was mixed with the material, and in every case it was recovered in the pan. We then sank test-pits around other holes and panned average samples of the material, and in this way re-tested 13 more of the original holes which had given the highest results. These were scattered over an area of three miles long and two miles wide. Not a particle of gold was found in any one of them, and the pans in the majority of cases contained from four to twelve particles of lead, purposely placed there to verify the panning, and which was in all cases recovered.

I then went to Santo Domingo and confronted the owner of the concession with the statement that his employees had previously salted nearly all the holes, and advised him to pay back to the Philadelphia company all the money it had cost them. This man denied having anything to do with any salting operation and stated that while he was willing to pay back all the money, that he was not financially able to do so. I then took the matter up with the American Minister and gave him a complete report of the facts.

During my first visit in August, in looking over the documents and papers concerning the concession, I found that this man had, both as individual and as president of the Barrero Mining Co., which was alleged to be the assignee owner of the Pedro Bran concession,

made a lease to some Philadelphia men of this same property. The lease provided that substantial machinery capable of handling 1000 yd. per day should be installed as soon as possible, and that preliminary work must be begun prior to September 13, 1913. Therefore, the lease to the Jaina Mining & Improvement Co., and the money paid on account of same, was a fraudulent transaction while this previous lease was in existence. One of the parties to the lease came to Santo Domingo and began preliminary work about September 3, 1913, and while it was claimed that he got on the wrong property, he and his men swore differently. During their operation, however, five of the employees died suddenly with what was alleged to be fever, but it was afterward rumored around the city that they had been poisoned. While fever does exist at times among the natives, the fact of so many people dying suddenly within a couple of weeks in the same locality was remarkable.

The alleged owner of the Pedro Bran concession, the Bueno Ventura concession, and the president of the Barrero Mining Co. was Ely Dorsey, a man who was originally supposed to come from Virginia and who has been living in Santo Domingo for many years. He was also the owner or part owner of nearly all the other concessions in this neighborhood. Intimately associated with him is one Pardo, the Santo Domingo agent of the Clyde Line, and I am informed that the following parties were more or less interested in the concessions known as the Ozama, Cuallo, Jaina, and Santa Rosa: Ely Dorsey, Pardo, Gonzales, Vincante Francischini, Rodrigues, Leonti Vasquez, and others. I only know of my personal knowledge that my samples were salted by employees of Ely Dorsey.

The purpose of this recital is to warn prospective investors from undertakings of this character. They would be a good deal safer in playing a 'three-card Monte' or 'shell game' against an expert swindler.

It might be interesting to state the probable manner in which this salting was done. From the best of my judgment, due to inspection and statements made by some of the Dominicans, the natives engaged in the work carried in their pockets small pellets of clay, prepared fresh each day, and about the size of homeopathic pills. Each one of these contained a few particles of gold. At convenient times these were secreted between the fingers and released among the dirt which was to be panned. The women who did the panning and who also performed their part in the salting when necessary, carried the particles of gold in the pocket which contained their smoking pipe, and as they were incessant smokers and always smoked before panning, took out a few particles of gold with their pipe and readily dropped it into the pan without discovery. As this operation has been going on for a good many years, there is no doubt that they are as skillful and dexterous as a magician or sleight-of-hand performer. A man who is not informed in advance of all these possibilities has very little chance of discovering the salting.

Messina Copper Mine, Northern Transvaal

By OWEN LETCHER

Interest in the cupriferous deposits of the Union of South Africa has hitherto centred mainly in the mines of Namaqualand, in the Cape Colony. During the last two or three years, however, the Messina mine, situated in the extreme northern part of the Transvaal, a mile or two to the south of the Limpopo river (Transvaal-Rhodesian border) has attracted much attention by reason of the ambitious development policy initiated, the substantial shipments of concentrated ore made, and the plans of the management to increase production. This property is in a sound position today, and that it is about to take a position of greater importance in the list of productive mines of the Union than it has hitherto held seems undeniable. Substantial reserves of ore have been blocked out, a new 250-ton concentrator has just been completed, and a short time ago smelting operations—the first to be conducted

roads; water was scarce, traveling and transport was difficult owing to dense bush; and the nearest base for stores and supplies, by the only available route, was the town of Pietersburg, the northern terminus of the Central South African Railways, about 140 miles south of the copper district. Owing to the enterprise of the Messina company these conditions have been vastly altered.

Character of the Ore

The principal rocks of the district are granite, gneiss, and schists, with masses of quartz and hornblende. The copper-bearing belt or zone is characterized by lines of fissuring. The chief discoveries of copper-bearing lodes so far are confined to the lines of old workings that generally follow the shear-zones which have been traced at Messina, running about north and south, for over 15 miles. The copper occurs as carbonates and sulphides, chiefly redruthite, bornite, chalcopyrite, and malachite.

The lodes run about parallel. The distribution of the ore is somewhat irregular, rich shoots occurring along the strike extending over 150 ft. in length, with intervening zones of poor or barren ground. The width of the orebodies varies in size from a few inches of compact ore up to 30 ft. or more, with rich masses of almost solid copper minerals that have been found to extend continuously in depth, from level to level, without showing any appreciable decrease in width or value.

Two main shafts, and a number of small pits, have been sunk on the property. In the old main 3-compartment shaft the principal ore-shoot, known as the Bonanza, was intersected at a depth of 764 ft., and the shaft continued in solid ore to the bottom. The 900-ft. level has recently been opened, where the ore is found to be of good value. Three lodes are now being worked. The north lode, which has proved to be the best ore-carrier, has been developed by continuous drifts along the strike for over 1500 ft. A new three-compartment shaft is down to the 700-ft. level and will be sunk to a depth of 1000 ft. A new hoist, with a capacity for at least 2000 ft., is being installed.

Preliminary exploitation of the lenticular cupriferous deposits of Messina commenced shortly after the end of the Boer war, and so satisfactory were the results that early in 1905 a company was formed, with a capital of £250,000, to acquire and work the Berkenrode, Vogelzang, Tempelhoff, and Maryland 'farms.' At first, ore was roughly sorted by hand; but in 1909 a concentration plant commenced operations, and there was a consequent substantial increase in output. From the end of June, 1906, and up to the middle of last year, the Messina company mined 76,135 tons of ore



NEW 250-TON CONCENTRATOR UNDER CONSTRUCTION.

on anything approaching a large scale in the Transvaal—were commenced at the mine. The Messina copper deposits lie in the centre of a huge granite area which extends beyond the Limpopo river into Southern Rhodesia. In this formation are numerous ancient workings, which indicate that this district was at one time the scene of an active industry in the mining and smelting of copper ores by native workers. The existence of these ancient workings scattered throughout South Africa has been known for many years. Those in the northern Transvaal were discovered by early hunters and prospectors; but it was not until 1902, after the termination of the Boer war, that active prospecting operations were attempted. At that time the region in the neighborhood of the Limpopo river was looked upon as a death-trap to white men, owing to malarial fever being prevalent during the rainy season: the country was infested with wild animals, and had but few native inhabitants. There were no

and produced 10,861 tons of concentrate averaging 52.7% copper. Productive work has of recent months been restricted, and energies concentrated on development and construction of additional plants in anticipation of the extension of the railway from Pietersburg to the Limpopo. The line has now been extended almost to the mine, and the Company is taking advantage of the facilities provided by the administration and the nearness of the railroad to the property.

Shipments and Ore Treatments

The shipment for last June, 462½ tons of concentrate, averaging about 40% copper, constitutes a record for the mine, and it should be noted that this result was obtained with an old mill of comparatively small capacity. A word regarding the grade of concentrate produced may here be in place. An examination of shipments during different periods reveals the fact that there has been a steady diminution in metallic contents per ton since 1906. Thus in that year the average assay of the 280 tons of concentrate produced was 66% copper. In the next year, from July, 1906, to the end of June 1907, the average was 60.66. The next year the copper had fallen to 58.3%, and in the next period it was 52.3%. This decline in grade has continued, and is, of course, due to ability to work ores of lower grade as the years have gone by and the mine and its equipment have become established. In the earlier days of the property the highest grade ore was hand-picked and shipped to Pietersburg in donkey-wagons. Lower grade ore, which can today be worked at a profit, would have been shipped at a loss under the primitive conditions obtaining at the mine a few years ago. With railway facilities near the mine, costs are reduced and the Company can thus earn substantial profits from ore hitherto regarded as unprofitable. With the new concentrator at work the rate of production will be increased, and this will tend toward still further economy in operating expenses.

Careful laboratory experiments have been conducted for some time on the Messina ores for the purpose of obtaining a definite knowledge of the most economical method of treatment, as well as the probable smelting cost. The treatment of the high-grade copper ores by concentration has presented no difficulties. For years regular shipments of concentrate have been made to Swansea, where this product has commanded a ready sale at the highest ruling market prices, owing to the purity and good quality of the metallic contents. A considerable quantity of material has been produced each month, known as 'jig middling', containing from 10 to 15% copper, which has been accumulated for re-treatment, either by re-grinding and further concentration, or by smelting. In connection with the new concentrator which has a capacity of 250 tons of ore per day, provision has been made for a re-grinding plant to deal with the present middling product. In addition to this, treatment by smelting was some time ago decided upon to turn to profitable account the large stock of accumulated middling, and also to

handle the lower grade carbonate and sulphide ores which are not so susceptible of mechanical concentration as the more massive sulphides. The character of the ores to be treated, and the nature of available fuel and fluxes, have been carefully considered in preparing the design and size of the most suitable furnace. Inasmuch as fine ore, concentrate, and middling had to be treated, it was considered advisable to erect furnaces of the reverberatory type, such as are used in Wales for smelting copper ores. Two furnaces have been erected, each having a hearth 23 ft. long by 11 ft. 6 in. wide, with both furnace flues leading to a 70-ft. chimney lined with fire brick. The fire-boxes have been arranged for burning coal. The slag is drawn into sand-baths and the matte containing the copper, is tapped into iron moulds. The ironwork for the construction of these furnaces has been supplied by Fraser & Chalmers, Ltd. The firebricks which comprise the bulk of the furnace material have been obtained from local makers, and are suitable for this class of work. Special silica firebricks have been



REVERBERATORY FURNACE, MESSINA.

imported from Wales for a start, although it is expected that a suitable quality of brick will yet be made in this country. The capacity of each furnace is about 20 tons of ore per day, for which amount the fuel consumption will be from 7 to 8 tons of small coal. Fuel from the Messina company's coal mine, about 20 miles south on the new railway line, has been found quite suitable. The limestone which is mixed with the ore for fluxing purposes is found in the neighborhood of the mine. The first furnace was started up with a charge of middling, mixed with some roasted copper pyrite containing about 15% copper, and about 5% of lime was added. This charge was successfully reduced, producing a matte containing 65% copper, with 1.5% copper in the slag. Since the initial charge was put through, the composition of the charge has been varied as regards copper content, lime, method of firing, etc. with highly satisfactory results, indicating that the Messina ores can be reduced by this method of smelting to give an average grade of 50% copper matte.

This practice is along the lines of the laboratory experiments. It is expected that the two furnaces will produce about 150 tons of copper matte per month, which at present will be shipped with the mill concentrates. Additions to the smelting plant are already contemplated. A roasting furnace and two additional reverberatory furnaces will be erected in the near future. The treatment of the matte is also under consideration and, with the addition of a refining furnace, blister copper will ultimately be produced, and ingots

containing 96% copper will be shipped.

During August No. 1 furnace turned out 76 tons of matte containing a trifle less than 51% copper. These operations indicate the commencement of serious efforts on a large scale to establish an important copper producing industry in the northern Transvaal. The Messina company, it will be recalled, is controlled by A. M. Grenfell and his associates. Part of the stock is owned by Camp Bird Ltd. and so the mine is affiliated with an American enterprise.

The Technology of Turquoise

By JOSEPH E. POGUE

Turquoise or turquoise, is from the French, meaning Turkish stone. It is generally supposed to have been so called because the mineral originally came to Europe through Turkey. It is more probable, however, that the important locality near Nishapur, in Persia, was once regarded as within the limits of vaguely defined 'Turkey' and the term had reference to the source of supply.

Turquoise is a mineral of superficial origin and is never found in quantity at depths exceeding 100 feet. In consequence, its mining is comparatively simple and inexpensive, for deep shafts and extended tunnels are unnecessary. Deposits, however, are usually confined to arid or desert regions, and many difficulties are encountered in mining them, due to excessive heat, lack of water and timber, and distance from supplies.

Before the advent of gunpowder, the mineral was mined by crude tools, and in some instances its extraction was probably effected by suddenly cooling the heated rock with water. Modernly, however, the material is obtained with the aid of blasting. Where the workings are restricted, a trench or shallow pit usually suffices; but with more extensive operations a shaft is sunk and drifts are driven along the vein. The loosened rock is broken into portable shape and carried to the surface in buckets hoisted by rope and windlass. After further crushing, it is hand picked, with the rejection of all unsuitable material.

Turquoise mines, as a rule, are not fitted with modern mining appliances, due in part to the isolated regions in which many deposits occur, and in part to the frequently temporary nature of the enterprise.

Cutting

Turquoise comes from the mines in rough pieces or nodules, and must be cut and polished before it is adapted for ornamental use. This is rarely done at the mine; the selected material is usually shipped to some trade centre, where the work is done by lapidaries. The most characteristic cut for turquoise, as for opaque stones in general, is the *cabochon*, consisting of flat bottom and polished convex top. Recently, some stones have been prepared with a dull, so-called

'satin finish,' with good effect. The shapes of cabochon stones range from elongated oval to circular, and the convexity or arch varies from nearly flat to dome shape. The turquoise is fashioned into other forms also, such as the pendant, heart, table, keystone, truncated cone, etc., and is sometimes elaborately carved.

The mineral is comparatively soft, and is readily worked. In the United States the customary procedure is as follows. A suitable piece, either selected or sawn from a larger mass by means of a revolving metal disk dressed with an abrasive, is cemented to the end of a slender wooden or ivory holder, and this is pressed against a rapidly rotating wheel or 'lap' of lead or tin on which emery or carborundum powder is spread. The abrading material works its way into the metal surface, which then readily 'bites' the turquoise as a file does steel. The wheel is adjustable to a lathe head and is rotated by foot power or a small motor. The turquoise is kept moving until the desired shape is given the specimen. The cutting wheel is then replaced by one of wool, flannel, leather, or silk, against which the gem receives its final finish and polish.

Turquoise Matrix

The stones introduced to the trade are either pure turquoise, that is, unaccompanied by foreign matter, or turquoise matrix, in which the mineral is cut with attached country rock, quartz, limonite, or other impurities. Attractive patterns and color contrasts are often yielded by the latter, but matrix never commands the price of the pure turquoise. Much material unfitted for pure gems is suitable and used for matrix. Cobweb matrix is a term used to distinguish a blue ground with markings of cobweb pattern. Mottled matrix is turquoise matrix showing two shades of blue or green.

Imitations of turquoise are of three kinds: blue glass or enamel, artificial compounds closely resembling turquoise in composition, and other minerals either resembling turquoise naturally or made to do so by stains or dyes.

Glass imitations are the most frequent counterfeits

of turquoise and are commonly seen in cheap jewelry. Some are crude and obvious, but others are skilfully made and require careful scrutiny to distinguish. Invariably, however, they have a glassy look, are slightly harder than the real mineral, and differ from it in specific gravity. The margin is usually minutely splintered from the grinding, and the small, broken surfaces have a shell-like shape, characteristic of glass. The stone, moreover, is apt to contain air-bubbles or faint flaw lines, indicating that the mass was once molten; and a fragment heated in a hot flame melts to an enamel, while turquoise flies into pieces.

Synthetic turquoise, the most successful substitute for turquoise, is prepared by mixing precipitated hydrated phosphate of aluminum with copper phosphate and subjecting the mass while damp to hydraulic pressure. The product closely resembles the mineral in all its properties and is consequently difficult to detect. The best test is to heat a small fragment in the tip of a hot flame or in a covered crucible; the substitute fuses to a slag, whereas the genuine will fly to pieces. During the past twenty-five years, stones made in the manner described have come upon the market in considerable numbers, particularly in Europe.

Substitutes

Blue chrysocolla is a hydrous silicate of copper which ranges in color from green to turquoise-blue. In its pure state it is too soft for cutting, but when silicified or intermixed with quartz it becomes available as a semi-precious stone. Blue specimens may be confused with turquoise, but the criteria given for copper-stained chalcedony hold also for their distinction. Chrysocolla from the Ural mountains has been cut to some extent, but only recently, and then only slightly has the mineral been so utilized in this country.

Odontolite, which was often confused in the Middle Ages with true turquoise, is fossil bone or ivory impregnated by phosphate of iron, and possesses a blue or green color resembling that of mineral turquoise in daylight, but appearing a dull gray by artificial light. Close examination reveals an organic structure which at once distinguishes it from turquoise. It is seldom encountered nowadays and has small value.

Copper-stained chalcedony, sometimes known as blue chrysoprase, at times resembles turquoise and may be mistaken for it. Its greater translucence, superior hardness, and vitreous appearance serve to distinguish it, however, and a fragment, unlike turquoise, will withstand a high temperature.

Blue dyes have recently been found for chalcedony and agate by means of which the delicate shades of turquoise may be reproduced, and in 1900 the English and French markets were plentifully supplied with stones of this character. Good imitations of this kind are difficult to distinguish without careful examination; they are harder, however, and show greater translucence about the girdle than the opaque turquoise.

and give none of the chemical tests of the latter. A fragment will also withstand a high temperature without flying into pieces. When the coloring is not skilfully done, the specimen presents a crudeness that at once discloses its spuriousness.

Lapis lazuli and azurite in rare instances might be confused with turquoise, but in general the blues of the former are so intense and entirely different from those of turquoise as to obviate deception. If green turquoise were prized by civilized peoples, it would be open to substitution by several minerals, for malachite, green chrysocolla, variscite, and green chalcedony in some instances resemble it closely, but its slight value renders such replacements without purpose.

Improvement in Color

From time to time turquoisees come into the trade which have had their color deepened or otherwise improved by artificial means. As such stones are apt to revert to their original shade upon continued wear, they are not sold except in attempts to defraud. Grease and moisture temporarily heightens the color of pale stones, but such expediences do not produce sufficiently lasting effects to be of importance.

The principal procedure to be anticipated is the use of a prussian blue dye. Stones so treated may be detected by washing in alcohol, wiping and soaking in ammonia, whereby the dye is dissolved; or by scraping the superficial coloration from the back of the stone with a steel blade. If the turquoise is valuable, it is preferable to build a small wall of wax on its back and partly fill the depression with ammonia, as the solvent effect can thus be noted at one point only without harm to the specimen. A stained stone is duller by artificial light and more inclined to show a grayish aspect than a stone whose color is original.

The turquoise requires constant care on the part of the wearer in order that its beauty may not be impaired. Its comparative softness and tendency to fade afford ample opportunity for its delicate tint to be marred by carelessness. It should never be worn in contact with other stones, nor permitted to come in contact with perspiration, soap lather, or strong gases. Perfumes are said to have a harmful effect upon its color. Its surface should be kept away from acids or grease of any kind, and should be carefully wiped with chamois skin after handling. The wearer should always remember to remove turquoise rings before washing the hands.

Production

In discussing the turquoise deposits of the world, it will be necessary to consider but four regions which have furnished practically the world's supply of this mineral since the beginning of time. These are the Sinai peninsula; the deposits near Nishapur in Persia; scarcely known localities in central Asia (Tibet and China); and the mines within the southwestern portion of the United States.

But little can be said of the production of the Sinai deposits. The mines were extensively and systematically worked under Egyptian control from the first to the twentieth dynasty, and during this period a great quantity of gem material was obtained. At intervals, for many thousand years, the natives of the peninsula secured turquoises here, part of which reached Egypt and the Continent. Since 1885 the Sinai stones have occasionally made some impress upon the turquoise trade (being known as Egyptian turquois), but this source has never assumed any great importance in modern times.

It is impossible to approximate the total production of the famous mines near Nishapur in Persia. It is neither known when first they were operated, nor are there records, until recently, of their output. It is certain, however, that for the past thousand years they have supplied nearly all the turquois used in Europe and until two decades ago in America. Their production, therefore, must have been enormous, amounting to millions of dollars. For the past 30 years the output has varied considerably, but probably \$100,000 is a fair estimate of the annual exports to Europe, though this figure greatly undervalues the retail worth of the stones after cutting.

Information is lacking whereby the extent of the production in central Asia may be judged. It is known that this mineral has found wide application since remote times in Tibet and that this country has furnished great quantities of material. Recently, turquoise matrix resembling that employed in Tibet has appeared on the London and Paris markets. During the past 200 years central China has produced considerable turquoise, most of which has been exported to Mongolia and Tibet. Modernly, considerable turquoise is used in the northern provinces of India, and both Tibet and Persia have contributed to this supply.

Deposits in the United States

The productive deposits of turquoise in the United States are confined to five states: New Mexico, Arizona, Nevada, Colorado, and California; and practically every locality, that has in modern times yielded this precious stone, was exploited of old by the Indians. In the Cerrillos hills of New Mexico, in particular, are extensive excavations made in pre-Spanish times. These workings alone supplied immense quantities of turquoise to the aborigines of the Southwest and were probably the chief source of the turquoise so abundantly used by the ancient Aztecs and allied peoples.

The recent domestic production has been very irregular. During certain years a large output has come from a few important mines, while in other years many deposits have shared in the production. Of late, turquoise matrix has been in great demand, and the large quantities mined have resulted in an overproduction. For this reason, and because turquoise is temporarily out of vogue, many mines are at present

closed. According to statistics gathered by the U. S. Geological Survey, the value of the production in the United States from 1883 to 1911 was \$1,946,460. The figure quoted represents the value of the rough turquoise as purchase by dealers. The value of the cut gems would be several times as great.

Value

The turquoise varies so considerably in value that it is impossible to assign precise rules whereby one can accurately appraise a given specimen. To do this successfully requires both skill in judging quality and knowledge of market conditions.

At present turquoise is somewhat out of fashion in the United States and not very popular. In consequence its market value is down, and \$10 per carat for the best quality is a good price. This applies only to stones of few carats weight; larger ones of the finest grade are worth more per carat. Inferior stones can be assigned no fixed value. Turquoise matrix, according to quality, brings about \$1 per carat. Frequently, however, matrix stones are sold without specific reference to weight and command from 50c. to \$5 each. In Europe the best quality turquoise is worth about \$12.50 per carat.

Grinding Short Zinc Shaving

By J. B. TREGLOAN

A small tube-mill, made from an oil tank such as oil is shipped in, has recently been installed at MacNamara mill, Tonopah, to grind the short zinc from the zinc boxes. The mill runs about 6 r. p. m., and is driven by a belt around the tube. On each end is bolted a 4½-in. flange, into which a short 4½-in. nipple is screwed and keyed, forming the bearings, the feed, and discharge. The inlet nipple is reduced to 1½ in., through which is a 1-in. feed pipe for solution. A few pebbles are used in the mill to grind the zinc a little, and when working, rich solution is allowed to run through and discharge to a pipe leading to the first cell of a zinc box. One test showed 66% of the metal in solution was precipitated in passing through the mill, and the precipitate coming out assayed 55% bullion. Some very fine zinc is left in the mill, but the troubles with short zinc in clean-ups are over. The idea originated at the Tonopah Extension plant, where a barrel, containing a few pebbles set at an angle of 40°, was slowly revolved by gearing. Results show that there is no need of any acid treatment. It is used only a few days each month at the MacNamara, and prevents the short zinc from being coated with white precipitate. It also reduces the cost of cleaning the zinc boxes by about 25 per cent.

The following measurements of different material equal 1 ton weight: Sand, 25 cu. ft.; earth, 18 cu. ft.; clay, 17 cu. ft.; quartz, 13 cu. ft.; earth before digging, 18 cu. ft.; when dug, 27 cu. ft.; and broken quartz, 20 cubic feet.

Accident Prevention at the Nevada Consolidated

By LINDSAY DUNCAN

Accident prevention in a large industrial plant is a business by itself and requires for its successful prosecution as much care, forethought, and energy as would be required by any other department.

The Nevada Consolidated has attacked the problem vigorously and spared neither time nor money in its effort to effect a material reduction in the tale of death and suffering which has been the inevitable accompaniment of modern industry. The first step was to obtain accurate data of the accidents, and this was done by requiring each foreman to file a report of every accident however trivial, answering the three questions:

(1) What happened? (2) How did it happen? (3) Could it have been prevented? These reports were studied and an earnest effort was made to prevent the recurrence of the same type of accident.

One difficulty which arose was that of meeting new conditions. The metallurgy of copper has advanced rapidly during the last few years, and practice at McGill has kept well abreast of modern methods, with the result that processes have changed greatly during the past six years and new types of accidents have arisen, requiring new safety devices. Thus the huge new basic converters, each of which can blow to blister copper 200 tons of matte in a day, have developed possibilities for accidents which did not exist in the smaller acid converters, and have necessitated a whole new line of safety appliances.

Underground Risks

In taking up briefly the various methods of safeguarding our employees, I will describe a few of the characteristics of the work in each department. In the Veteran mine a top-slicing system is used whereby the ore is taken from the top of the deposit, dumped down raises into ore-bins on the main haulage level at the bottom of the orebody, then trammed to the foot of the shaft, where it is elevated in five-ton skips to the surface. Signs, marked 'Fire Escape', with an arrow pointing the direction of travel, are placed underneath an electric light at all cross entries. At the mouth of the drift leading to the fire escape itself, a large red light is placed. The fire exit is downcast, while the main shaft is upcast. In the fire exit are rest platforms every eighteen feet, on which four or five men can stand at one time. Fire drill is held every two weeks, when all the new miners are required to use the fire exit in leaving the mine.

Three complete Draeger rescue outfits are kept at the head-frame and a selected body of men are trained in their use. A man equipped with one of these

helmets can travel and work in a poisonous atmosphere for a long period of time. Their use and availability in the case of a mine fire would doubtless mean the saving of lives which would otherwise be lost.

The cage in the main Veteran shaft is, of course, equipped with safety-dogs; but in order to be sure that the safety devices are operative, once a week the safety devices are tried, to prove conclusively that everything is in working order.

Risks in Open-Pit Work

Most of the Nevada Consolidated ore is mined by steam shovels at Copper Flat. The risks incidental to mining of this nature fall readily into four classes: (1) those due to the operation of steam shovels and churn drills; (2) those due to blasting and handling of explosives; (3) those due to transportation of ore and over-burden; and (4) shop accidents.

Most of the accidents on the shovels and drills have been due to men getting caught in the machinery. To prevent this, all gears, on both the shovels and drills, have been housed. On the shovels, the crowding and swinging engines are completely enclosed, and also the moving parts of the main engine. The crane-man's seat has been changed from underneath the boom to the bull-wheel, so that now there is no chance for a chain to strike him should it break; and the steam pipe to the crowding engine is run inside the boom and strongly bracketed to prevent its being jarred loose and scalding him. Both drills and steam shovels are well provided with steps and grab irons, which are always kept in good repair and are at once replaced when damaged. The shovels and drills are worked two shifts, and between shifts there is a fireman on duty at each machine. This effectively prevents malicious or irresponsible persons from deranging or starting the mechanism. In case of serious accident the locomotive crane, which is under steam twenty-four hours of the day, can start at once for a wreck and quickly lift cars, timber, rocks, or whatever might be upon an injured man.

Powder handling and blasts have been a prolific source of injury. The Company has appreciated this and in the booklet of rules, issued to each employee of its mining department, sixteen out of the sixty-eight paragraphs are devoted to shops, shovels, and drills; eighteen to train service; and thirty-four to blasting, the use of explosives, and warning signals for blasts. In general these regulations lay down the approved methods of blasting and handling of explosives and counsel safety in every line.

Each shovel and each drill is equipped with a high-grade whistle, one of a different tone being placed on each machine. These whistles are inspected and kept

*Read before the Industrial Safety Conference, University of Nevada, January 27.

up the same as a piece of machinery. Loading, firing, and handling explosives, is done by certain particular employees who are known as 'powder men' and wear distinguishing badges. No others are permitted to officiate, and any unauthorized person handling powder would be at once discharged from the Company's service.

Safety precautions for the train service at the mines, and also at the smelter, are patterned very closely after standard switching practice. Equipment is carefully inspected and promptly repaired; all accidents to equipment, however trivial, are reported and investigated; approved danger signals and semaphores are installed, and as far as possible only experienced men are employed.

Surface Work

Shop accidents are guarded against (1) by making the machinery as nearly fool-proof as possible and then preaching *Caution—First, Last, and Always*. By way of illustration, all emery wheels are cased, circular saws have protectors, all gears are housed, safety set-screws are used throughout, goggles are provided for workmen whose eyes are exposed, motors and switches are fenced in, etc.

Unloading the ore on the concentrator trestle has always been a prolific source of accidents. Ore is received in 55-ton hopper-bottomed steel cars, running in trains of twenty-one or twenty-two cars each, as many as ten trains a day arriving from the mines. The ore as loaded by steam shovels is frequently in lumps several feet in diameter and in the winter season an entire car is sometimes frozen into a solid mass. The ore in fully two-thirds of the cars has to be blasted, and this is done by a special crew carefully instructed in its duties and acting under a definite set of rules for the handling of explosives.

The tops of the bins are protected by heavy iron gratings which effectively prevent any one from falling in while the ore is being discharged. Before the gratings were installed several workmen were injured, both by falling into the bins and going to sleep and then forgetting to wake up before ore was dumped. The stairs, working platforms, and walk-ways of the mill are thoroughly protected by hand-rails. Projecting set-screws on shafting have been removed, and no loose flooring or open hatchways are permitted. In a plant of the size of the Steptoe plant, these simple precautions entailed a vast amount of labor and expense.

The shops of the Company are very complete and include a pattern shop, foundry, tin shop, garage, paint shop, machine shop, blacksmith shop, structural shop, pipe shop, and planing mill. In these shops about 150 men are employed, a fairly large industry in itself. Every emery wheel has a heavy steel plate protector fitted around it, and the saws and planes in the wood shop are similarly protected. Most of the machines are motor driven, and where belts are unavoidable they are boxed in wherever it would be possible for a

workman to come in contact with one. Drip pans are provided to catch the oil from machines so that there can be no slippery places to invite falls. Metal cans with self-closing lids are conveniently placed to receive oily waste. Several chemical fire-extinguishers of approved type are in each building, and on several occasions incipient fires have been extinguished by promptly using them.

The power plant is rated at 10,000 hp. and is actually generating an average of 7000 hp., which is an unusually large output for a plant of this rating. In fact 25 to 30% is the usual ratio of output to capacity, and the 70% output at McGill is an indication that the power plant is worked well up to capacity. The plant consists of nine direct connected engines and eighteen water-tube boilers; ten of the boilers are in the flues of the reverberatory smelting furnaces and utilize the waste heat of the gases.

The power house is the original home of the hand-rail in McGill, and it is encountered on all sides. The switch-board is surrounded by a railing within which no one is permitted except the operator. The metal steps leading to the main engine bearings are not only supplied with hand-rails but the treads are also of rubber studded with lead. This is the same material which has been adopted by the Pullman Car Co. as a standard for the car steps. The stair and hand-rail habit has percolated thoroughly through the entire power plant: fly-wheels, generators, vacuum-pumps, condensers, economizers, feed-water heaters, and boilers are all so equipped.

The steam lines are all strongly anchored and well supported and a leaky steam joint is not tolerated. Superheated steam at high pressure is hard to handle and as a result no liberties are taken with it.

Danger Signals

In case of men working on an electric line, the switch is opened and a sign, "Danger: Men are working on this line," is hung on the open switch. The switch cannot be closed until the man who has been working on the line, and no one else, removes the sign.

The automatic stokers have been a fruitful source of injury to the fire-room labor. Only recently one of the ash-wheelers, in an idle moment, availed himself of the temporary absence of the fireman and essayed to start one of the stokers 'to see what would happen.' He not only saw what happened, but felt one of his fingers depart.

In the smelter, sheet iron protectors have been placed along all elevated hot metal and calcine tracks, to prevent men passing underneath from being burned. All charge hoppers are protected by gratings; hand rails are liberally used and walk-ways and stairs are of substantial and permanent construction.

Signs and warnings in English, Greek, and Slavish are liberally used, and respirators and goggles are distributed to the workmen whose occupations make them necessary.

In the industrial car system, which is used to carry concentrate from the mill to the roaster, calcines from the roaster to the reverberatory furnaces, matte from the furnaces to the converters, and slag and secondaries from the converters back to the reverberatories, many safety devices have been placed, both on the cars and the locomotives. These include chains to prevent slag pots from dumping during transmission, grab-irons and steps, steel running boards, and wooden treads to prevent slipping. An earnest endeavor is made to keep the track up to modern standard. Manganese steel frogs are used on account of better wearing qualities, cast iron frog fillers are used to pre-

vent a switchman catching his foot and being thrown in front of the train. Safety niches have been placed in trestles and places where the trains run with narrow clearance to lessen the danger of a switchman being caught. ●

The Nevada Consolidated has organized a regular Safety Department under W. H. Droll as safety engineer, and to him I am indebted for much of the information contained in this paper. The Safety Department suggests changes and protective devices, and in general makes it its business to investigate and report on all accidents which occur, or which might occur, around the plant.

The Globe Mine and Mill

By WALLACE MACGREGOR

The properties of the Globe Consolidated Mining Co. are situated near Dedrick, Trinity county, California. The mill commenced operations on November 25, 1913, and at the mines and mills 50 men are employed. The Company owns three groups of mining locations above Dedrick, namely, the Globe, Chloride, and Bailey claims. The Globe mine was located on July 29, 1890, and after being worked for several years, and the subject of considerable litigation, it became the property of the Globe Consolidated company in 1909. Robert Woodburn worked the mine from 1891 to 1899, and operated a 5-stamp mill under great difficulties at the mine, which is situated just over the ridge on the other side of Dedrick. Heavy snows fall at that altitude, and little progress was made then. The Chloride claims were located in 1889 and were first worked with a Huntington mill. The Bailey claims were located the same year, but soon after passed into the possession of the owners of the Chloride group, and the ore from the Bailey mines was crushed in the Chloride mill. About 1897 the Chloride Bailey mines passed to the Chloride Bailey Gold Mines Co., and later were sold to the Trinity Gold Mining Co., which equipped the property, worked the same, and then bonded the property to H. M. Hall, who later transferred his interest to the Globe Mining Co. The present Company bonded the united property from the Globe Mining Co. in the latter part of 1911, and next year began extensive development and equipment of the property held by them under bond. The Company's holdings consist of 36 quartz locations, 3 placer-mining claims, a number of millsites, lots in Dedrick, and power and telephone lines.

The orebodies of the Globe mine are well developed, uniform in value, and have extended to a considerable depth. There is a large amount of ore in sight as shown by development work done by adits, shafts, and cross-cuts. The Chloride mine, on the opposite side of the mountain, has always contained high-grade ore, and the necessary development to be done will

undoubtedly open a large body of high-grade ore. The Bailey mine contains ore of good milling value.

The properties have never before been equipped with a plant sufficient to properly handle and extract the gold from the large orebodies. The present equipment is the latest for the treatment of gold-bearing quartz, and the mill has a capacity of 100 tons of ore per 24 hours. The mine and mill are operated with three 8-hour shifts. The ore now being crushed is taken from the Globe and Brown Bear claims. Richard James is foreman at the mine.

The ore is taken out through a cross-cut at the Globe mine and transferred to the ore-bin at the top of the main aerial tramway, 6000 ft. long, with a 2500-ft. drop and 35° slope. It is then conveyed to the mill in buckets of half-ton capacity each. On arriving at the mill it is dumped into an ore-bin, weighed, crushed, sampled, and delivered to the storage bin behind the stamp-mill. The return buckets on the aerial tramway carry all necessary timber and freight to the mine.

The mill is a 20-stamp, all-sliming, cyanide plant, with a capacity of 100 tons per day. It covers an area 225 ft. long and 66 ft. wide, on the steep slope of the mountain, and consists of eight distinct sections under cover, namely, crushing, sampling, stamping, separating, tube-milling, agitating, filtering, precipitating, and pumping. It is the finest and best equipped plant of the kind in the state, and was constructed by J. W. Rutherford.

The plant is driven by water-power, the water being conveyed from Canyon creek through a ditch 6800 ft. long and 3700 ft. of 20 and 18-in. pipe, and is brought to the mill under a head of 600 ft. In each department of the mill there is a separate water-wheel which furnishes power to that department.

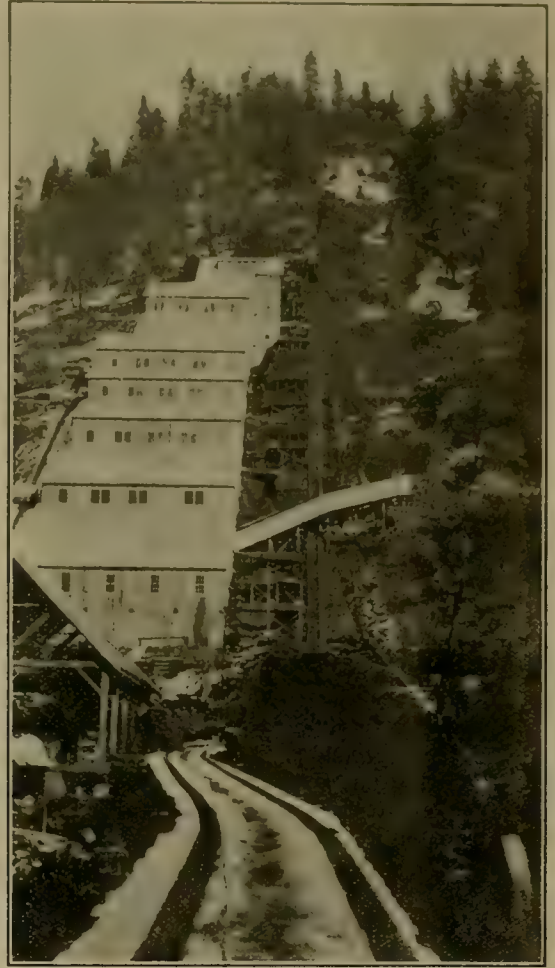
The ore is crushed in cyanide solution through coarse screens. There are no copper plates used. From the batteries the pulp goes to a Dorr classifier and the coarse sand is separated from the slime. The sand

goes to the tube-mill for regrinding, and the slime goes to thickening tanks for settling. The reground sand returns to the classifier by a bucket-elevator for reclassification. The final product is next agitated in Dorr agitators. After several hours of agitation, the pulp is transferred to more thickeners, the clear solution overflow containing the gold. This is precipitated by zinc shaving. The thickened pulp is sent to an Oliver filter which extracts the balance of the cyanide solution and dissolved gold, the waste pulp being transferred by belt-conveyor to the dump. The spent solution from the zinc-boxes flows to sumps, where it

ferred to a site near the mill. There is also a saw-mill with a capacity of 10,000 ft. per day, together with all necessary equipment, driven by water power. The logging is done by a water-power hauling system. This sawmill was used for making the lumber for the mill, boarding-house, office, and other company



AERIAL TRAM FROM MINE TO MILL.



THE GLOBE MILL AND CYANIDE PLANT.

is made up to strength and pumped back to the battery tank, to again enter the continuous circulation through the plant.

The tailing discharged on the dump contains from 40 to 70c. in gold per ton. The value of the spent solution in the sumps is 5c. in gold and about 25c. in cyanide per ton. This is saved in the continuous circuit solution. No cyanide escapes from the mill, and no cyanide is discharged with the residue. H. S. Payson is mill superintendent.

The property is also equipped with an electric power and air-compressor plant, the latter furnishing power for drills and will also furnish the necessary power for the air hoists. A new compressor is to be installed near the mill. The electric plant will also be trans-

ferred to a site near the mill. There is also a saw-mill with a capacity of 10,000 ft. per day, together with all necessary equipment, driven by water power. The logging is done by a water-power hauling system. This sawmill was used for making the lumber for the mill, boarding-house, office, and other company

buildings, and also for mining uses. The timber was obtained from the National Forest, and during all the time of the manufacture of the same the business relations between the Company and the Forest Service officials were very pleasant.

The Globe Consolidated Mining Co. is incorporated under the laws of Arizona. J. B. Goodhue, of Derby Line, Vermont, is president, and T. M. Craig, of Sherbrooke, Canada, is treasurer.

Rubber exports from the Amazon district, South America, during October 1913, were 6,995,915 lb., compared with 9,032,657 lb. in the same month of 1912. Prices were low and financial conditions at Para were unpromising.

Antimony: Its Ores, Metallurgy, and Uses

By L. C. MOTT

*The beginning of the antimony industry in America was at the plant of the Mathison Smelting Co., in San Francisco, established some time in the 80's and removed to Staten Island, New York, about 1893. The San Francisco plant obtained its ores from Nevada and various mines scattered throughout southern California. The high freight rates then in effect made the industry a purely local one; but the local market not being of sufficient importance to induce capital to go into it on a large scale, it became necessary for Mathison and company to move to Staten Island, New York, where they erected a plant to treat foreign ores. This plant continued for some time to treat ores from Mexico and other parts and finally went out of business. At the present time all the antimony produced in the United States is that obtained from the lead refineries as a by-product, and only amounts to about one-tenth of the antimony consumed in this country.

Source of Antimony Ores

France, Algeria, Italy, Mexico, China, and Australia, besides several other countries, produce antimony ores. For a great many years France was the largest producer, but of recent years China has taken the first place. The antimony mines of the different European countries are rapidly nearing exhaustion. The ores being treated at present are of low grade. The largest deposits of China now worked are situated in the far inland provinces. These ores are roughly concentrated by lixiviation and shipped to the markets of Europe and America. England, France, and Germany are the countries producing the refined metal at present time. The only country that the United States need fear as a future competitor for antimony ores is China; but with a better understanding of the metallurgy of antimony, and with the present better means of transportation, many of our western antimony deposits should be able to produce this metal at a lower price than that at which it can be imported into this country.

Of the ores of antimony, those most commonly found are those which contain the sulphides or the oxidized sulphides of antimony. There are two compounds of sulphur and antimony, the trisulphide and the pentasulphide. The trisulphide is known in both the crystalline and amorphous state. The crystalline sulphide is the ore found in nature and is known as antimony glance, or stibnite; it has a metallic lustre and a grayish black color. The amorphous trisulphide can be obtained by artificial processes and is of a red or orange color according to its method of preparation. Kermes mineral, or the red trisulphide, can be prepared by boiling antimony glance with carbonate of

soda or potash. The passing of sulphuretted hydrogen through a solution of antimonious salt precipitates the orange colored trisulphide. Antimony glance, or stibnite, contains 71.4% antimony and 28.6% sulphur. It is seldom entirely free from other metals such as arsenic, lead, or zinc.

Native antimony is occasionally found, but never in large enough quantities to be of commercial importance. Antimony oxide (Sb_2O_3) is the most important source of antimony apart from the sulphide. It is dimorphous, the cubic form being known as senarmonite and the rhombic form as valentinite. It contains 83.4% antimony and 16.6% oxygen. It is the product of the weathering of antimony sulphide and occurs in the upper portion of antimony ore deposits. It seems very probable that the only situation in which one could expect to find extensive bodies of the oxides would be in or near limestones or similar formations.

There are numerous minerals in which antimony occurs, but not in sufficient quantity to make them a commercial source of the metal. Among these minerals are: antimony ochre or cervantite (Sb_2O_4), and antimony blend, or pyrostibite ($2\text{Sb}_2\text{S}_3 \cdot \text{Sb}_2\text{O}_3$) which contains 75% antimony, 20% sulphur, and 5% oxygen. Many of the ores of gold, silver, copper, and lead contains varying quantities of antimony.

The development of the metallurgy of antimony has been slow for various reasons, the principal one being that until recent years the consumption was not sufficiently great to induce a careful search for new methods. A plant that produced a thousand tons of the metal per year was the exception rather than the rule. The small furnaces that were developed in Europe for the smelting of lead and copper ores were very crude and inefficient compared to our modern American plants. As long as the antiquated methods were sufficient to produce all the metal that was needed, there was but little incentive to improve; but under the spur of increasing uses and needs there has recently been a rapid advance.

Early Method of Treatment

The old method for the treating of sulphides, and one that is still in common use in some parts of the world, consisted in melting them in silica or graphite pots. The ore was introduced into a small pot usually holding not more than 50 lb. This pot had small holes in the bottom and was placed directly over another smaller pot which was sunk in the sand to keep it away from the direct flame. A roasting stall or furnace was built about the upper pot and a small fire started; after several hours the antimony sulphide would have liquated out and run into the lower pot. The extraction was poor and the fuel consumption high. This liquated

*Abstract from a paper read before the Los Angeles section, American Chemical Society.

material then had to be re-smelted with light iron scrap and salt to remove the sulphur. This was done in graphite crucible. The product was known as 'singles' and contained about 91% Sb, 8% Fe, and 1% S. This was again re-smelted, the new charge consisting of about 93% singles, 5% liquated antimony sulphide, and 2% salt. After about one and one-half hours heating it was stirred with an iron rod and carefully poured under a slag cover. The product was known as 'doubles', and contained about 98% Sb, 0.2% Fe, 0.2% S, with various other small impurities. To purify further it was necessary to add potash and sulphide of antimony and re-smelt.

As the demand for antimony grew larger it also became apparent that some new and more economic method of production had to be obtained. About this time a method was perfected for the treatment of sulphide ores under an iron bath in a reverberatory furnace. The furnace did not differ greatly from a small modern reverberatory. In this process, first, a bath of ferrous sulphide was smelted on the hearth of the reverberatory furnace; next, the antimony sulphide ore was dropped into this and rapidly rabbled so that the ore was thoroughly mixed with the bath. At this point wrought iron scrap was added in sufficient quantity to precipitate the metallic antimony. The temperature was kept fairly high; the antimony was tapped from under the sulphide cover into moulds. The greatest objection to this kind of a furnace was that it produced a product that had to be refined further.

The Direct Process

A little later two Frenchmen, taking advantage of the easy volatilization of antimony, evolved a process that produced a commercial product direct from the ores which could be easily and inexpensively reduced to the metal. They worked along different lines, but the basis of their ideas and patents was the introduction of ores with either coal, coke, or charcoal direct into a shaft furnace. The furnace was connected by a series of cooling and condensing flues with an exhaust fan. Most of the metal was precipitated as an oxide in the flues and the remainder blown through a coke-tower over which water was sprayed. The cardinal principle of both of these processes was the formation of the volatile oxide by controlling the volume of air. This was done by varying the speed of the fan and controlling the thickness of the ore charge. One of these methods claims to recover 95% of the antimony in the ore and to produce a product that is 99.6% pure. This process has proved eminently successful in France. Such troubles as are encountered are purely mechanical and are easily overcome. The process has, moreover, this great advantage that one can successfully treat ores containing other valuable metals. Lead, copper, gold, and silver are left with the scoria and can later be extracted. Arsenic, the great bogy of antimony, would be eliminated as it is more volatile than antimony and would be carried farther along before being precipitated.

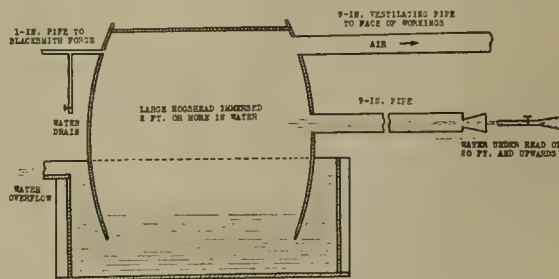
This process of smelting oxide ores was none other than that used in a modern lead furnace, but it had to be modified to some extent before it worked successfully. The column was raised and the blast pressure was higher than that of the average lead smelter blast, but in all there was not any great change. The product was not pure, ranging from 93 to 97% antimony, and had to be sent to Europe for refining; but it was a great improvement over the old pot method, and thoroughly demonstrated that the oxides could be smelted. The reduction of the precipitated oxide to metal in the volatilization process was obtained by mixing with soda ash and coke breeze, or charcoal, and slowly melting in pots or in a reverberatory furnace.

Antimony is used largely for type metal. English type metal, for example, contains 25% antimony. Antimony is used in the manufacture of babbitt and other anti-friction metals, the amount used varying from 11% to as high as 25% antimony. It is used in pewter, which contains 11% antimony. The anti-friction match, which has come into such universal use of late, contains 25% antimony sulphide in the heads, and the smear on the box 53%. It is used in medicine in the form of tartar emetic, and other products of pharmacy. Large quantities are used in calico printing and dyeing. It is used largely in the ceramic arts. A patent has recently been issued covering the use of antimony in the place of tin for the manufacture of bath-tub enamels. It is the base of a very high-grade paint, both in the form of the oxide and the amorphous trisulphide, the latter being used for ship paint. Large amounts of antimony sulphide are used in vulcanizing rubber, especially for automobile tires, it having the advantage of not changing by weathering or sunlight.

The latest statistics show a consumption of about 24,000,000 lb. of antimony and its salts in the United States in the year 1912. All of this, apart from that contained as a by-product of the lead refineries, dross, and old metal scrap, is imported from abroad.

A Small Air-Blast

Below is a figure illustrating a simple small air-blast run by water and used for ventilating a 3000-ft.



adit with raises and drifts. A smaller blast of the same sort might be used for a blacksmith forge. The apparatus can be easily improvised at any mine.

Transportation and Government Regulations in Bolivian Tin Fields

By G. W. WEPFER

All the South American countries have adopted the metric system, but in practice they use mostly the old Spanish system. The following conversion table shows the relation between the old Spanish units and the present standards:

- 1 metric ton = 10 metric quintals = 21.734 Spanish quintals.
- 1 Spanish quintal = 20 Spanish quintals = 920.80 kilos = 2000 libras.
- 1 English ton = 1015.938 kilos = 2240 lb. English = 20 cwt. @ 112 lb.
- 1 metric quintal = 100 kilos = 220.47 lb. English.
- 1 Spanish quintal = 46 kilos = 101.40 lb. English (accurate, 101.4116 lb. English).
- 1 English quintal = 50.7969 kilos = 112 lb. English.
- 1 hectare = 10,000 square metres = 2.4711 acres = 1 pertencencia.
- 1 cajon = 50 Spanish quintals = 50 × 101.4 = 5050 lb. English (say 5000 lb. avoirdupois).
- 1 marco (weight) = 5070.58 : 10,000 × 0.507058 lb. avoirdupois (say = 1 $\frac{1}{2}$ lb. English).

The contents of silver in ore is not given in per cents, but always in the number of marcos per cajon of ore.

The superintendent of the Bolivian Customs states that the amount of tin exported in 1912 amounted to the value of \$23,289,732.

Bolivian Export Duty on Tin

Based upon the price of Straits tin, which is obtained every two weeks from London the corresponding duty remains unchangeable for two weeks.

Price of Straits tin in £ per ton.	Concentrates. Duty per 100 kg.		Tin bars. Duty per 100 kg.	
	\$	Bs.	Bs.	\$
Up to 100.....	0.80	2.00	3.25	1.30
100 to 110.....	0.88	2.20	3.50	1.40
110 to 120.....	1.14	2.85	4.37	1.75
120 to 130.....	1.40	3.50	5.24	2.10
130 to 140.....	1.66	4.15	6.11	2.45
140 to 150.....	1.92	4.80	6.98	2.79
150 to 160.....	2.18	5.45	7.87	3.15
160 to 170.....	2.44	6.10	8.74	3.50
170 to 180.....	2.70	6.75	9.61	3.85
180 to 190.....	2.96	7.40	10.48	4.20
190 to 200.....	3.22	8.05	11.35	4.54
200 to 210.....	3.48	8.70	12.22	4.90
210 to 220.....	3.74	9.35	13.09	4.24
220 to 230.....	4.00	10.00	13.96	5.58
230 to 240.....	4.26	10.65	14.85	5.94
240 to 250.....	4.52	11.30	15.70	6.28
250 to 260.....	4.78	11.95	16.57	6.63
260 to 270.....	5.04	12.60	17.44	6.92
270 to 280.....	5.30	13.25	18.31	7.32
280 to 290.....	5.56	13.90	19.18	7.67
290 to 300.....	5.82	14.55	20.05	8.02
300 and up.....	6.08	15.20	20.92	8.37

In this table the value of the Boliviano is taken at \$0.40 gold.

In the article published last week I gave the beginning of the mining industry as 1548. The settlement of

La Paz was due to the discovery of the great mineral wealth of the country. The Spanish statistics were started in Potosi in 1545, recording accurately the production of gold and silver mining in Bolivia. The Spanish silver production from 1545 to 1800; that is, in 255 years, amounting in U. S. Cy. to \$3,339,262,000. The production from 1800 to 1825 (the date of Independence) was \$67,104,000, and the total Spanish silver production, 1545 to 1825, in U. S. Cy., \$3,406,366,000. The Spaniards were not laggards, they worked fast, not knowing how long their stay would last. They wanted to get the most of the treasure in shortest time. This is also evident from their manner of mining. Trained men were sent out to hunt for natives to work in the mines and for women to cultivate the fields and to raise crops for the population to live upon. The old records in connection with mines always speak of two special classes of men, the Conquistadores and the Jesuits. The Conquerors were the Rulers, the Jesuits were the mining engineers. At the time the Spaniards had to leave, they had more than 10,000 silver mines, all producing. There were 5000 tunnel mines on Mount Potosi. Many times great difficulties were experienced with flows of water in the mines, but these were overcome and no mine was lost or had given out.

Sr. José Maria Dalence was requested by the government in 1848 to visit all the mining districts and report on the condition of the mines. He has published his report in a book entitled 'Bosquejo Estadístico de Bolivia', in 1851, and after careful investigation he gave detailed reports which show the number of silver mines abandoned, 10,000; the number of silver mines operating more or less feebly, 135; and the total number of silver mines, 10,135.

The Bolivian government statistics state that these figures hold good to the present date and the reason of the increased production is mainly due to improved methods in working. Regarding gold mines, Sr. Dalence gives the number of mines abandoned as 1300; gold mines in operation, 13; total number of gold mines, 1313. The condition of these gold mines has not changed since the time of Sr. Dalence. Any of these abandoned mines can be obtained for working on perpetual leasehold; that is, as long as the taxes are paid. The mine tax amounts to Bs. 2 (\$0.80) per hectare (10,000 square metres = 2.4711 acres) every six months. A certificate also has to be obtained for all the hectares contained in the mine ground. This certificate costs Bs. 10 (\$4). The Spaniards, after burying their treasures of gold and silver, left the mines in a body. A few stayed behind as caretakers until the others would return. These few men were murdered by the Indians in retaliation for the treatment the Indians had received. The portals of the mines

were closed, the reduction works were destroyed, and the Indians placed guards on outposts, that no white man might come near to take notice of the changes. The Spaniards had no wagon roads, only trails. When the rainy seasons came the trails were overgrown with bushes and trees. The farms were not cultivated so that the Indians could not find sufficient food and migrated to other parts of the country.

Records of Lost Mines

At the town hall in the city of Potosi which had a population of 200,000 before the city of Boston, Mass. was founded, the production records were kept of all the mines, so that the 'Royal Fifth' could be collected and year by year could be sent to the treasury of the king of Spain. This record is now in the government archives at La Paz. From this record it is found that in the province of Inquisivi there are 160 abandoned mines and only five in operation, mines which according to record had furnished bonanzas in their days. Sr. Dalence, provided with old maps, endeavored to find some of these abandoned properties in the mining district of Chuquicamiri, especially the great mine of 'San Juan Bautista', which was destroyed by the Indians after the revolt of the 12th of June, 1666, but was not successful. The whole district was depopulated and no guides could be found to aid in their discovery. There is a standing reward offered by the Government for the discovery of these mines, yet no prospector could be found with sufficient means to relocate them. There are good stage roads built and maintained, as the road from La Paz to Chililaya (the harbor Puerto Perez) Lake Titicaca which is 45 miles long; La Paz to Oruro, 150 miles; Oruro to Cochabamba, 123 miles; Oruro to Lagunillas, 135 miles; Cochabamba to Sucre, 195 miles; and Potosi to Sucre, 77 miles long. Roads from Uyuni to Tupiza, and Tupiza to Tarija, and others are in course of construction. The roads are built as in the United States. Every citizen has to work for two days on the public highways, or pay the road money, which amounts every year to Bs. 1 (\$0.40). The Indians build practically all the roads.

Concentrates and bars are generally conveyed by llamas from the mines to railway stations and placed in charge of agents. These agents consign the same to shipping agents at the sea ports of Antofagasta, Mejillones, Arica, or Mollendo with instructions. The seaport agents, advised by naval gazettes of coming ships in advance, contract for space for concentrates or bars, so that as soon as the ship arrives, the freight is put on board without delay. Small mine owners with only small funds consign their freight to the nearest commission merchant, who attends to all the shipping by his own agents, and who also advances the freight charges, etc., for which services he charges a high commission, as he has to wait for his money until the concentrates or bars are sold in the United States or Europe.

Besides the direct railways from Oruro to Guaqui on

Lake Titicaca there are two other ways to ship concentrates or bars to Lake Titicaca. The Peruvian Corporation, Ltd., of London and Lima owns the railway from Mollendo to Puno on Lake Titicaca, and all the lake steamers, and has received from Bolivia a franchise to maintain steamships and barges on the Desaguadero river. This river is navigable for 350 miles from the Lake Titicaca, port Desaguadero, to near the city of Oruro. This corporation will accept the concentrates and bars of copper, silver, and tin at any point from near Oruro and deliver the same at the Port of Mollendo. The second opportunity is the conveyance of freight by llamas to Lake Titicaca at the port of Chililaya, and from there by the Peruvian Corporation across the lake and down to Mollendo. This route takes more time but is the cheapest.

A llama will carry 100 lb. and costs nothing for feed. A donkey will carry 150 lb. but has to be fed and the feed has to be taken along. The comparative cost, for example, from Oruro to Arica on the coast is:

Per 100 lb. per llama, requiring 30 days, about \$1.25 U. S. Cy.

Per 100 lb. per donkey, requiring 12 days, about \$2 U. S. Cy.

Per 100 lb. per mule, requiring 5 to 7 days, about \$2.75 U. S. Cy.

The descent from the Western Cordillera is very steep and this part of the railway was expensive to build and place in operation. It is a question whether the railway can establish a freight rate that can compete with pack animals and with the rates of the Peruvian Corporation.

A case is known where a custom smelter has been re-located near a railway, the respective mines of copper and silver being further up in the Cordillera. This Company built an expensive railway to the mines and now at the lowest possible freight rate the Company finds that it cannot in every case compete with the llama, which takes a shorter and steeper trail.

Alluvial Washings

There is but very little done in placer mining, and what there is, is done by small parties with but little capital and is not conducted in a systematic way. There are large masses of debris rich in tin, and sometimes tin and gold at the foot of ravines where the placer deposits occur. In the summer mountain torrents rush down these ravines and in the winter, at high altitudes, the sun will only melt the ice for about three hours a day, which furnishes enough water for washing. Where there is a moderate amount of water the ground is dug up and the larger pieces, or whatever can be sorted out by hand, is recovered. The fine material is washed in a hand jig which can be used to advantage for this work. In the winter and when there is not water the material has to be carried by llamas to the nearest place where water can be had for the washing of this material. Most of the work has to be done in winter, as when the torrents appear nothing can be

done. The great mass of tin placers will be left untouched for the future times.

Dumps of tailing, heaps of waste of low-grade ore and scoria, are also a great asset for future times. No mine taxes have to be paid on these deposits. They only have to be registered. These dumps contain all the tin from silver mines which was thrown out by the Spaniards together with low-grade silver ore. There are large slag heaps everywhere; at Oruro are the large accumulations of slag with 30 per cent of tin and 20 per cent of lead and silver. Most of the tin is shipped in the form of concentrates, only a few companies ship the tin in bars. Besides these, there are a number of small custom smelters which smelt the ores of small producers. These furnaces are small water-jacketed furnaces. They use charcoal fuel and *taquia* (the dung of llamas). *Taquia*, used for the roasting and smelting of ore, is cheap. It is collected by Indians and is sold for a few centavos per hundred weight.

In the Chorogüe district, North Chichas, Department of Potosi, 175 tons of concentrate give about 105 tons of bar tin. Tin bars as a rule are very low grade and are merely made to reduce freight cost. Where tin bars are made which have to be carried by llamas, each bar has to weigh not more than 50 lb., so that the llama carries in the pocket of the pack-saddle on each side, one bar, making together 100 lb. as the load for one animal.

Granulating Copper Matte

By R. L. HALLETT

*The process described was installed by B. H. Benetts at the Humboldt plant of the Consolidated Arizona Smelting Co., Yavapai county, Arizona. The blast-furnaces were charged with a low-grade copper ore and the resulting matte was so low in copper that a second concentration was necessary. The original method of operation was to make a regular matte-run concentration in the blast-furnace, as is usually done. The matte resulting from this run went directly to the converters, but the operation was costly and the matte not quite as high in copper as was desired. The object of this article is to describe briefly the method which was used in place of the blast-furnace concentration for treating the first-run low-grade copper matte.

The matte was taken directly from the blast-furnace settler in the molten condition and granulated with water. The granulated matte was roasted in Edwards furnaces and then charged hot into the reverberatory furnaces. This gave a reverberatory matte high in copper and desirable for treatment in the converters. The cost of granulation and roasting was not excessive, and this method of treatment was found to be a profitable one. The apparatus used and the method of operation will be understood from the accompanying

figure, which is a vertical section of the granulating unit. The molten low-grade matte, from the settler, was brought by the electric crane and poured into an old V-shaped cast iron slag pot supported by a steel framework. Four tons of matte was poured at one time. The matte ran through a $1\frac{1}{8}$ -in. hole in the bottom of the slag pot into a short launder, and from there into a long one leading to the settling tank. Two streams of cold water, one above the other, issuing from fish-tail nozzles, struck the stream of matte as it fell from the short launder, solidifying and granulating it and carrying it into the settling tank. The granulated matte settled perfectly in the settling tank and the clear water overflowed continuously. The water was turned on only when matte was being



SECTION OF GRANULATING DEVICE.

poured. When the settling tank was full, the water was thoroughly drained by removing plugs from a vertical row of screen-covered holes down one side of the tank. The settling tank was made of wood, with a hopper bottom, and discharged into a car. The discharge hole was covered by a swinging door, battened down and made tight by means of a heavy rubber gasket. The water for granulation came from a high-pressure pump, through a 4-in. pipe which fed the two 3-in. pipes connected with the nozzles. The water was under a pressure of 60 lb. per square inch, and 900 gal. of water was required for granulating one ton of matte. The pump was automatically regulated to deliver constant pressure by means of a Fisher governor. The short launder was an iron casting, and the long one was lined with cast iron. The matte was granulated to about $\frac{1}{4}$ in. and under. There was practically no oxidation during granulation, the sulphur content decreasing only about 0.3%. After draining off the water, the granulated matte was drawn into cars and taken to the roasters.

In the smelting of low-grade copper ores this process is worth considering, and under favorable conditions it may be found the most desirable method of treating the first run of low-grade matte. Granulation can be used for lead matte as well as for copper.

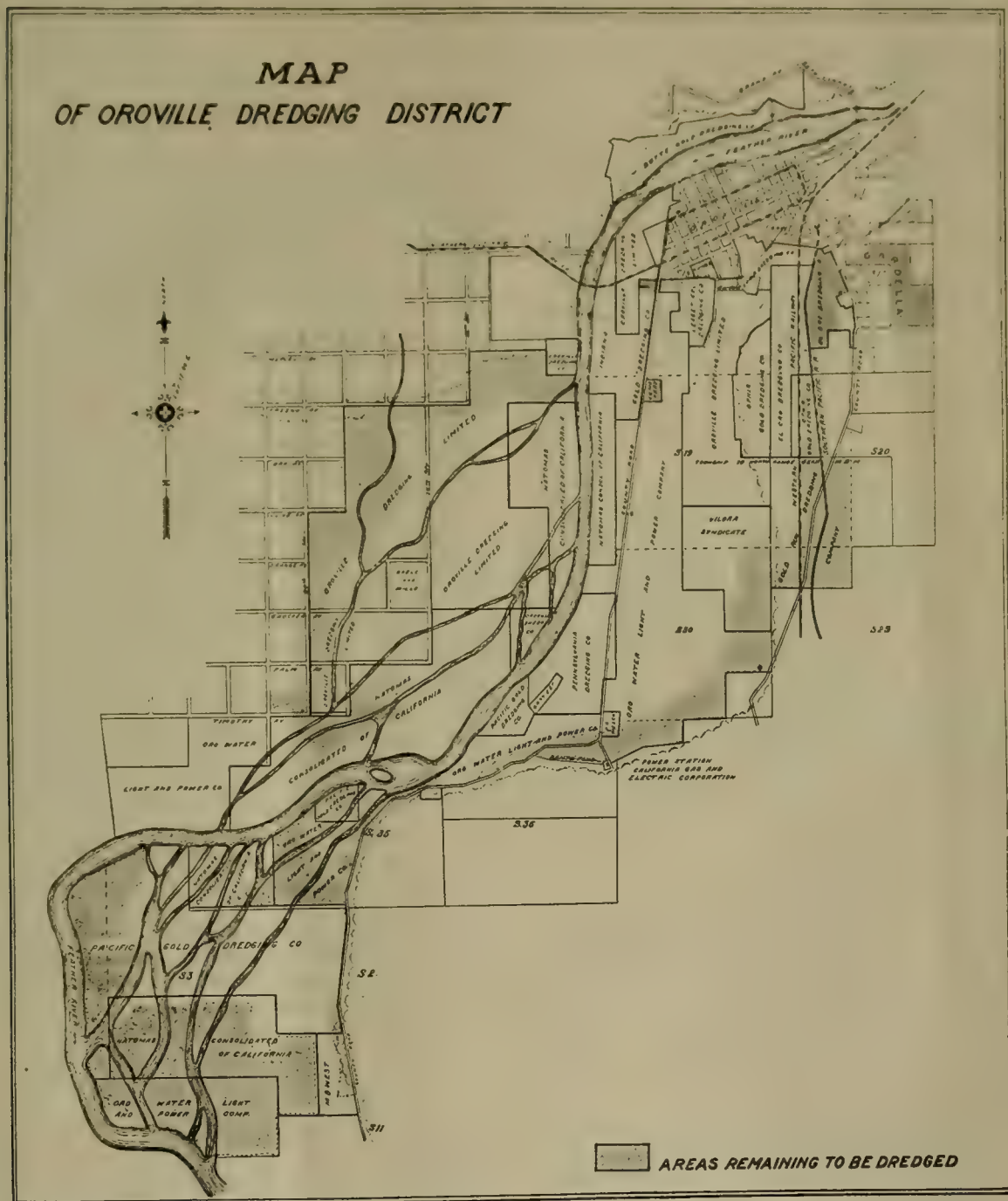
*Abstract from the Colorado School of Mines Magazine.

Dredging at Oroville

By M. W. von BERNOWITZ

To obtain a proper idea of the amount of work done,

Holman, superintendent of the El Oro Dredging Co., and who marked in the areas remaining to be dredged in the accompanying cut, I studied the present situation at Oroville. There are 16 dredges working, but it is safe to say that within six months there will be



being done, and to be done in this well known district, one has to cover the area in an automobile or buggy, and be careful he does not get lost among the 21 square miles of dredge tailing. In company with Charles

only 13, as one boat owned by each of the Oroville, Ophir, and Pennsylvania companies will soon have finished its respective area. Narrow strips of gravel are still left on each side of the field, as indicated.

Discussion

Readers of the MINING AND SCIENTIFIC PRESS are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment. Insertion of any contribution is determined by its probable interest to the readers of this journal.

California Miners and the Exposition

The discussion of plans printed under the above title in the *Mining and Scientific Press*, January 31, has called out the following interesting letters, addressed to Mr. van Barneveld. We print them in the hope that they may serve to stimulate further interest in the project. [EDITOR.]

My dear Sir—I have read with interest your suggestions, in the last issue of the *Mining and Scientific Press*, for a collective and consolidated California mining exhibit in the Palace of Mines and Metallurgy. Because of no appropriation for a state exhibit, I fully agree with your conclusions that the counties should merge their efforts in a thoroughly representative and general educational exhibit, rather than in the usual scattered form of individual county fair exhibits that leave no lasting impression. I sincerely hope the mining counties and the mining industry of the state at large will coöperate with you in carrying out your suggestions, which I feel confident are the very best possible under the circumstances.

F. W. BRADLEY.

San Francisco, February 3.

Dear Sir—I have read with interest your article in the last issue of the *Mining and Scientific Press*, entitled 'California Miners and the Exposition.' I am heartily in accord with your views in this matter, and I very much hope that you will succeed in your effort to persuade the counties to coöperate in the carrying out of your plans.

ARTHUR GOODALL.

San Francisco, February 3.

Dear Sir—I have just read your article, 'California Miners and the Exposition,' in the last issue of the *Mining and Scientific Press*, and wish to say that the method of making exhibit as proposed by you I feel sure is to the best interests of the mining counties of the state, and will prove of most interest.

LOUIS ROSENFELD.

San Francisco, February 2.

Dear Sir—Your splendid article in the *Mining and Scientific Press* for January 31, 1914, entitled 'California Miners and the Exposition,' has been called to my attention, and I have read it with delight. It has in it the elements of proportion, completeness, and common sense, that are quite refreshing after the many suggestions of disorganized county exhibits that have been exploited. Unless we have at the Panama Expo-

sition an educational exhibit in some such concrete form as you suggest, in some way coördinating the exhibits of the respective phases of the mining industry, such as placer mining, copper mining, oil mining, gold-quartz mining, etc., the exhibition will have no attraction for the general public, and will be void of educational effect. To have no collective exhibit, or no exhibit that could be put forward in some such spectacular form as you suggest, would mean an aggregation of isolated county exhibits, interesting, it is true, to men who are familiar with the details of the mining industry, but a matter of utter weariness and no educational value to one who is not a mining man, and if too extensive and too multiplied in character, of no absorbing interest even to a mining man. By all means, no matter what individual exhibits certain mining counties may feel constrained to make, on account of local conditions, let them all coöperate in sufficient degree to bring about the splendid collective educational exhibit foreshadowed in your article.

JOHN F. DAVIS.

San Francisco, February 3.

Dear Sir—I have read with interest your recent article relative to an exhibit of the mineral industry of California. The suggestion made appears to me to be a good one, especially to attract the attention of people who know nothing of these matters and who might by this pictorial representation get a general idea of the industry. For those who are looking for investment, there should in addition be provided statistical information, so arranged and presented as to attract and hold their attention, until they become interested enough to make inquiry and obtain more definite information. This could be done by projecting on a screen pictures of dredges in operation, of hydraulic operations, stamp-mill interiors, underground flashlight pictures, mine hoists in operation, drag-line machines, washing plants, cyanide operations, oil wells, drilling, spouting, and pumping, pipe-lines, loading racks, trains of oil cars, refineries, and finished goods in packages, interspersed with statistical statements as to individual and collective outputs, profits, and details of men employed; in fact, a complete picture show, depicting all the different operations actually going on. In no other way that I can suggest, can any adequate and rapid idea be given of the nature, extent, methods, and value of the mineral industry.

S. A. KNAPP.

San Francisco, February 3.

Water in Veins

The Editor:

Sir—The letter from James F. Kemp, appearing in your issue of December 13, is so disarming that not much appears left for me to say. However, in order to complete the record I venture to point out that in my friendly protest I did not claim priority so much as recognition. I have no further quarrel with my

friend at Columbia University on the score of priority. He is deservedly welcome to it, but does that explain why he, with Messrs. J. W. Finch and W. H. Emmons, should have failed to refer to my numerous writings on this particular subject? Obviously, not. It was probably an accidental oversight, and I am content to leave it at that.

T. A. RICKARD.

London, January 21.

The Rand Banket

The Editor:

Sir—Although I have already contributed to this discussion, I shall be obliged if you will allow me to make the additional remarks contained in this letter. I have no desire to enter into polemics on the subject of priority, but the last of Mr. Horwood's articles (published in your issue of December 27) contains a passage which must call for comment on my part, since it is implied therein that my ideas on the Rand banket owe their origin to a perusal of Mr. Horwood's paper. The passage referred to is on page 1006 and reads as follows: "Since the writer has in the above papers emphasized the similarity of the bankets to ordinary gold-quartz veins—others have gradually adopted the same view; for example, Hatch wrote in 1911 as follows: 'The origin of the gold in the Witwatersrand banket has been referred to as one of the greatest riddles of modern times, but evidence is slowly accumulating to prove that the Rand banket is not a fossil 'placer', but rather that its gold has an origin similar to that of quartz veins'" ('Types of Ore Deposits').

That my ideas on this subject were not borrowed from Mr. Horwood (who came out to the Rand as my assistant in 1903 or 1904 and first wrote on the subject in 1905), but rather the reverse, will be made sufficiently clear, I think, by a quotation of the following passage from my paper on the 'Geology of the Witwatersrand' read before the Geological Society of London in 1897.*

"Examination under the microscope shows that the cementing material of the conglomerates consists of a mosaic of minutely granular but distinctly crystalline quartz. The rock is so firmly knit together by this secondarily deposited silica that, when broken, the fracture passes irrespectively through pebbles and matrix. In places the newly deposited quartz has grown on to the pebbles in such a manner as to obliterate their original margin and to produce a rock resembling a homogeneous and glassy variety of vein quartz. Of other minerals, finely divided iron pyrite is the most common, being disseminated through the matrix of the rock in fine crystalline particles; and native gold, when present, is in intimate association with this mineral. Galena, blende, and copper pyrite occur, but rarely. In the surface rocks, down to about 100 ft., the sulphides of iron are replaced by the oxides of that metal. The silicification, or more generally the

mineralization, of these conglomerates is, in my opinion, the result of secondary processes of infiltration and crystallization. It is significant in this connection that when most mineralized the conglomerates are often seamed with veins of white quartz; and there can be little doubt that these veins were formed in connection with the mineralization of the conglomerates. There is no reason for ascribing a special method of origin to the gold; and I hold, therefore, that the gold has been introduced with the pyrite with which it is in intimate association, as a part of the general process of mineralization, and I cannot agree with those authors who describe the conglomerates as deposits in which the gold was either pre-existing (alluvial gold) or was introduced contemporaneously with the deposition of the pebbles and sand."

Thus, already in 1897, not only did I point out that by intense silicification the banket had assumed the character of a quartz vein, but I also drew attention to the intimate genetic connection of the gold with the pyritization of the beds.

F. H. HATCH.

London, January 12.

The Editor:

Sir—In the *Mining and Scientific Press* for January 31, Kirby Thomas, in writing of the Rand Banket and the relations of the ore deposits on the Rand to dikes, brings out some interesting and significant facts regarding the veins at Cobalt and Kirkland Lake in Ontario. He cites various other regions within which deposits supposed to the 'unique' may conceivably have been formed in connection with the intrusion of igneous dikes and ends by asking whether such a genesis cannot be conceived in connection with the Wisconsin lead and zinc deposits. It can, but gratuitously; just as anyone can imagine for himself a rich Uncle in the Klondike. But such imaginations bring but small heritage.

Writing in 1910,¹ I summarized the objection to such a hypothesis as follows: "Their derivation through igneous agencies is excluded by (1) the known absence of any intrusive or extrusive igneous rocks of as late or later age than the rocks in which the ores occur; (2) by the presence under the area of unbroken sheets of artesian water in sedimentary beds, precluding the rising of heated solutions from depths into these beds without dissipation; (3) the absence of faults or fissures reaching down into the lower beds, an absence confirmed by the presence, as stated, of underlying artesian waters; and (4) by the positive and sufficient evidence of the origin of the ores by other agencies." Fuller details were published in the report on the 'Zinc and Lead Deposits of the Upper Mississippi Valley,'² and other papers on the region. It is to be remembered that the region is one that has been studied in much detail and in which mining and geological work have

¹'Types of Ore Deposits,' p. 100.

²U. S. Geol. Surv. *Bull.* 294, pp. 128-129.

*See *Quart. Jour. Geol. Soc.*, Vol. 54, p. 80, 1897.

been conducted for more than a century. It is also driftless and there are excellent rock exposures, so that however much we may differ as to interpretation, there should be no room for differences of opinion as to such fundamental facts as the presence or absence of igneous rocks in the region. While I recognize that evaluation of evidence is largely personal, the facts in this case have seemed to me to be singularly clear and open to but one interpretation; namely, that the ores are sedigenetic in type. Furthermore, it may be asked, why should they be considered 'unique'? To me it is as natural for a deposit of that type to be derived from the action of the agencies that produce sedimentary rocks, as for the veins at Cripple Creek, for example, to be related to a volcano.

If I had had any lingering doubt in the matter it would have been set at rest when I studied the fluor-spar deposits of southern Illinois.³ Here, in the midst of the great Mississippi Valley is a district in which veins are found that are related to igneous rocks, here evidenced by dikes of lamprophyre and mica-peridotites. The veins contain lead and zinc, as do the other and common types of deposit in the Mississippi Valley limestones, but they are different in almost every other particular. They are true veins of fissure type, fluor-spar is the most important gangue mineral, the galena is argentiferous, and in minute detail they resemble the common type of lead vein in the Cordilleran limestones. It is almost as if Nature had set this district in the great valley for the purpose of affording the exception to prove the rule. When one studies the Ozark region it is necessary to admit certain things in the general geology that point to such a possibility as Mr. Thomas suggests, but even here it is distinctly a possibility only, and the deposits link themselves in character with those of Wisconsin, which form one type, rather than with southern Illinois, the other.

The Ozark uplift is a broad, low, elliptical dome. Its northeast-southwest axis is about 300 miles long and the minor axes are perhaps two-thirds as long. The dome rises to 1000 to 1500 ft. above sea-level, roughly 500 to 1000 ft. above the surrounding country, which rises gently to the west. It is clear that no stratum concerned is competent to support such a dome, and careful physiographic studies indicate that it is in fact a warped peneplain, presumably in isostatic equilibrium with the low land around. If so, it must have been bowed up by the influx of material under it at some depth, though, if this be ordinary adjustment in the zone of flowage, the depth is probably too great to permit the influence of the material so transferred to have been felt at the surface. An alternative hypothesis is that there has been an actual introduction of liquid igneous rock under the area and in the skin of the earth; that, in fact, the Ozark uplift is an enormous laccolith. Supporting such a hypothesis is the fact that igneous rocks have in fact found their way clear to the surface, on the south in Arkansas; on the south-

west on Spavinaw creek, Oklahoma; on the east in southern Illinois and western Kentucky; and in the heart of the Ozark country in Camden county, Missouri, where E. M. Shepard some years since found a dike of graphic granite. I do not cite the igneous rocks of southeastern Missouri, which are clearly of pre-Cambrian age, while the dome, and the ore deposits which were formed after it, cannot be older than late Cretaceous, and presumably are of Tertiary age. It is true that the igneous rocks cited are by no means all of the same type, it is not even known that they show consanguinity, as J. P. Iddings has phrased it, nor are their ages certainly known. J. C. Branner was able to determine with fair certainty that some of the Arkansas dikes are of post-Cretaceous age. In Illinois others cut and coke coal beds that belong to the Carboniferous. Since the close of the Cretaceous marked a great change in the region in many particulars, it is at least logical to assume that the rocks were in the main intruded then or shortly after. At any rate the region is one within which igneous agencies were sufficiently active to cause intrusions not far below the surface and not long, geologically speaking, before the ore deposits of the region were formed. So much may fairly be said for Mr. Thomas' hypothesis.

It is one thing, however, to determine a 'might have been' and another to prove a 'was.' When search is made for definite evidence connecting the ores with the supposed igneous rocks it uniformly fails. Unless one start with the fixed hypothesis that there can be no deposits without igneous agencies being active, it is difficult to see how the evidence can be interpreted in favor of an igneo-genetic or igneo-sedigenetic origin of the ores. The deposits in content, character, and every critical detail show kinship to those of Wisconsin and just as certainly show contrast with those of southern Illinois. There is the same practical absence of silver in the galena, total absence of arsenic and antimony, and the same simple gangue of calcite and dolomite, as contrasted with the fluorite and silicified beds of southern Illinois. H. A. Wheeler has found one vein of galena in southeastern Missouri that is argentiferous, but this very fact sets it off as different from the common lead deposit of the region, and my recollection is that the evidence that it is the same age as the others, is decidedly weak.

Mr. Horwood, in his series of articles on the Rand Banket, has given detailed evidence supporting the view that the gold ores of the Rand are intimately related to the intrusive rocks. Mr. Thomas has cited facts of the same sort in connection with the occurrence of the ores of Ontario. Similar evidence is considered ample to connect the southern Illinois veins with other igneous rocks. It would seem but logical to count the failure of such evidence, against any assumption of such a connection in the case of the zinc and lead deposits of Wisconsin and of the Ozarks in general.

H. FOSTER BAIN.

San Francisco, February 2.

³U. S. Geol. Surv., Bull. 255.

Concentrates

Most of these are in reply to questions received by mail. Our readers are invited to ask questions and give information dealing with the practice of mining, milling and smelting.

Magnesite contains about 52% carbon dioxide.

Coal in the United States yields an average of 7.53 gal. of tar per ton.

If porphyry copper ore is exposed to the atmosphere it starts to oxidize.

Eucalyptus oil for flotation purposes costs 14 to 18c. per pound in Australia.

The graphite of Pennsylvania is believed generally to be of organic origin.

Crucibles used in melting materials with high melting points are usually made of 3 parts of graphite, 2 parts of clay, 1 part of sand, and smaller amounts of kaolin.

Crushing rolls have an 8% higher output per horsepower hour than does a dry-crushing ball-mill, according to Philip Argall. This advantage is materially lessened when allowance is made for the fact that the ball-mill grinds, elevates, and screens, in one operation.

Winzes or passes should be properly covered when not in use, especially if a staging has been built over them for the purpose of driving a raise. Recently in a Western Australian mine this was being done, the stage collapsed and one man was thrown down a pass and killed.

Bournonite is a lead, copper, antimony sulphide having the composition $(\text{PbCu}_2)_3\text{Sb}_2\text{S}_9$. According to F. R. Van Horn, it occurs abundantly at Park City, Utah, though its presence has been overlooked owing to its similarity to tetrahedrite, which is relatively scarce at Park City.

Speed of the 'runner' of a centrifugal pump must be in definite ratio to the height required to lift the pulp. With an excessive speed and a high peripheral velocity, the scouring effect on lining is so great, and the internal friction so largely increased, that the simple pump is unsuitable for lifts above 25 or 30 feet.

Pipes used for the conveyance of cyanide solution are liable to rapid internal incrustation, and supposed pump troubles are often traceable to this cause. In order that such piping may be easily removed for periodic cleaning, it should be laid, wherever possible, above ground; and every effort should be made to avoid cementing in of pipes in foundations or under concrete flooring.

Extralateral rights under agricultural ground can be claimed by owners of mineral claims outside the land in question, if the mineral claim was located first; not otherwise. In other words, a claimant under agricultural law takes title subject to accrued rights but with this exception he owns all the mineral under his ground. He has no right to follow outside his land any veins or lodes.

The terrestrial atmosphere consists of a mixture of gases that may be divided into two distinct classes, namely, (1) the elementary gases such as nitrogen, hydrogen, oxygen, and the gases of the argon group; and (2) the compound gases such as vapor of water, ammonia, ozone, carbonic acid gas, and others. The first group is practically a fixed quantity, but the others vary greatly.

Mica does not enjoy a free market in the United States. The large consumers have their own sources of supply or buy on long-time contract, and there is little general trade. Some sheet mica is bought for export, and clear stock in sizes 2 by 3 inches or larger can be sold to advantage. San Francisco prices range from 75c. to \$1 per pound for the minimum size, depending on the quality of the material.

The theoretically correct form for a surface condenser is one having a triangular cross-section, the steam being admitted over one of the sides, and the amount of surface exposed to the steam diminishing in proportion to the decrease in the quantity of steam to be condensed. The air and non-condensable vapors should therefore be taken off at the apex of the triangle opposite the entering steam. In this manner practically all of the tubes will at all times be surrounded by steam and will do approximately an equal amount of work; thus the efficiency of the tube surface as a whole will be increased.

Oil production of California during 1913 was greatly benefited by increased technologic developments, by which the oils were topped and dehydrated with much greater efficiency. These developments included the successful introduction of the Cottrell electric dehydration process. The adoption of the Trumble and Dyer topping and dehydrating processes, and the great advance in methods for obtaining gasoline from natural gas were among the striking achievements of the year; but while less spectacular, the economies effected by many minor improvements in the great refineries at Point Richmond, Oleum, and El Segundo contributed perhaps equally to the general problem of efficient refining. In the United States, according to the U. S. Geological Survey, there was unusual progress in many parts of the country during the year in petroleum refining, especially in the dehydration of heavy crude oils, in obtaining gasoline from natural gas and synthetically from heavy oils, and in obtaining many special products from crude oils.

Special Correspondence

BUTTE, MONTANA

NORTH BUTTE ACQUIRES MORE PROPERTY.—DEVELOPMENT IN THE NEW AREA.—ANACONDA AND GREAT FALLS PLANTS.—COSTS AT BUTTE.—BUTTE & SUPERIOR MILL PRODUCTS.

With the daring characteristic of its president, Thomas F. Cole, the North Butte Mining Co. has recently invested a large sum in the purchase of new mining ground in Butte. Over \$1,500,000 in cash, and 20,000 shares of North Butte stock is to be given for 700 acres of undeveloped mineral ground in the eastern part of the district. If the copper veins in this section can be shown to be similar in value to those on Anaconda hill, the area of Butte's productive copper zone will be greatly increased. The only developments of importance in that area are those of the Bullwhacker Copper Co., and of the Butte & Duluth Mining Co. These mines show a different kind of mineralization from that of Anaconda hill. They are east and west veins, but as a rule are small. The main zone of profitable ore formation strikes north and south along a wide fault zone, with the copper in a disseminated condition, as silicate and sulphide in the adjacent granite. This disseminated mineralization would be called porphyry ore in other copper states. It gives promise of extending over a large area and of being profitable.

An important and significant change is gradually taking place at the reduction works at Anaconda and Great Falls. Anaconda is soon to get all the concentrating ore, and the Great Falls plant will be limited to smelting first-class ore and concentrate. There are several good reasons why Anaconda should get all the concentrating ore. At Great Falls the tailing has never been saved, but is dumped into the Missouri river, there to be irretrievably lost. On this account, Great Falls has paid no attention to re-treatment of tailing, while Anaconda has been developing a leaching process which is a greatly advanced step in the treatment of copper ores. There would be useless expense in building two of these leaching plants with auxiliary sulphuric acid plants, so that the natural result has been the decision to do all the wet concentration at Anaconda. There is also a haulage charge of \$1 per ton from Butte to Great Falls on low-grade ore which is greatly reduced by shipping to Anaconda.

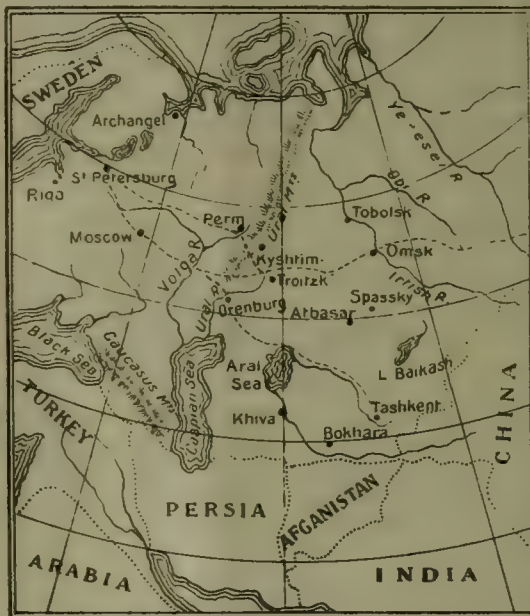
An interesting discussion concerning mining costs at Butte was recently published in *The Butte Miner*. The writer states that the Anaconda Copper Mining Co. spends \$100,000 per day in its operations. Of this, 50% is for labor, 13% for power and fuel, 8.5% for lumber and timber, 7.5% for supplies, 16% for freight, and the balances in taxes, etc. Now that all the concentrating ore is to go to Anaconda, the freight expense will be considerably decreased.

The monthly statements required of the Butte & Superior Copper Co. by the federal court make interesting reading for the metallurgist. Out of 28,758 tons of ore treated in December, 6656 tons of concentrate was recovered by oil flotation. The cost of flotation per ton of concentrate was \$4.56. The concentrate was valued f.o.b. cars, Butte, at \$23.79 per ton. The concentrate assayed 50% zinc, 2.4% lead, 0.5% copper, 1.3% iron, 2.7% manganese, 11% insoluble, 26.3 oz. silver, and 0.05 oz. gold per ton. As the gross value of the merchantable minerals in this product is about \$80 per ton at present prices, it becomes strikingly apparent that the charges and losses beyond the mill are eating up 70% of the value. No wonder that anyone with a reasonable scheme for zinc refining gets a hearing. The Minerals Separation-Hyde case is to be argued on appeal before the Circuit Court at San Francisco February 20.

LONDON

POSSIBILITIES OF MINING IN THE RUSSIAN EMPIRE.—RUSSO-ASIATIC CORPORATION'S ACTIVITIES.—THE RIDDER, SOKOLNI, NERCHINSK SILVER-LEAD-ZINC CONCESSIONS.

Amid the gloom of the London mining market shine the bright rays of the Russian activities of Leslie Urquhart and H. C. Hoover. The Russian Empire has been recognized for some time as a mining field of enormous possibilities, and it is unfortunate, therefore, that many ventures there have been failures. Two factors that make for success have usually been lacking, one being an intimate knowledge of the country, and the other the ability to apply funds to the best advantage on expert advice. In the present combination these factors are present. Mr. Urquhart having lived in Russia practically all his life and knowing the business methods and business opportunities, and Mr. Hoover being endowed with an unusual amount of financial and technological acumen.



----- RAILWAYS. BOUNDARIES.

THE RUSSIAN EMPIRE.

These two gentlemen have made a great success of the Kyshtim copper property, and are now doing the same thing for the Tanalyk, both of these being properties in the South Ural. They have done so much better than most of the English companies operating in Russia that St. Petersburg financiers have been keen to gain their assistance in connection with other properties. They therefore formed the Russo-Asiatic Corporation, 18 months ago, in partnership with Russo-Asiatic Bank, and the Banque du Commerce Privée, and have since had a great number of properties examined. Three concessions have already been obtained in different parts of Siberia, two containing zinc-lead sulphides carrying precious metals, and the other being a coal deposit. The first in order of importance is the Ridder. This concession covers 3000 square miles and is in the southern part of the Altai mountains. Here a silver-lead mine was worked from 1778 to 1863; but operations terminated on the exhaustion of the oxidized ore. It was then found that the foot-wall contained gold, so the oxidized portion was mined by open-cut and treated in primitive stamp-mills until the year 1901. Reliable reports showed that at the time the mine was closed, 98,000 tons of solid

sulphide ore was standing above water level, averaging 28.5% zinc, 13.5% lead, 1.7% copper, and \$16 gold per ton, together with 110,000 tons of ore requiring concentration, averaging 5.5% lead, 1.2% copper, and \$14.60 gold per ton. In addition, there was 42,000 tons of oxidized ore assaying \$14 gold. In order to test the continuity of the deposit, two bore-holes were put down 250 ft. apart on the strike, and calculated to intersect the lode on the dip, about 200 ft. below the bottom level. Where bore-hole 'A' cut the lode, there was first 23 ft. of solid sulphide assaying 29.2% zinc, 19.1% lead, 2.06% copper, 7.8 oz. silver, and \$17.20 gold per ton. Following this 23 ft., there was 100 ft. of disseminated sulphides, averaging, as far as assayed, 4.5% lead, 8.3% zinc, 1.4 oz. silver and \$15.20 gold per ton. After this came 122 ft. of gold ore assaying \$11.40 per ton. The second bore-hole gave equally satisfactory results. It may be legitimately assumed that 1,300,000 tons of sulphide ore is in place between the bottom level and the horizon at which the bore-holes cut the lode. The gold ore is not included in this estimate. Another property close by is the Sokoln, which appears to contain similar ore. The development of the Ridder and Sokoln mines, and the concentration and further treatment of the ore, will be in the hands of T. J. Jones, D. P. Mitchell, and R. Gilman Brown.

The Nerchinsk concession covers 8000 square miles. Here also is an old silver-lead-zinc mine, the Kadalsky. The ore is much coarser than that at Ridder, which is similar to that from Broken Hill. The sulphides of zinc and lead can be largely separated by hand, and subsequent water-concentration presents no difficulty. A drilling outfit has been despatched so as to prospect the deposit on the dip. At the Ekibastus coal deposits, which have been examined by Forster Brown & Rees, of Cardiff, there are a large number of seams outcropping. The coal is of Carboniferous age and is of high quality, suitable for household purposes, steam-raising, and coking. Several shafts had been sunk by previous owners, and the Company is now engaged in clearing the deepest workings.

The above is a mere outline intended to give a general idea of the properties and the nature of the business of the Russo-Asiatic. The directors, with exemplary frankness, tell shareholders that some years must elapse before profits will be made, as the deposits have to be tested and developed, metallurgical works erected, and means of communication improved. These will require funds, as well as time. What impresses itself upon the technologist is the extraordinary nature of the Ridder orebody, and he looks forward with unusual interest to the results obtained by development.

MELBOURNE, AUSTRALIA

FIREFLY FIELD.—A TASMANIA PROPOSITION.—AN EXTRAORDINARY PROCEEDING.—STAKING AN AREA BY NIGHT.—SULPHIDE CORPORATION.

The chief inspector of mines of New South Wales, J. B. Jaquet, has issued a report on the newly discovered Firefly copper field in the Hillgrove district. He expresses himself as "very favorably impressed with the prospects already obtained, and the discovery may lead to the opening of an important new mining field" and further states that, "the true value and extent of the deposit or deposits can only be determined after the expenditure of a considerable amount of capital, and I confidently recommend that the circumstances warrant the required outlay." According to the description he gives of the field, it is difficult of access, but this present disadvantage may ultimately tend to good, since the precipice, which now stands in the way of easy development, may lead to cheap working, by gravity tramways to the river below. Mr. Jaquet states that the field was discovered once before, as far back as 1896, when he found the copper sulphide lode then

worked, to be worth 40% copper and from 10 to 13 oz. silver per ton. Why the locality should have remained untouched till the present time is not easy to understand. Mr. Jaquet's samples of the recent discovery, which is quite distinct from the old one, give from 2 to 12% copper, 13 to 18% lead, and 2 to 14 oz. silver per ton. A galena vein gave 30% zinc, 2% copper, 19% lead, 6% iron, and 7 oz. silver per ton. As the sulphides are found outcropping in places it appears as if the one of oxidation does not extend far below the surface.

The Hercules mine, Tasmania, is once again attracting attention. This is a silver and lead property, with ore estimated to average \$38.40 per ton, but so far the metals have not been extractable. For years the mine has struggled along with little satisfaction to shareholders, and lately an arrangement was made for an amalgamation of the Hercules with the Primrose company, which was operating a mine of similar character. The proposition was to be worked by a company of 300,000 shares, of which the Hercules shareholders were to receive 120,000 and the Primrose shareholders 40,000 shares; 50,000 of the 140,000 shares for the provision of working capital, \$700,000, for the installation of a suitable smelting plant. However, the attempt to raise the requisite money in London has proved a failure. To atone for this failure, experiments made with the treatment of ore by the De Bavay process are understood to have been successful, with the result that Hercules shares, which were naturally unfavorably affected by the failure of the capital-raising scheme, have made a good recovery. Not only has the Hercules large ore reserves, but those in the Primrose are understood to total about 100,000 tons.

The Port Davey Tin Mines, recently formed in Melbourne to exploit certain mineral leases at Cox's Bight, Tasmania, is on the point of liquidation. The chairman, at a recent meeting of the shareholders, had to announce that the claims which A. E. Langford had purchased on behalf of the Company, were not after all the property of the Company, because the vendors had had no title to dispose of. The vendors, when faced with the fact that two of the leases they had sold to the Company were actually held by one Smith, with whom they had had no dealings, maintained that the holder of the leases was a man named Bryant, and that it was from him that they had obtained the option they had passed on to the Company. They were unable to produce any document to show Bryant's ownership; and yet there seems to have been no difficulty in forming the Company. But, most astounding fact of all, the directors resolved to offer the vendors the sum of \$1000 to cancel the contract. That is to say, they are offered \$1000 to cancel an agreement their part of which they are unable to fulfill. Any way the matter is viewed, the directors, Langford, and the vendors are greatly to blame, and it is the innocent shareholders who have to pay, and to pay moreover to those who are to blame perhaps most of all. Even before this debacle was made public, there had been a sensation in connection with the property. An application was made to the Tasmanian mines department for the granting of a lease between two of those held by the above mentioned Smith, the application being made by a man named Cummings, who was acting as an agent for Langford. To this application an objection was entered by Smith on the ground that the claim had not been staked as stated. Cummings asserted that his pegging was done in the dark, without the knowledge of those who were with him. As this necessitated a tramp of four miles over some of the roughest and wildest country in the state, the objector held that the performance was impossible, and as the mining magistrate who heard the case agreed with him, the application was refused. But another interesting question arises out of this: was this central block, which was, or was not, staked in between two blocks supposed to be held by the Port Davey Tin Mines, to be retained by Langford for himself or to be handed over to the Company? The whole affair is not likely to advance the cause of mining.

During the year ended June 30, 1913, the Central mine at Broken Hill produced 211,593 tons of ore, of which 210,440 tons was treated, yielding 32,295 tons of concentrate averaging 67.2% lead, 6.3% zinc, and 33 oz. silver per ton. The flotation plant produced 71,394 tons of zinc concentrate assaying 43.7% zinc, 10.3% lead, and 17.1 oz. silver. The smelter, near Newcastle, treated 53,285 tons of concentrate yielding 13,410 tons lead, 53,642 oz. gold, and 1,112,265 oz. silver. The gold came from custom ores. Ore reserves total 2,352,000 tons. Net

of the rather high-cost producers of copper, but has a vigorous life before it yet.

The fire which destroyed the sampling plant of the First National Copper Co. is another item added to the bad luck which has attended the experimental development of the Hall process at the smelter. This is rather typical, however, for it is rare that a new process does not have to contend with many difficulties which are entirely foreign to the process, but which often serve to condemn it. Word from the plant is that the process itself is giving entirely satisfactory results, but that the operating costs are higher than was at first estimated.

Word from Butte is to the effect that B. B. Thayer, president of the Anaconda Copper Co., has asked the board of directors to authorize the construction of a 2000-ton leaching plant, to use the process devised by Frederick Laist. The plans for the plant have been drawn for some time, but the management has been waiting for the results of further experiment before beginning construction work. The most important point is where to draw the line between wet concentration, followed by smelting, and leaching. The most expensive work in concentration is the regrinding and handling of the fine material, and the coarser the copper-bearing material can be handled the better, so far as the plant required for wet concentration is concerned. However, throwing a larger tonnage on, the leaching plant will require additional capacity there, and the problem

is to find the exact line of separation which will correspond to the lowest working cost, including the interest on the cost of equipping the plant.

The Guggenheim Exploration Co. has issued its annual report, showing a net income of 16.13%, a slight increase over last year. No very important changes in the investments are recorded, except an increase of 33,100 shares of Ray Consolidated stock. The total assets of the Company are given as \$45,000,000, with a surplus of \$24,811,340. It is interesting to notice that the Exploration company does not hold any Braden or Chile Copper Co. stock, in spite of the close relation between the organizations. The Braden continues to show an increase in its output and is now producing at the highest rate in its history. The Utah Copper has given out its report for the fourth quarter of 1913, showing an output of 23,884,467 lb. copper at an average cost of 9.987c. per pound. The average assay of the ore milled was 1.2165% copper, 2,113,080 tons having been milled during the quarter, of which 56% was treated by the Magna plant and 44% by the Arthur. The stock of unsold copper on hand December 31, 1913, was 39,854,993 lb. The amount of stripping removed during the year was 4,835,489 cu. yd. E. A. Wall has filed suit for \$12,000,000 damages against the Company, asking \$2,000,000 for the surface rights to his properties which have been covered by waste, and \$10,000,000 for the claims which have been buried under waste. The Utah company would feel lonesome if Mr. Wall were not tilting against it, however. The Nevada Consolidated, in its report for the fourth quarter, shows a decrease in operating cost, having produced 16,684,955 lb. copper at a cost of 8.63c. per pound, from 833,989 tons of ore averaging 1.53% copper. The Company has on hand 27,916,946 lb. copper. Of stripping, 982,689 tons was removed at a cost of \$308,519, of which \$171,272 was charged to operating cost and the rest deferred.



RESIDUE DUMP AT THE CENTRAL MINE, BROKEN HILL, NEW SOUTH WALES.

profits were \$1,340,000, and \$940,000 was paid in dividends. C. F. Courtenay is general manager, James Hebbard mine manager, and P. S. Morse metallurgist.

NEW YORK

UNITED VERDE COPPER CO.'S NEW SUBSIDIARIES.—FIRST NATIONAL PROPERTY.—LEACHING AT BUTTE.—GUGGENHEIM EXPLORATION HOLDINGS.—UTAH COPPER AND NEVADA CONSOLIDATED.

The most interesting news of the week is that the \$3,000,000 United Verde Copper Co. is to be 'unscrambled.' The Company has only two dozen shareholders, being closely controlled by W. A. Clark, its shares are rarely traded in, and but little information about the output or technical operations of the Company are ever given out, it being still in the dark ages in this respect. The newly fledged legislature of Arizona has been displaying its energy by passing some futurist laws on taxation and other subjects. For this and other reasons, the sum of the activities of the United Verde are to be dissociated, and the business which is not directly connected with mining and smelting is to be placed in the hands of four new companies: the Verde Tunnel & Smelter Railroad, \$450,000 capital, to construct and operate the railroad from the mine to the new smelter; Clarkdale Improvement Co., \$1,500,000 capital, to develop the townsite at the new smelter; Upper Verde Farm & Orchard Co., \$175,000, to own and manage the farm and orchard lands; and the United Verde Public Utilities Co., \$250,000, to handle the water, lighting, and sewer systems at Jerome and Clarkdale. The stockholders of the United Verde have been offered the opportunity to subscribe for these shares, pro rata, at par. Mr. Clark took hold of the mine in 1888, and it has since developed into one of the best known mines in the world, having paid over \$30,000,000 in dividends. In its present stage it is one

LEAD, SOUTH DAKOTA

NEW EQUIPMENT AT THE HOMESTAKE.—WASP No. 2.—A MILD WINTER IN THE BLACK HILLS.—THE MINNESOTA, GOLDEN CREST, TITANIC, AND HIDDEN TREASURE.—OIL AT ARDMORE.

Extensive plans for improvements have been arranged by the Homestake Mining Co., expenditures for which during the present year will probably total \$350,000. Among these will be a plant containing six 600-hp. boilers, equipped with superheaters. The site chosen is close to the Northwestern railway, where good facilities are offered for delivery of fuel. Experiments will be made with oil fuel. Should this fuel be adopted it will be the first application in the Black Hills mines. Steam from this plant will be used to operate an electric-generating station and a new hoisting engine at the B. & M., formerly known as the Old Abe shaft. The electric plant will be used as an auxiliary to the Spearfish hydro-electric station. It will have a normal capacity of 3200 and a maximum, for short periods, of 4800 hp. The new hoisting engine will have a capacity of 3000 ft., and will be the best on the property. Contracts have been let for this machine, and delivery will shortly commence; and it is hoped to have it in operation before the end of the current year. The shaft is now 1500 ft. deep, has five compartments, and is equipped with a complete electrically driven pumping system. The new engine will make it one of the most important ore-hoisting shafts on the property. The machinery for the three plants mentioned will cost about as follows: boiler plant, \$100,000; electric station, \$45,000; and hoist, \$75,000. In addition the buildings will cost about \$130,000.

The Wasp No. 2 is working practically at normal capacity, producing nearly 500 tons of ore per day. John Gray has resigned as general manager, his health necessitating the action, and he has been succeeded by Edward Manion, one of the best known mining men in the Black Hills. C. E. Brenner, for several years mill superintendent, has also resigned on account of poor health, and Ray Craig is in charge of the plant.

Salubrious weather has marked the winter season in the Black Hills. Up to January 20 the snowfall at Deadwood had been only 5 in. for the season, with none lying on the ground at that time. The coldest night reported was 2° below zero. Many nights in December and January were recorded when the thermometer was well above the freezing point. This weather has been of great benefit to the mining industry, permitting of outdoor and construction operations on a scale greater than for years past. At the Wasp No. 2, Bismarck, Homestake, and other properties, where considerable open-cut mining is done, conditions have been ideal for the work. At the Mogul and Rattlesnake Jack, construction on the mills and about the mines has been pushed almost as during the summer. Other properties report greater activities than would have been possible under adverse conditions; and all operators are praying for a mild winter.

Dewatering the 200-ft. shaft of the Minnesota property, at Maitland, is proceeding under the direction of Joseph Kellar. At the 70-ft. level a connection is made, by adit, with the surface, and the 100-ft. level is above water, where the ore was followed upward on the dip. The 200-ft. level contains extensive workings and will require some little time to drain. Preparations are being made to start further development as soon as the water is removed.

F. W. Bird and associates have secured title to the Golden Crest property, in the Galena district, and state that the property will be in full operation in a few months. The title was secured upon judgment for \$120,000, against the Detroit interests in the Company, who failed to redeem within the time granted by law. Litigation started about the time the mill was completed, and as a result the plant, which contains 40 stamps, and is one of the most modern and thoroughly

equipped in the Black Hills, has never turned a wheel. Bird and associates have done some development, and report having uncovered a large body of ore at the surface, which, while low in grade, they state will pay if handled in large quantities by steam-shovel mining methods. On the lower levels are some bodies of good grade milling ore.

Sinking is going on rapidly at the Titanic property, at Carbonate, the shaft now being 190 ft. deep. It is the present intention to go to 300 ft. before further crosscutting is undertaken. Ingersoll Rand jackhammer drills are being used in sinking, and are giving good results.

Encouraged by the results of work done in an adit west of the shaft last summer, the Hidden Treasure company, owning property on upper Deadwood gulch, has decided to sink the shaft an additional 200 ft., and at that depth do some lateral



DRILLING FOR ORE AT ARDMORE, SOUTH DAKOTA.

work. The property is equipped with a gasoline-driven hoist and compressor, air drills, pumps, etc. Banks Stewart, of Deadwood, is general manager for the Company.

The Continental Copper Co., near Hill City, has just completed the installation of a big Goulds Manufacturing Co.'s electrically driven triplex pump on the 700-ft. level. The machine, complete, weighed 23,000 lb., and was put in place with little difficulty. The shaft is 800 ft. deep, is to be sunk 200 ft. farther, and the pump will later be removed to the 1000-ft. level.

Well No. 1 of the Ardmore Oil Co., at Ardmore, was 1100 ft. deep on January 19. Progress lately has been rather slow, owing to encountering some hard strata dipping to the southeast, which deflected the drill. The hole is still being carried down with a diameter of 12½ in. It is expected that the Dakota sandstone, the most likely formation for containing oil, will be cut at a depth of about 1700 feet.

JOPLIN, MISSOURI

ZINC AND LEAD PRICES.—DRAINAGE OF A FAMOUS OLD DISTRICT.

—RUSH FOR LEASES TO NEW SHALLOW-MINING DISTRICT.—

GEOLOGICAL WORK.—NEW MILLS.—PUMPING AND DRILLING WORK.

The zinc and lead ore markets are stronger than they have been for several weeks, producers of both ores finding a ready demand at fair prices. The large tonnage of spelter on hand at the various smelters has a tendency to lessen the demand for ore. However, as the smelters are reported to be operating at about 75% capacity, they are in the market for about 5000 tons of zinc sulphide ores per week at prices ranging from \$40 to \$43, basis of 60% metallic zinc, while

the higher grades bring as high as \$46 per ton. Spelter at East St. Louis is quoted at \$5.20 per 100 lb. In the corresponding week of 1913, blende brought \$44 to \$48, basis, with choicer grades selling for as high as \$51. Spelter was then quoted at \$6.40. Calamine is selling for \$20 to \$22, basis of 40% metallic zinc, with top grades bringing up to \$26. Lead ore brings \$50, and pig lead at East St. Louis is quoted at \$4.05. In the corresponding week of 1913, calamine brought \$24 to \$26, basis, with top grades selling for \$30. Lead ore brought \$53, basis of 80% metallic lead, and pig lead was quoted at \$4.225. Despite the apparent strength of the market a year ago compared with the offerings of today, the demand at that time was on the decline and prices were dropping steadily. In a single week's time zinc sulphide ores had dropped from \$54 to \$56, basis, to \$44 to \$48, basis.

Prior to pumping operations, which have been started in Lone Elm 'bottoms,' this old mining region remained virtually idle for about 15 years. The Schoenherr Development Co. has acquired leases on the Granby Mining & Smelting Co.'s land, and the Picher Lead Co.'s land, the property being situated in a long valley, in the northwest portion of the city of Joplin. It was once the scene of many rich finds, both zinc and lead sulphides being produced. As the residential portion of Joplin gradually extended northward, it was found that the constant pumping in Lone Elm caused more or less inconvenience to property owners in the residence districts, as the removal of water from old drifts of mines worked in the early days caused several cave-ins. As much of the north part of the city thus effected was in danger, pressure was brought to bear against the operators in Lone Elm and work was stopped. Several years ago pumping was again started, and as a result the ground beneath the beautiful Congregational church, constructed of sandstone, gave way and the church had to be removed to another property. One big residence, in an exclusive residence portion, narrowly missed being swallowed by a gaping cave in that opened over night beneath its foundations. Numerous other smaller cave-ins occurred. Again pumping operations were stopped. The present Company has progressed with success and no cave-ins of importance have been reported, although the water has now been lowered to a depth of 125 ft. The richest bodies of ore occur at 100 to 120 ft., and as the ground has been cut to a limited extent, a heavy production of concentrate can be expected from this area. Plans are already on foot for the construction of several large concentrating plants.

A tent city has sprung up in the Cedar Creek district, 10 miles south of Joplin, and scores of prospectors are flocking to a region where recent discoveries of calamine and carbonate of lead have been made from shallow levels down to 70 ft. At some places the ore is found in outcrops, and prospectors are clearing from \$50 to \$150 per week each in cleaning these low-grade products for the markets. The bulk of the work is being done on the McAntire farm, the Butts property, and the German-American Mining Co.'s land. On the Scherl farm, 1½ miles distant from this field, lead and calamine have been discovered at shallow levels in drilling, while in deeper prospecting good zincblende is shown. Along Cedar creek, which, prior to a few months ago, traversed a remarkably secluded country in which little mining was undertaken, more than a dozen wash places have been started, while many other prospectors are selling only their 'chunk' ore and are keeping their fine 'dirt' for future cleaning. The mines of this immediate vicinity are now figuring conspicuously in the weekly production of ore, and a still larger increase may be looked for.

The Missouri Geological Survey plans to establish offices in Joplin with the view to getting more detailed information on mining conditions. The Survey is trying to work in co-operation with mining men and prospectors, and is meeting with encouragement from some of the larger companies. The

plan is to keep complete drill records from as many portions of the district as possible, and also gather other information concerning geological formations, mining practice, and so forth. The importance of a knowledge of geology in relation to zinc and lead development is beginning to be more greatly appreciated than ever before, especially by the old-timers, who formerly were wont to scoff at anything that hinted of scientific methods in mining.

Two large new concentrating plants in the West Joplin field will begin operations in the near future. One is the Arco Mining Co., equipped with a large mill of 200 tons daily capacity, situated on the Connor land at Central City, due west of Joplin. The other is that of the Dundas Mining Co., situated on the Connor land at Chitwood, northwest of Joplin. In the latter mine some of the highest grade zinc-blende found in the district is mined, assays having shown the concentrate to carry as high as 64% metallic zinc.

Work is now well under way at the Lennan mine, North Miami, Oklahoma, where pumps are draining the ground to a depth of 320 ft. This is the deepest work in the entire Missouri-Kansas-Oklahoma district, and one of the largest pumping plants in the district is employed. The deep ground contains lead ore that is exceptionally high grade, as much as 84% metal, and thus commanding \$4 per ton above the ordinary basis settlement paid for 80% ore.

The Co-operative Prospecting Co., a subsidiary company of W. M. Sheridan & Co., has recently acquired a lease on the Schifferdecker land in West Joplin, and has begun drilling operations on the tract formerly mined by the Alice of Old Vincennes Lead & Zinc Co., and later by the Abigail Mining Co., both of which companies operated large concentrating plants. In addition to this lease, the Co-operative company has been developing tracts in various other portions of the district. Following this prospecting work, which has resulted in two or three encouraging properties being opened, new concentrating plants will be erected in the near future by companies which have taken subleases on the lands thus prospected.

PEARCE, ARIZONA

COMMONWEALTH MINE AND MILL.—THE PEARCE DISTRICT.—COMMONWEALTH EXTENSION.

The recently completed stamp-mill at the Commonwealth mine is at present treating from 275 to 300 tons per day, and improvements are contemplated to increase the capacity and improve the results at present being obtained. Betterments include increased tube-mill capacity and the perfection of minor details in the mechanical handling of the mill production. Diaphragm pumps are being substituted for the air-lifts on the Dorr thickener discharge, and screw feeds are to be substituted for the present spiral feeds of the tube-mills. The Oliver filter-plant has recently been overhauled and satisfactory results are being obtained from this department. The mine is in good condition, and a large tonnage of ore is at present developed and in the stopes ready for extraction by the shrinkage method of mining, which is being employed. The one-man drill is being used entirely and with excellent results. The present workings extend only to a depth of 350 ft., and ore is being mined through an inclined shaft and hoisted by means of 3-ton skips. The present development is entirely in the oxidized zone, and the indications are that the sulphides will not be found until great depth is attained.

A number of prospects are being developed in the Pearce district and some with a great deal of promise. Active operations will be commenced on the Commonwealth Extension soon. At the Johnson property development work has opened a good sized orebody and shipments are being made, the company at present employing ten wagon teams for transporting ore from the mine to Cochise for shipment.

General Mining News

ALASKA

FAIRBANKS

The underground dredge, owned by the Tanana Mines Excavation & Manufacturing Co., is to be tested in some ground at the lower end of Fairbanks creek. The gravel here is about 65 ft. to bedrock, and the machine will be erected at the shaft bottom. It is hoped to reduce mining costs by 66% with the apparatus, although on Cleary creek it did not work satisfactorily, the ground being very hard. John Beck, the designer and maker, is in charge.

VALDEZ

For the construction of a wharf and ore-bins at the foot of Solomon gulch, the Grauby company of British Columbia, which owns the Midas mine in Solomon basin, is calling for bids for 38,000 ft. of piling. It is expected that over 300 men will be employed on the property during the summer.

Development at the Nelchina district is promising, and there are 250 men and 3 women in camp, according to Angus McDougall, of Fairbanks. He has ordered a 5-in. Empire drill to prospect the wet ground on his claims. Griffith brothers have an option on three claims on Crooked creek for \$9000. A 9-in. drill is working. A new discovery of good gravel is reported from Dublin gulch, 18 miles from Crooked creek. Bedrock on Shovel creek was 40 ft. deep. From Crooked creek to Copper Center takes two days, and from there to Valdez, another four days, over good trails.

ARIZONA

A bill is to be discussed before the state legislature at Phoenix, concerning the non-employment in mines of any person who does not understand the English language. Petitions from Gila county contain enough names to place the measure before the voters at the election next November.

COCHISE COUNTY

On February 2, the Calumet & Arizona smelter beat all previous records, for the old and new plants, by treating 400 tons of ore and 250 tons of converter products, the metal output for the day being 324,000 lb. of copper. The new smelter consists of receiving bins, a 200-ton per hour crushing and sampling plant, an ore bedding and conveyor system with a holding capacity of 60,000 tons, a roasting plant of twelve 21½-ft. Herreshoff furnaces, two 40 by 48-in. blast-furnaces, four 19 by 100-ft. reverberatory furnaces, and Great Falls type of converters.

GILA COUNTY

The Ray company, at its mill at Hayden, has just completed the construction of a long flume to carry tailing from the mill to more available ground. The company owns the entire valley land from Hayden Junction to Winkelman, a distance of about four miles, which is being used for depositing the tailing. The old system of allowing it to run down through cañons is now being replaced by the system of flumes so that the tailing can be carried farther away and allow the land there to be covered up and then filling up gradually back toward the mills. The plant is treating 8000 tons of ore per day.

(Special Correspondence.)—About 7000 ft. of development was done in the Inspiration mine in January, and 9000 tons of ore was sent to the flotation plant. Connection between the Colorado and Incline shaft, at 600 ft., should be made within 60 days. This will aid work on the Colorado orebody. On account of a slide in the Geneva railroad cut, between the millsite and the Inspiration camp, the test mill was shut down until the débris was cleared away. Practically

all steel is in place for the crushing plant, and riveting will soon be started. Grading for the smelter site is finished.

Miami, February 7.

(Special Correspondence.)—The Iron Cap mine shipped 16 cars of ore in January. A night shift is now employed, and the country on the 800-ft. level westward along the main vein is to be prospected. About 500 ft. west of the shaft the vein has been faulted, and what is known as the cross-faulted area is to be explored. Good progress is being made on the 1300 and 1400-ft. levels of the Arizona Commercial, and within 30 days the vein should be cut on the latter level. Water at 1200 ft. is the reason that the two lower levels, which are dry, are being opened first. At the Superior & Boston, the vein has been reached by the cross-cut on the 1000-ft. level. Lessees are busy mining ore from three different areas of the mine.

Globe, February 7.

GREENLEE COUNTY

Five per cent copper ore has been opened in the claims of the Keating Copper Syndicate, near Metcalf. At a depth of 250 ft. the vein is 18 ft. wide. Two shafts have been sunk and drifts driven from them. English capital is interested in the property.

PINAL COUNTY

An unaccountable explosion at the Carney mine, near Ray, destroyed the machinery and a house on February 3. Nobody was injured. There has been a bad feeling among the miners of the district of late, and this explosion is supposed to be due to that.

MOHAVE COUNTY

Litigation concerning the Frisco Gold Mines Co.'s property has been settled, and the superintendent, James A. Roberts, has recommended the erection of a 500-ton mill. An air-compressor, pumps, and drills are being installed at the Telluride mine, at Oatman. The 200-ft. level is opening well.

MARICOPA COUNTY

A bond has been secured on the old Vulture tailing dump, 16 miles below Wickenburg, on the Hassayampa river, by M. B. Lauzon, John Perry, and J. F. Powell. The tailing contains from \$1 to \$5 per ton, and probably a 100-ton cyanide plant will be erected.

SANTA CRUZ COUNTY

The World's Fair mine was valued at \$155,000 by the tax commission of the state of Arizona, and \$7000 was collected in taxes. Frank and Josephine Powers questioned the validity of the mine tax law, but have been defeated in two courts.

YAVAPAI COUNTY

Mining in the Walker district is quite encouraging at present. The Lambertine and Eureka mines are opening good ore-shoots. A head-frame, hoist, and pump are being installed at the Poorman.

CALIFORNIA

California mine operators desiring to take out working-men's compensation insurance with the state, can obtain blank forms and full particulars from the treasurer or the clerk of any city, town, or county in the state.

INYO COUNTY

Lessees at the Cerro Gordo mine, at Keeler, have opened a large orebody on the 700-ft. level. A drift is being driven at 200 ft. to cut this shoot. About 25 tons of ore containing 110 to 125 oz. silver, 10% lead, and \$1 gold is being shipped daily. Zinc ore is not being shipped, pending development of the new orebody. Thirty men are employed.

PLACER COUNTY

The dredge of the Eldorado & Placer Counties Gold Mining & Power Co. is ready for work, this making the third boat on the middle fork of the American river. This Company will dredge the river from Poverty flat to Oregon bar,

a distance of two miles. Keystone drill tests show the gravel to contain good gold content. Just below this point, the Pacific Gold Dredging Co.'s boat is working on the Mammoth bar.

SAN BERNARDINO COUNTY

Production of potash from Searles Lake is now expected to begin in April, by which time the American Trona Co. anticipates having the first unit of its plant in operation. This will be a small pilot plant, of about 1% of the capacity of the main works. It will be used to determine the proper slope of the dryers and similar facts necessary to large-scale economical working. The Trona railroad has been graded to the works and about 20 miles of rails are laid. Part of the new town of Trona has been built and material is being rapidly delivered. To haul in machinery and supplies, auto-trucks are employed to supplement mule-trains. In part, the work is by contract, \$3.33 per ton over 27 miles of desert road, and in part a big Peerless truck belonging to the Company is employed. A Renard locomotive, hauling a train of small cars, is also used. This engine runs on heavy steel wheels at the rear, but has ordinary rubber-tired auto wheels in front. About 20 tons per load is hauled, and satisfactory service has been maintained for more than a year.

SHASTA COUNTY

Experiments are to be conducted at the Noble electric smelter, at Heroult, by R. C. Palmer and C. S. Smith, of the Forest Service, to see what can be done in the way of producing by-products from the distillation of California woods. In the meantime the smelter has been temporarily shut down during the changing of graphite for carbon electrodes. Since early in December about 3000 tons of iron has been made.

SIERRA COUNTY

There are 600 men working for wages in the gold district of Sierra county this winter. About 150 of these are em-



MAP OF SIERRA COUNTY.

ployed about Alleghany, followed by Sierra City, Pike, Forest City, Downieville, Howland Flat, Scales, and Brand City. By July 1, at least 1000 men are expected to be at work underground. Two shifts are working in the Claybank mine near La Borte. The old adit, 6500 ft. long, is being repaired and will be used for drainage. Both the Sixteen-to-One and Occidental mines, near Alleghany, are developing satisfactorily.

SISKIYOU COUNTY

The Sugar Pine hydraulic mine, in Selad valley, near the

Klamath river, is working full time. Water is secured from Selad creek, and goes to the monitors through 5½ miles of flume, and a half-mile of 11 to 20-in. steel pipe. P. R. Kelsey is manager. In the Forks of Salmon district, hydraulic elevators are busy at the Michigan Salmon, Forks of Salmon, Bennett, and other gravel properties. A soft quartz vein formation is being sluiced on the Noonung estate on the Scott river. Rich pockets of gold are occasionally found. There is plenty of water for hydraulic mining in the county.

TRINITY COUNTY

The Lagrange company's siphon has been repaired, and hydraulicking is being done day and night. It is said that gold returns will amount to \$1000 per day. Water is in abundance.

TUOLUMNE COUNTY

Work is to be started at once at the Corbin mine, near Jamestown, and the shaft will be sunk 200 ft. Jesse P. Mangante is superintendent of the Jamestown Exploration Co., which owns the property.

COLORADO

LAKE COUNTY (LEADVILLE)

The tonnage of ore from the Yak tunnel during January was up to the average. Zinc sulphide is being shipped from the White Cap stopes, and some high-grade silver ore from the lower levels of this mine. A large tonnage is being mined from the Cord. From the Vega and Diamond ground, at the breast of the tunnel, some lead ore is shipped. Sulphide ore, containing silver and lead, is being extracted from the Louisville, Iron hill, and is sent out through the Yak tunnel.

TELLER COUNTY (CRIPPLE CREEK)

January gold yields from the district mines are estimated as follows:

Plant and location.	Tonnage.	Val per ton.	Gross val.
Golden Cycle, Colorado Springs.	36,600	\$20.00	\$ 732,000
Colburn-Ajax	10,000	20.00	200,000
Smelters, Denver and Pueblo...	4,300	55.00	236,500
Cripple Creek:			
Portland	15,500	3.00	46,500
Stratton's Independence	9,963	2.96	29,490
Colburn-Ajax	4,800	5.50	26,400
Kavanagh-Jo Dandy	1,700	2.15	3,655
Wild Horse	1,200	3.68	4,416
Gaylord-Dante	1,100	3.50	3,650
Isabella mines	750	3.00	2,250
Rex M. & M. Co.....	300	2.25	675
Total	86,213		\$1,285,536

Dividends totaled \$176,185, paid by the Golden Cycle, Portland, Vindicator, and Mary McKinney companies. Over 4000 tons of ore was shipped from the Elkton mines during the month.

During January the Vindicator produced nearly 3000 tons of ore, of which 1800 tons of \$30.75 ore was mined by the company.

Four feet of rich ore is being opened at 400 ft. in the Ajax estate, Block 13, and returns from two carloads were \$40 and \$70 per ton, respectively. B. Colburn is superintendent. The flow of water from the Roosevelt drainage tunnel is 7480 gal. per minute, an increase over recent measurements.

IDAHO

ELMORE COUNTY

(Special Correspondence.)—The Overlook Mining & Development Co. is operating gold-bearing claims near Atlanta. About 3500 ft. of underground work has been done to a depth of about 700 ft. The property is being thoroughly developed before installing a plant. During next summer a

Stamp Joshua Hendy mill, with quadruple discharge, will be used for testing the ore. Nell Campbell is general manager. Atlanta, January 28.

NEZ PERCE COUNTY

(Special Correspondence.)—A cyanide plant is to be erected at the Jumbo mine, near Lewiston, in the spring. Mr. Buerlocher is manager of the Jumbo Mining & Milling Company. Greencreek, January 26.

SHOSHONE COUNTY

There are two parallel veins in the Interstate-Callahan mine; one contains lead and silver, and the other zinc with a little lead. The zinc lode has now been opened for 800 ft., showing 8 to 12 ft. of shipping ore, but in places it is from 20 to 40 ft. wide. The mill is working at full capacity producing clean lead and zinc concentrates. A cross-cut in the Virginia has cut the vein. During January the Stewart Mining Co.'s net earnings were \$78,000, against \$22,000 for the same month of 1913.

The annual meeting of the Tamarack & Custer Consolidated Mining Co. was held at Wallace on January 28. Nothing of importance transpired. Ore shipped in 1913 was worth \$366,071. The cash reserve is \$64,610, and ore and concentrate worth \$20,000 is in transit to the smelter. Improvements cost \$57,000, and \$40,000 of indebtedness has been liquidated. Jerome J. Day is general manager.

Ore and concentrate shipments from 15 Coeur d'Alene district mines in January totaled 41,000 tons. The Marsh mine is now treating 150 tons of ore per day.

MISSOURI

JASPER COUNTY

According to the annual issue of the *Joplin News Herald*, the value of zinc and lead ores from the Missouri-Kansas-Oklahoma district from 1830 to 1913, inclusive, was \$255,530,078. Of this, approximately \$150,000,000 is the production of the last 10 years, that of 1913 being \$14,356,461.

ST. FRANCOIS COUNTY

(Special Correspondence.)—Litigation over the St. Joe-Doe Run lead companies is evidently not to be immediately ended. On January 29, Justice Cardozo of the New York Supreme Court dismissed the action of Robert Holmes, who sought to restrain the St. Joseph Lead Co. from borrowing \$2,500,000 from White Weld & Co., and Smith Moore & Co., and at the same time paying a 4% dividend. Holmes contended that the price paid for the loan was excessive and that if the dividend were not paid it would be unnecessary to borrow. The court held that the directors had not exceeded their authority in contracting for the loan, but declined to pass upon the point whether the directors might not be enjoined from paying a dividend. Mr. Holmes declares that he will carry the fight further and states that with the exception of one or two departments the business of the companies is being poorly conducted, principally because there is no resident head. At the recent stockholders meeting Mr. Holmes and his friends voted 30% of the stock.

St. Louis, January 31.

MONTANA

Seventeen 3.25 and 4-ton locomotives have been ordered by the Anaconda Copper Mining Co. from the Westinghouse Electric & Manufacturing Co. for underground haulage in its various mines. The mining company has in the past preferred the standard steel-plate construction of locomotive, sometimes referred to as the armor-plate design. However, about a year and a half ago one of the subsidiary companies purchased, somewhat in the nature of an experiment, three open-frame bar-steel locomotives. These locomotives have been in constant service ever since they were installed, not requiring any mechanical or electrical repairs with the exception of the renewal of the brake shoes. On the strength of this

performance, the Anaconda company decided last summer to purchase five 4-ton bar-steel frame locomotives with commutating-pole motor equipment for certain surface haulage. The operators found this type of construction so satisfactory that it was specified on the order mentioned. Each locomotive will be equipped with two 11 hp. commutating-pole motors, representing the latest advance in mining locomotives for narrow-gauge haulage.

NEVADA

The new Nevada Safety Commission, appointed on February 6, to continue the work of the Safety First Conference held at Reno during the last week of January, consists of the following members: Tasker L. Oddie, governor of the state; L. L. Ricketts, editor of the *Reno Gazette and Goldfield News*; W. B. Alexander, secretary of the Mine Operators' Association; G. A. Bartlett, ex-congressman and attorney general for the Pacific Power Co.; H. A. Lemmon, industrial agent for Truckee River General Electric Co.; W. E. Wallace, legislative agent for the Brotherhood of Railroad Trainmen; E. Ryan, state mine inspector; J. J. Mullen, secretary of the State Industrial Commission; and J. G. Scrugham, professor of electrical engineering at the University of Nevada. The formation of this commission was suggested by Mr. Mullen on the last day of the Safety First Conference.

ESMERALDA COUNTY

An air-compressor of four 2¼-in. machine-drill capacity has been ordered for the Silver Pick mine. At the 500-ft. level a triplex 5 by 12 in. electrically driven pump of 200 gal. capacity is to be installed. Walter S. Norris is superintendent. A drift has been started in the incline raise, above the 359-ft. level of the Florence, to determine the extent of the rich shoot. Ore on the 500-ft. level of the Sandstorm-Kendall maintains its value. The pump is working well, as is also a new air-compressor. Development in the Vernal is encouraging. The Jumbo Extension shipped 1183 tons of ore in December worth \$12,322. The Bonne Claire mill treated 1080 tons, yielding 83 tons of concentrate worth \$10,766 net. The month's profit was \$11,058. A system of reconcentration is being tried in the mill. This involves pumping the concentrate, after it has passed from the lower tier of tables, to the upper Deister tables below the second batteries.

MINERAL COUNTY

At the bottom of a shaft in old workings of the Aurora mine, which have been unwatered, there is an 8-in. vein assaying from \$700 to \$3125 in gold per ton.

NYE COUNTY

The Tonopah Extension Mining Co. reports that the December output was \$34,694, and current expenses \$42,753. A large amount of development is being done, and the grade of ore treated in January showed an improvement. The mines at Tonopah produced 11,563 tons of ore worth \$276,370 during the week ended February 7. The Tonopah Mining Co. has taken an option on a property in Nicaragua. At the annual meeting of the Manhattan White Caps Co., the proposed amalgamation of this Company, the Associated Milling, and White Caps Leasing companies was discussed, and it was decided to have a valuation made of the respective properties for this end. John G. Kirchen stated that the White Caps refractory ores can be treated.

WHITE PINE COUNTY

The State Railroad Commission has ordered reductions in freight rates on black powder, pig iron, and ore and concentrates carried by the Nevada Northern railroad. The reductions amount to 7c. per cwt., 19.5c. per cwt., and from \$1 to \$3.50 per ton respectively.

NEW MEXICO

SOCORRO COUNTY

A new orebody, assaying \$17 to \$25 per ton, has been opened

Hill mine to Perth Amboy, New Jersey. From 14 to 16 in of ore is being mined at a depth of 45 feet.

The Dome mill, at Porcupine, treated 500 tons of ore during one day of the last week in January. Good progress is being made on the additional 40 stamps and treatment plant. In new ground, the diamond drill working on the 425-ft. level has cut two new shoots in the Hollinger mine. The ore is of good width and grade. Two new air-compressors have been ordered. Thirty-eight machine drills are used at present. There will be an air-chamber underground for the new plant. The additional 20 stamps are being steadily erected.

YUKON

The mining recorder at Mayo states that the district is promising. A Keystone drill is still working at Duncan in hard gravel. The silver properties open well, and the first load of ore has been delivered at Mayo. The owners intend shipping 100 tons this winter to go out to a smelter in the spring. The galena ore has given assays from 144 to 1327 oz. per ton.

KOREA

The Seoul Mining Co., operating the Suan concession in Whang Hai province, reports the following results for January 1914:

Stamps working	40
Time, days	29 1/4
Ore crushed, tons	5940
Total recovery	\$52,067
Operating expenses	20,000
Net earnings	32,067

The Oriental Consolidated company's January output was \$141,225, against \$142,980 in December. During the latter month there was a shortage of water at the Tabowie and Kuk San Dong mills, and interruptions to the power service.

MEXICO

CHIHUAHUA

Owing to the revolution, neither the Dolores nor El Rayo mine, owned by the Mines Company of America, is in operation.

HIDALGO

The Santa Gertrudis mill treated 32,187 tons of ore in December, yielding a profit of \$92,000.

SONORA

An important mining ruling in Mexico is that of the 'Constitutional' department of mines, which became effective January 16. It was issued in all territory under rebel control. By virtue of this order, claim-owners can obtain temporary title, guaranteed by the rebel government in any portion of the country under their control. Later, when the rebels have the entire country under control, the edict states, permanent titles will be issued.

It is stated that the old Mulatos mine, in the Sahuaripa district, has been sold to Boston people for a large sum. The Mines Company of America has only the Creston-Colorado and Grand Central mines in operation. La Dura is shut down. The Grand Central was bought in October 1913, and produces gold and silver ore worth \$6 to \$7 per ton. During the period of January 1 to September 30, 1913, the Company's revenue was \$1,560,768, and net profit \$461,847. Dividends amounted to \$210,256, and the surplus at the end of September was \$2,656,179.

The Lampazos mine, situated 40 miles south of Moctezuma, has been sold to Epes Randolph and associates of Tucson, Arizona, by the Bank of Sonora. This property is one of the *antiguas* of this state, and includes several claims, the most important being Los Tajos. There are large tonnages of high-grade ore, but the lower grade of silver ore will be treated by cyaniding. Machinery for the Nacozari Consolidated concentrating plant has arrived and is now being erected. El Temblor mill is working steadily.

Personal

D. C. JACKLIN is in New York.

R. C. TROEGER is at Los Angeles.

W. H. ALDRIDGE is in the West.

CHARLES C. SEIRD has gone to Africa.

E. B. BRADEN is back from New York.

S. H. BRADY was in San Francisco Tuesday.

F. L. GRAMMER was in New York last week.

R. M. ATWATER, Jr., has returned from Europe.

J. CLAUDE JONES was in San Francisco Saturday.

BRAXTON BIGELOW has left New York for Morococha.

S. S. SORENSEN is now manager for the Braden Copper Company.

LESTER W. STRAUSS is visiting various mining districts in Chile.

T. A. RICKARD has been lecturing at the Royal School of Mines.

FREDERICK G. FARISH has left Sneffels, Colorado, and is in Denver.

KARL EILERS was in San Francisco last week, and has gone to Arizona.

C. B. WHITWELL is examining mining property in Kern county, California.

R. T. WHITE has returned to the United States from Chile by way of Europe.

NEWTON CLEAVELAND's office is now at 623 Insurance building, San Francisco.

ARCHER E. WHEELER has sailed for Europe to take up his work at Tanganyika.

H. C. BELLINGER expects to return from the Great Cobar to New York early in April.

G. J. SIELAFF has been appointed general manager for the Abangarez Gold Fields of Costa Rica.

ELI T. CONNER has removed to Room 1315, Stephen Girard building, 12th street, Philadelphia, Pennsylvania.

W. M. HENDERSON SCOTT has gone to Central America in connection with properties owned by the Breitung Mines Corporation.

H. W. HARDINGE has left New York for a six weeks' tour of the West, visiting practically all of the mining centres before he returns.

F. N. WATTS, mill superintendent at the Black Oak mine, Tuolumne county, California, is visiting the cyaniding and milling plants and mines at Grass Valley.

CECIL POCOCK has left Peru on six months' leave, and is making a trip through the United States and Europe. On February 3 he was married in Lima, Peru, to Miss Gwen Sutton-Flack, of London. His address until July, will be 892 Avenue C, Bayonne, New Jersey.

The annual report of the Portland Gold Mining Co., of Cripple Creek, Colorado, gives the following names as members of the staff: manager of mines at Victor, Frank L. Smale; mining engineer, Fred Jones; master mechanic at mines, L. E. Flamboe; general manager of milling department, George M. Taylor; at Colorado Springs mill, superintendent, James B. Heffernan; assistant, J. M. Tippet; constructing engineer, S. J. Connolly; master mechanic, P. Kalaher; at Victor mill, superintendent, Thomas B. Crowe; assistant, L. W. Lennox; and master mechanic, W. W. Lawhead. The consulting engineers and metallurgists are Hills & Willis, and the Merrill Metallurgical Co., respectively.

San Francisco members of the Mining and Metallurgical Society met at dinner February 12.

The Metal Markets

LOCAL METAL PRICES

San Francisco, February 12.

Antimony	9	— 9½c
Electrolytic copper	15½	— 15¾c
Pig lead	4.25	— 5.20c
Quicksilver (flask)		\$39.00
Tin	41	— 42½c
Spelter		6½ — 6¾c
Zinc dust, 100 kg. zinc-lined cases, 7½ to 8c. per pound.		

SILVER

Below are given the average New York quotations in cents per ounce, of fine silver.

Date.		Average week ending.		
Jan. 29	57.50	Dec. 24	57.77	
" 30	57.25	" 31	57.52	
" 31	57.25	Jan. 7	57.50	
Feb. 1 Sunday		" 14	57.75	
" 2	57.75	" 21	57.58	
" 3	57.62	" 28	57.60	
" 4	57.37	Feb. 4	57.46	
Monthly averages.				
Jan.	1913. 63.01	1914. 57.58	July	58.70
Feb.	61.25		Aug.	59.32
Mch.	57.87		Sept.	60.53
Apr.	59.26		Oct.	60.88
May	60.21		Nov.	58.76
June	59.03		Dec.	57.73

Writing on January 29, Samuel Montagu & Co. state that the main strength of the silver market continues to be the covering of sales as they fall due; but the rather better undertone that was felt this week accelerated the inclination of 'bear' operators to close their commitments. The holdings of silver in Shanghai, by banks and others, consist of \$5,380,000 in cycee or currency, and of \$180,000 in bars. A shipment of silver worth \$8000 was made from San Francisco to Hongkong.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Average week ending.		
Jan. 29	4.15	Dec. 24	4.02	
" 30	4.15	" 31	4.15	
" 31	4.15	Jan. 7	4.15	
Feb. 1 Sunday		" 14	4.10	
" 2	4.15	" 21	4.10	
" 3	4.15	" 28	4.10	
" 4	4.15	Feb. 4	4.15	
Monthly averages.				
Jan.	1913. 4.28	1914. 4.11	July	4.35
Feb.	4.33		Aug.	4.60
Mch.	4.32		Sept.	4.70
Apr.	4.36		Oct.	4.37
May	4.34		Nov.	4.16
June	4.33		Dec.	4.02

COPPER

Quotations on copper as published in this column represent average wholesale transactions on the New York market and refer to electrolytic copper. Lake copper commands normally 1-5 to 1-4c. per lb. more. Prices are in cents per pound.

Date.		Average week ending.		
Jan. 29	14.50	Dec. 24	14.28	
" 30	14.50	" 31	14.56	
" 31	14.55	Jan. 7	14.39	
Feb. 1 Sunday		" 14	13.97	
" 2	14.65	" 21	14.03	
" 3	14.65	" 28	14.35	
" 4	14.70	Feb. 4	14.59	
Monthly averages.				
Jan.	1913. 16.54	1914. 14.21	July	14.21
Feb.	14.33		Aug.	15.42
Mch.	14.72		Sept.	16.23
Apr.	15.22		Oct.	16.31
May	15.42		Nov.	15.08
June	14.71		Dec.	14.25

The first week of each month is nearly always characterized by an inactive copper market, both buyers and sellers waiting for the Copper Producers' report. Speculation is always rife as to what it will show, and for this month guesses ranged from 10,000,000 to 20,000,000 lb. increase in stocks. Early last week the agencies made good sales at 14½c., but the demand was not sharp. Buying fell off at the end of the week, reflecting a fall of \$1 per ton for standard on the London exchange. Exports from February 1 to 5 were 6448 tons, as

compared with 8445 tons in the same period last year. The period is too short for an accurate comparison, however.

QUICKSILVER

The primary market for quicksilver is San Francisco, California, being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending		Monthly averages.	
Jan. 15	39.50	Jan. 29	39.00
" 22	39.00	Feb. 5	39.00
		" 12	39.00
1913.		1914.	
Jan.	39.37	July	41.00
Feb.	41.00	Aug.	40.50
Mch.	40.20	Sept.	39.70
Apr.	41.00	Oct.	39.37
May	40.25	Nov.	39.40
June	41.00	Dec.	40.00

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date.		Average week ending.		
Jan. 29	5.25	Dec. 24	5.15	
" 30	5.25	" 31	5.13	
" 31	5.25	Jan. 7	5.02	
Feb. 1 Sunday		" 14	5.08	
" 2	5.25	" 21	5.05	
" 3	5.25	" 28	5.20	
" 4	5.25	Feb. 4	5.25	
Monthly averages.				
Jan.	1913. 6.88	1914. 5.14	July	5.11
Feb.	6.13		Aug.	5.51
Mch.	5.94		Sept.	5.55
Apr.	5.52		Oct.	5.22
May	5.23		Nov.	5.09
June	5.00		Dec.	5.07

TIN

New York prices control in the American market for tin, since the metal is almost entirely imported. San Francisco quotations average about 5c. per lb. higher. Below are given average monthly New York quotations, in cents per pound:

Monthly averages.		1913.		1914.
Jan.	1913. 50.45	1914. 32.85	July	40.70
Feb.	49.07		Aug.	41.75
Mch.	46.95		Sept.	42.45
Apr.	49.00		Oct.	40.61
May	49.10		Nov.	39.77
June	45.10		Dec.	37.57

L. Vogelstein & Co., writing on February 2, state that statistics published by the New York Metal Exchange show Straits shipments 5235 tons, United States deliveries 3600 tons, and an increase of 966 tons in the visible supply. This is a small increase when the month's transactions are considered. The visible supplies in England, Holland, and the United States, stocks and afloat, are 17,284 tons.

COPPER PRODUCERS' ASSOCIATION REPORT

The Copper Producers' Association statement, February 9, shows a decrease in production and stocks on hand. The details are as follows:

Pounds.		Increase.	Decrease.
Stocks of marketable copper of all kinds on hand at all points in the United States, January 1, 1914 ..	91,438,867		
Production of marketable copper in the United States from all domestic and foreign sources during January	131,770,274		
Deliveries for consumption, January	47,956,955		
Deliveries for export, January	87,955,501		
Stock of marketable copper of all kinds on hand and at all points in the U. S., February 1	87,296,685		
Recent changes in surplus have been as follows, in pounds:			
January 1913	17,885,770		
February	896,134		
March	18,032,928		
April	28,720,162		
May	8,074,883		
June	14,569,619		
July	690,330		
August	15,280,908		
September	8,531,043		
October	2,773,288		
November	15,363,047		
December	43,509,438		
January 1914	4,142,182		

The Stock Markets

SAN FRANCISCO STOCKS AND BONDS (San Francisco Stock and Bond Exchange.)

February 11.					
BONDS					
Listed.	Bid	Ask	Unlisted.	Bid	Ask
Associated Oil Co.	\$ 97½	98½	Natomas Consol. Co.	25½	—
Unlisted.	—	—	Pac. Port. Cement Co.	—	100½
Ass. Oil Co.	80	—	Santa Cruz Cement Co.	—	10
General Petroleum Co.	41	—	Union Oil	—	88

STOCKS					
Listed.	Bid	Ask	Unlisted.	Bid	Ask
Amalgamated Oil	85	—	General Petroleum	5	—
Associated Oil	42½	—	Noble Electric Steel	5	—
E. I. du Pont pfd.	—	90	Natomas Consol.	1½	—
Gladi	84½	—	Pac. Port. Cement	—	69
Pac. Cut Borax, pfd.	70	—	Riverside Cement	80	—
Pacific Crude Oil	—	35c	Santa Cruz Cement	—	52
Sterling O. & D.	—	1½	Stand. Port. Cement	19	—

NEVADA STOCKS

(By courtesy of San Francisco Stock Exchange.)
February 11.

Atlanta	\$.17	Mispah Extension	\$.46
Belcher	.30	Montana-Tonopah	1.12
Belmont	7.75	Nevada Hills	.40
Big Four	.15	North Star	.41
Con. Virginia	.21	Ophir	.39
Florence	.58	Pittsburg Silver Peak	.35
Goldfield Con.	1.60	Round Mountain	.42
Goldfield Oro.	.12	Sierra Nevada	.06
Halifax	1.10	Tonopah Extension	1.70
Jim Butler	1.00	Tonopah Merger	.63
Jumbo Extension	.27	Tonopah of Nevada	7.00
MacNamara	.10	Victor	.30
Mexican	1.12	West End	1.57
Midway	.39	Yellow Jacket	.35

COPPER SHARES—BOSTON

(By courtesy of J. C. Wilson, Mills Building.)
February 11.

	Bid	Ask		Bid	Ask
Allouez.....	\$ 40½	40½	Mohawk	\$ 4½	45
Ariz. Commercial.....	5	5½	Nevada Con.....	16½	16½
Butte & Superior.....	36½	36½	North Butte.....	30	30½
Calumet & Arizona.....	63	63½	Old Dominion.....	52	53½
Calumet & Hecla.....	453	455	Oscuela.....	81	—
Copper Range.....	39½	39½	Quincy.....	66½	67½
Daly West.....	2½	3	Shannon.....	7	7½
East Butte.....	12½	12½	Superior & Boston.....	2	2½
Franklin.....	4½	4½	Tamarack.....	38	40
Granby.....	88½	88½	U. S. Smelting, com.....	42½	42½
Greene Cananea.....	41	41½	Utah Con.....	13½	13½
Ile-Royale.....	22	22½	Winona.....	3½	4½
Mass Copper.....	3	3½	Wolverine.....	46	47

NEW YORK CURB QUOTATIONS

(By courtesy of E. F. Hutton & Co., Kohl Building.)
February 11.

	Bid.	Ask.		Bid.	Ask.
Braden Copper...	7%	7½	Mason Valley...	3%	3%
Braden 6s	153	157	McKinley-Dar. .	1%	1½
B. C. Copper.....	2¼	2%	Mines Co. Am....	3½	3%
Con. Cop. Mines...	2½	2%	Nipissing	6½	6½
Davis-Daly	2½	2%	Ohio Copper	¾	¾
Ely Con.	3	6	San Toy	17c.	20c.
First National....	2½	3½	Stand. Oil of Cal.	300	302
Giroux	1½	1½	Tri Bullion	¾	¾
Hollinger	17½	19	Tuolumne	¾	¾
Iron Blossom....	1½	1½	United Cop. com..	¾	¾
Kerr Lake	4%	4%	Wettlaufer	7c.	9c.
La Rose	1½	1½	Yukon Gold	2½	2½

NEW YORK STOCK EXCHANGE

(By courtesy of J. C. Wilson, Mills Building.)
February 11.

	Bid	Ask		Bid	Ask
Amalgamated.....	\$ 76	76½	Miami.....	\$ 23½	24½
Anaconda.....	37	37½	Nevada Con.....	16½	16½
A. S. & R.....	68½	69½	Quicksilver, com.....	3½	4
Calif. Pet., com.....	28½	29½	Ray Con.....	19½	20
Chino.....	43	43½	Tenn. Copper.....	36½	36½
Guggenheim Ex.....	51½	51½	U. S. Steel, pfd.....	110	110½
Inspiration.....	17½	17½	U. S. Steel, com.....	65½	65½
Mexican Pet., com.....	72	72½	Utah Copper.....	56½	56½

GUGGENHEIM EXPLORATION COMPANY

Results of the operations of this well known Company in 1913 may be summarized as follows.

	1913.	Changes.
Net income	\$ 3,353,852	+\$ 82,102
Dividends	2,357,145	+ 277,815
Surplus	996,707	- 195,713
Previous surplus	23,814,632	+ 1,192,420
Total surplus	24,811,339	+ 996,707

The net income was equal to 16.13% on the capital stock. The general balance-sheet at the end of 1913 shows the following:

Assets:	1913.	Changes.
American Smelting Securities 'A'	\$ 3,060,000	- \$ 990,000
Utah Copper Co.	9,161,767	—
Yukon Gold	10,114,563	+ 23,375
Chino Copper	2,534,802	—
American Smelting & Refining Co.	4,767,265	—
Ray Consolidated	3,245,851	+ 660,213
Miscellaneous investments	56,439	+ 3,429
Alaska-Yukon properties and equipment	1,119,443	- 24,659
Furniture, fixtures, and equipment	2,255	- 54
Accounts collectable	5,088	+ 539
Cash and demand loans	11,537,164	+ 1,233,865
Total	\$45,604,640	+\$ 996,707
Liabilities:		
Capital stock	\$20,793,300	—
Surplus	24,811,340	- \$ 996,707
Total	\$45,604,640	+ 996,707

All of the securities in the assets, with the exception of the American Smelting Securities Co. 'A', are carried at cost.

GOLD PRODUCTION IN WESTERN AUSTRALIA

The November yield from all mines in the state was \$2,504,400, and returns from the principal producers were as follows:

Mine.	Tonnage.	Value.	Profit.	Dividend.
Associated	10,837	\$ 66,000	\$ 9,700	—
*Associated Northern	10,457	56,000	10,500	—
Bullfinch	5,966	69,000	39,000	\$119,000
Golden Horse-Shoe	26,853	155,000	2,400	—
Great Boulder	16,761	220,000	125,000	—
Gt. Boulder Perseverance	20,475	97,000	7,400	—
Great Fingall	5,876	45,000	—	—
Ivanhoe	20,033	175,000	67,000	—
Kalgurli	10,780	101,000	44,000	—
Lake View & Star	18,318	101,000	16,000	—
Mountain Queen	4,095	21,000	8,000	—
Oroya Links	12,400	67,000	14,000	—
Sons of Gwalia	13,500	101,000	24,000	—
Yuanmi	10,030	82,000	19,500	—

*Including the Victorious.

The Nova Scotia Steel & Coal output in 1913 was as follows:

	Tons.
Coal	820,000
Iron	73,878
Steel	78,379
Coke	100,000

The quantity of iron ore received at North Sydney from the Company's ore mines at Wabana, Newfoundland, during the season amounted to 130,000 tons.

IRON ORE mined in the United States in 1913 is estimated by the U. S. Geological Survey to have been between 58,000,000 and 60,000,000 long tons. The Lake Superior district supplied about 50,000,000 tons.

Company Reports

FALCON MINES, LIMITED

This Company operates a property situated 60 miles west of Gwelo, in the Blinkwater district, Rhodesia.

Development has shown a steady increase in gold values below the third level, the average figures being: No. 3, \$3.80; No. 4, \$5.60; No. 5, \$6.10; No. 6 level, \$7 per ton.

Ore reserves at June 30, 1913, showed an increase of 187,134 tons compared with the previous year. They consist of 178,622 tons of oxidized ore containing 0.71% copper and \$6.40 gold; and 638,389 tons of sulphide ore averaging 3.15% copper and \$5.57 gold, worth at present copper prices about £2,380,686. It is hoped to have the plant in operation in June, 1914.

VINDICATOR CONSOLIDATED GOLD MINING COMPANY

This Company operates at Cripple Creek, and the report covers work during 1913. The superintendent, H. P. Nagel, Jr., reported as follows: At No. 1 shaft, 73,084 tons of crude ore was produced on Company account, yielding 22,829 net tons, or 31.24% of shipping ore, of a gross gold content of \$702,119, or \$30.75 per ton. Lessees working through No. 1 shaft produced 2222 net tons, of a gross gold content of \$85,965 or \$38.69 per ton. Royalties received from the sale of this ore amounted to \$20,728. Lessees working through other shafts on the property produced 8466 net tons, of a gross gold content of \$132,273 or \$15.62 per ton. Royalties received from the sale of this ore amounted to \$16,635. Development work of a total length of 10,187 ft. was done during 1913, making a total of 192,103 ft. to date. Development of the 1600-ft. level progressed satisfactorily, and ore-shoots were opened in six veins. Other shoots were opened on the 1200, 1300, 1400, and 1500-ft. levels. The report of Fred W. Crosley, mining engineer, gives details of development work done. The cost of powder, fuse, and caps was \$25,028, used in 10,187 ft. of development. The finances of the Company are as follows:

Gross proceeds from all ore sales (33,517 tons).....	\$723,727
Mining	296,885
Paid to lessees	110,577
Mining profits	316,264
Sundry receipts	6,205
Cash on hand January 1, 1913.....	84,643
Dividends in 1913	180,000
Cash on hand January 1, 1913.....	227,112

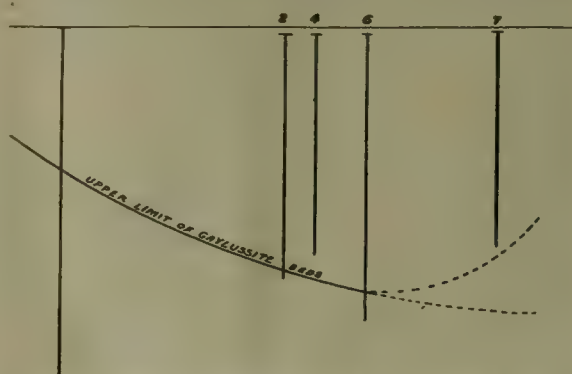
RAILROAD VALLEY COMPANY

This Company operates in Nevada, and has been drilling for potash in Railroad valley, Nye county. Details of some of this work were published in this journal of August 2, 1913, and at various other times. A special meeting is being held at Tonopah on February 10 to consider the situation of the Company, to receive the report of E. E. Free, the consulting geologist, to decide if further work is warranted, and to discuss other matters of importance.

The president, Victor Barndt, states that in two years over \$115,000 has been spent in searching for potash. Over 10,000 ft. of drilling was done. A considerable amount of the work was useless, but it was pioneer work. The Company was the only private interest in the United States proving or otherwise the 'dry lake' theory of buried salt deposits. Another company, the Pacific Coast Borax Co., has since started drilling in Death valley, California. In July 1913, \$15,000 was received from the sale of treasury stock, but this was spent in sinking No. 3, 4, 5, and 6 wells. In October a loan of \$4480 was obtained under certain conditions. This

was used in sinking No. 6 well deeper, putting down No. 7 well 745 ft. deep. Cold weather stopped further work early in December. While results are inconclusive, the chance of finding potash remains as good as heretofore. Mr. Barndt recommends that other land be secured and tested, and all future work be conducted by some operating concern which will work under lease at certain royalties. The authorized capital is 1,000,000 shares, of which 73,318 are in the treasury. The balance at December 31, 1913, was \$203.

The report of E. E. Free states that the practical significance of the data now at hand rests almost entirely on the gaylussite beds. These were cut in No. 2, 4, and 6 wells. The precise correlation of the beds in No. 2 and 6 is not possible. They may be variable and local, and may persist over considerable areas. It is impossible to draw a line between No. 2 and 6 beds and show them as representing the bottom of the basin at any particular time. Although this is so, there is no reasonable doubt that gaylussite series of both wells are substantially synchronous. From general deductions, two theories are possible: (1) it may be that No. 6 well is in or near the greatest depression; and (2) it



SECTION SHOWING PROBABLE POSITION OF GAYLUSSITE BEDS.

may be that the southerly dip of the gaylussite beds continues beyond No. 6, and that the deepest depression lies an unknown distance to the south. These alternative theories are shown on the accompanying cut. The beds are reasonably well established north of No. 6 well, and are shown by the solid line, while south of this well their course is uncertain, and the two possibilities are shown by the dotted line. If the first theory is true, and No. 6 is in the depression, hopes of a potash deposit must be abandoned; but if the depression is south of No. 6, the chance of finding this material is good. The drilling of No. 7 showed nothing which can be correlated with the gaylussite beds, and it seems possible that this well was beyond the edge of the deposits. Wells No. 3 and 5, 1½ miles northeast and 1½ miles northwest of No. 2 respectively, failed to cut any gaylussite. The gaylussite probably covers an area of several square miles, about 100 ft. thick, around wells No. 2 and 6, and if this is so, and the material is of fair purity, and if methods can be devised for mining at low cost, there is a possibility of manufacturing soda commercially. Mr. Free recommends that No. 7 well be drilled further to cut the gaylussite, or to prove that it does not extend so deep. If a southerly extension is proved, four more wells should be put down. If this is not found, further drilling should be done to determine the extent of the present deposits cut, also one or more should be drilled right through the gaylussite. For the work recommended, for either scheme, a sum of \$25,000 would be necessary, and \$5000 for contingencies.

Gaylussite, mentioned frequently in this review, is a hydrous double carbonate of calcium and sodium, having the formula $\text{Na}_2\text{CO}_3 \cdot \text{CaCO}_3 \cdot 5\text{H}_2\text{O}$. It contains 35.81% sodium carbonate, 33.78% calcium carbonate, and 30.41% water.

Recent Patents

1,071,791.—PROCESS OF TREATING ORES. Frank W. Pugsley, Pittsford, N. Y.

A process of separating metals from ores, consisting in passing minute bubbles of chlorine gas upwardly through comminuted ore suspended in a liquid not of itself capable of reacting on the ore.

1,073,928.—ORE CONCENTRATOR. Marlon L. Porter, Silverton, Ohio.

A receiving tank for the mineral-impregnated liquid, collecting plates for the mineral particles arranged in the tank, a discharge pipe connected to the tank to withdraw the water therefrom and means for heating said plates to dry the concentrate.

1,073,932.—PROCESS FOR THE MANUFACTURE OF FLUORESCENT SUBSTANCES. George Rupprecht, Hamburg, Germany.

As a new article of manufacture, a fluorescent substance comprising an artificially produced basic salt of a refractory salt forming acid, and one of the earth metals of the zinc group of the periodic system, and a small percentage of a modifying agent.

1,074,088.—ELECTRODE SUPPORTING-ROD FOR ELECTROLYTIC TANKS. Peter Jensen, Perth Amboy, N. J., assignor of one-third to Leo Goldberger and one-third to John Kudrik, Perth Amboy, N. J.

An electrode suspending-rod formed from angular stock and twisted around its longitudinal axis for producing a plurality of helical edges for engaging the suspending hooks of an electrode.

1,071,838.—MAGNETIC SEPARATOR. Joseph Weatherby, New Cumberland, Pa., assignor, by mesne assignment, to Electric Ore Separator Co., New Cumberland, Pa., a corporation of Delaware.

A combination with fixed and rotary pole pieces having a vertically elongated air gap between them, of means for maintaining a body of comminuted material in rubbing contact with the movable pole piece at one side of and in proximity to the fixed pole piece and air gap between the pole pieces.

1,071,763.—ORE-TREATING PROCESS. Thomas J. Lovett, Chicago, Ill., assignor to Copper Process Co., Chicago, Ill., a corporation of South Dakota.

A gradual reduction method of treating ore containing ductile metal in fine particles, which consists in subjecting ore-lumps holding the fine particles of metal to a prolonged rub-rolling action under pressure, to simultaneously disintegrate the gangue and roll the ductile metal particles into pellets or slugs.

1,071,715.—PROCESS AND APPARATUS FOR CLASSIFYING CRUSHED ORES. William F. Deister, Fort Wayne, Ind.

Classifier having in combination, a shell having an outlet at its lower end, a diaphragm extending across the shell, means for introducing water into the shell at a point intermediate the outlet and diaphragm, the diaphragm having openings there-through for the downward movement of the solid materials and the upward flow of the water, and means for gravitally directing the solid materials into said openings.

1,073,587.—ART OF MAKING IRON AND STEEL. James R. Billings, Birmingham, Ala., assignor to Billings Process Co., Birmingham, Ala., a corporation of West Virginia.

First obtaining the metal in a molten mass, confining the mass in a suitable receptacle, then while so confined, rapidly but under regulable control, introducing and thoroughly dis-

persing through all parts of the mass carbon or carbonaceous fuel and simultaneously effecting the generation of carbon dioxide and heat by concurrently introducing and dispersing through the mass under regulable control oxygen under a pressure not greatly in excess of the ferrostatic pressure and in quantities limited to conform approximately to the amount necessary to effect substantially complete combustion of the carbon or fuel so introduced.

1,073,653.—SIEMENS-MARTIN FURNACE. Kurt Albert, Wiesbaden, Germany.

For working up masses containing iron or ferric oxide and volatile metals, the combination with a hearth chamber, air chambers and gas chambers, flues connecting the air chambers and the gas chambers with the hearth chamber; of additional independent flues leading from the hearth chamber; means for guiding the gases of combustion through said additional flues during the volatilization period of the volatile metals and a recuperator for receiving the discharged gases.

1,074,068.—ELECTROMAGNETIC ORE-SEPARATOR. Georg Rietkotter, Hagen, Germany.

A device including a frame, a shaft fixed in said frame, an opposed pair of magnets supported fixedly from said shaft, bearing brackets fixedly mounted on said shaft; a second shaft journaled in said brackets, spaced disks, revolubly mounted on said first mentioned shaft, internal gears on the inner sides of said disks, other gears on the second shaft meshing with said internal gears, means to rotate one of said disks, and a cylinder removably mounted on said disks and surrounding said gears and magnets.

1,073,644.—SEPARATING TABLE AND PROCESS OF SEPARATION. Henry M. Sutton, Walter L. Steele, and Edwin G. Steele, Dallas, Texas.

A concentrating table having a pervious floor, means for reciprocating the table adapted to propel the material in a predetermined direction, an air chamber arranged under said floor, an obstruction arranged diagonally across the line of travel of the propelling movement of the material forming an obstruction of concentrate free from direct passage in the line of imparted movement, and having passages at an angle to the line of movement of the material.

1,073,820.—PRODUCTION OF PORTLAND CEMENT. Joseph W. Richards, South Bethlehem, Pa., and Walter B. Landis, Bethlehem, Pa.

Making portland cement in a single furnace operation, which consists in making up the charge of ore in an iron-ore reduction furnace having a basic lining with the raw materials for producing a lime-alumina silicate slag and with excess of limestone sufficient to produce a liquid product having the percentage composition of portland cement clinker, and generating in said furnace a sufficient temperature to reduce the ore and to cause the clinker to flow from the furnace in the liquid state.

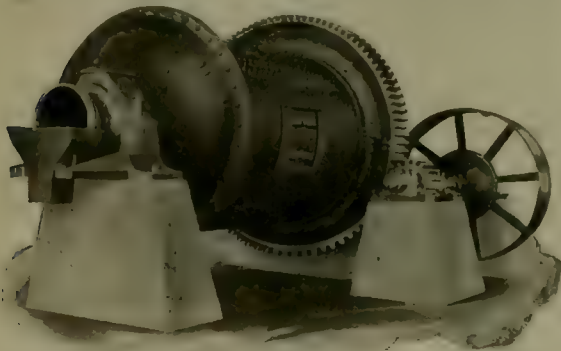
1,071,839.—ORE CONCENTRATOR. Joseph Weatherby, New Cumberland, Pa., assignor to the Electric Ore Separator Co., New Cumberland, Pa., a corporation of Delaware.

A transversely inclined longitudinally differentially reciprocating dressing table having incorporated therein longitudinal strips of magnetic metal and means for differentially reciprocating said table horizontally to effect stratification and separation of the material thereon in divergent paths due to the difference in specific gravity of the elements composing the material, of a fixed magnet mounted above the table and having a pole terminal with an extended face in proximity to and above the magnetic strips in the table, whereby elongated magnetic fields are formed in which the lines of force converge toward the ore supporting the surface of the table.

A Tube-Mill Test at Butte

*During the past year several interesting articles have appeared tending to prove that the pebble mill is entitled to serious consideration in connection with the fine grinding of milling ores in the process of preparing the material for the various concentration systems. The results obtained indicate that for certain sizes and certain ores, the pebble mills are superior to the Huntington or Chilean mill, and that it does not necessarily follow that grinding by means of pebbles will produce a greater percentage of the very undesirable colloidal material. There seems to be a growing belief that the small percentage of slime produced is due to the shape of the mill, and yet no definite proof is brought forward to bear out the theory. That there is some question as to the soundness of this theory, is indicated by the fact that there is an increasing tendency to lengthen the cylindrical portion of the mill without changing the dimensions of the conical portions. Such a change seems to result in an improvement in the results obtained without materially affecting the percentage of slime produced. It appears that the power and pebbles consumption per ton of ore reduced was even less in the lengthened mill.

It is of particular interest that the Butte & Superior Copper Co., Ltd., recently made a series of tests to determine which of two types of pebble mills was the better suited for regrounding its zinc ores. The material to be ground carried about 10% zinc in the form of an included grain, a portion of the zinc mineral having been roughed out on the primary rough-



TUBE-MILL USED IN TEST.

ing tables. The middlings from these roughing tables are then classified in a Richards-Janney hydraulic classifier and the material from the first two spigots, which is approximately 10 to 30 mesh, is treated on secondary roughing tables. The middling from these secondary roughers, which contains practically no free mineral, is then reground. Chilean mills have been used for this purpose, but the large increase in capacity of the mill had overtaxed them, and it was decided to test pebble mills for this work. Accordingly a Power & Mining Machinery Co.'s improved tube-mill, 7 ft. diameter by 10 ft. long, was installed for competitive test with the popular type of conical pebble mill, 8 ft. diameter with a 30-in. cylinder. Each mill was driven from a separate and independent motor, belted to the pinion shaft. The packet type of lining was used in the straight mill after the first test, and it was found that plain plate lining wore too fast. The conical mill was lined with El Oro lining in the cylindrical section, and 18 in. of the discharge cone, the remainder of the mill was lined with plate. Six-inch lifters were also used in the conical mill during the first test, but were removed at the suggestion of the builder's representative.

*Prepared by the chief engineer for Power & Mining Machinery Company.

The initial charge to each mill was No. 4 Danish pebbles and additional pebbles of the same size were fed, together with the feed during the test, as needed. Speed of the straight mill remained at 22 r.p.m. throughout the test. The conical mill was first run at 30 r.p.m., but this was later changed to 25 r.p.m. The axis of the straight mill remained horizontal throughout the test, while the conical mill was raised 1½ in. at the feed end following the completion of the first test, owing to excessive flattening of the pebbles. The ground product discharged from these mills was elevated by bucket elevators and discharged to the Richards-Janney classifiers already mentioned, and it will thus be seen that each mill formed part of a closed circuit and that any oversize was returned. Owing to the inability of one section of the concentrator to furnish enough feed for both mills, they were installed in separate sections, and it was not practicable to split the feed going to the mills. This did not permit of ideal testing conditions, but every effort was made to keep each mill running on the same class of feed. The object in view was to grind this 10 to 30-mesh material so that the largest percentage would pass a 40-mesh screen, yet at the same time produce the least possible amount of minus 200 mesh material.

It seems from the result of this test that not the shape, but the dimensions of the tube-mill are the factors to be taken into consideration in figuring capacity, the class of product to be produced, and efficiency. It is true that an all-slime product can be secured from a tube-mill, but it is also equally true that a granular product will be the result if the mill is built in the proper dimensions and operated under proper conditions. The tonnage treated, and percentage of solids in the feed also bear a strong relation to the product of the mill.

The results of these tests were such as to greatly strengthen the contention that no advantage had been gained by a departure from the cylindrical type of tube-mill, but the manufacturers of the mill prefer to delay publishing the figures obtained until they have had an opportunity to substantiate the same by further tests on other ores. Negotiations for such tests are now being carried on. The Power & Mining Machinery Co. will, however, furnish copies of these figures to anyone interested.

Commercial Paragraphs

THE TERRY STEAM TURBINE Co. of Hartford, Conn., is distributing a bulletin, No. 17, describing the return flow turbine made by that Company.

YUBA CONSTRUCTION Co. has issued a special bulletin, Model D, descriptive of irrigation pumps, a type suitable for any situation when the volume is large and the head low.

THE LUFKIN RULE Co. is now furnishing steel case liners and leather cases with push-button opener, with its general line of steel tapes, without extra charge. 'Challenge' and 'Challenge Junior' steel tapes now have leather cases, steel lined throughout. This gives the case extra stability, also permits making it narrower than before by ½ in. 'Rival' and 'Rival Junior' steel tapes have nickel-plated steel cases as before, but the edge or case band is knurled to afford a good firm hand-hold. The cases of all these tapes are now also equipped with a positive action, winding handle, opener.

WATER SANDS in gravel beds may be easily made available as sources of domestic or industrial supply by means of driven wells. Such sands usually afford exceptionally pure water and if the wells be properly put in, it is free from contamination. In making such a well a special screened point attached to suitable lengths of pipe, is actually driven through the overlying beds and into the water sand. For such use pipe must be especially well made. The NATIONAL TUBE Co. makes a 'National Reamed and Drifted Pipe' which is described in Bulletin 18A in which will also be found a complete account of the method of making such wells.

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EDITORIAL

WHAT it will cost to mine coal in Alaska is a matter about which there has been much dispute. We are glad to present this week definite statements of what it has cost, written by Mr. W. R. Crane, who obtained his figures on the ground and who is thoroughly familiar with coal mining costs elsewhere.

UPROOTING a batholith might well be considered an attempt to get to the bottom of things. Mr. A. C. Lawson has just published a suggestive paper in which he shows that, so far as published evidence goes, there are no adequate grounds for considering the granite at Butte to be batholithic. If, as he thinks, it represents a laccolith, opinions regarding the genesis of the ores will need further revision.

IN New Zealand, according to a decision recently handed down by the chief justice, Sir Robert Stout, "it is not lawful for the defendant union to apply any of its funds for the purpose of assisting unions while the members of those unions are engaged in a strike. The union cannot make levies on its members for that purpose." Evidently, so far as legal machinery can be used to that purpose, strikes are to be blotted out in this, universally considered to be the most progressive of the Dominions.

MEETINGS of the engineering societies are now in season. The American Institute of Mining Engineers assembled at New York this week. We print on another page the program of the technical sessions which were so crowded this year that the meetings were held in sections. This is a healthy sign of the new interest in the Institute as a technical society which is now so apparent. Supplementing the regular sessions, semi-technical ones were scheduled for Tuesday and Thursday evenings and at 4:30 on Wednesday afternoon where Messrs. H. W. DuBois, I. N. Knapp, and Samuel A. Taylor gave illustrated lectures on various phases of mining. The Canadian Mining Institute is to meet at Montreal March 4, 5, and 6, and any engineer who can arrange to be present is sure to be well paid for his time. Thursday morning, March 5, an excursion will be made through the Mount Royal tunnel, which was recently holed through. In many particulars this tunnel and the work done while driving it are of unusual interest. The Mining and Metallurgical Society will meet at dinner in New York on

the evening of March 9 to present its medal to Mr. and Mrs. H. C. Hoover. This is to be a ladies' night, and the Society, already famous for its dinners, will make especial efforts to honor the occasion.

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PRACTICAL men as well as educators will rejoice in the consummation of negotiations for coöperation between Harvard University and the Massachusetts Institute of Technology in support of engineering education and research. The agreement just reached covers the fields of mechanical, electrical, civil, sanitary, and mining engineering, and metallurgy. The work in these departments is to be conducted in buildings belonging to the Institute to be erected on its new site at Cambridge, bordering Massachusetts Avenue and the Charles River Embankment, but both teaching and research work are to be supported by practically all the funds of both institutions available for such work. While it is impossible to syndicate brains, and independence is of first consideration in intellectual work, we believe that the plan here adopted will appeal to the good sense of the graduates of both great schools. It was shown by investigation of the Carnegie Foundation that educational institutions, judged by ordinary business standards, are most inefficiently run. There is endless and unnecessary duplication of plant and apparatus, much of which is idle 80 per cent of the time. No thoughtful man wants his *Alma Mater* to become a factory, but it is anomalous to lecture embryo engineers on efficiency of plant under conditions ordinarily obtaining at universities. Germany was characterized some years ago by Lord Palmerston as "a land of damned professors." Since that was said the professor both in Germany and the United States has demonstrated his practical value to the social organism to an extent then wholly unsuspected; but Germany, in the judgment of keen and sympathetic observers, is now over-educated, and America is moving in the same direction. There are too many schools and there is not enough research. More engineers are being graduated than can be absorbed by industry, and each year men trained in engineering take up the selling of life insurance or some similar unrelated

vocation. At the same time, we continue to grope in the dark as to many fundamental problems. Only the large and rich school can afford, under actual conditions, to support research. The combination of forces and funds by Harvard and 'Tech', as it is known by its graduates, affords an exceptional opportunity for investigative work along engineering lines.

Leaching Copper in Africa

The great amount of attention which is being directed in this country toward the possibilities of the application of leaching processes for the recovery of copper from its ores tends to make us overlook what is being done abroad. There also proposals once discarded are being brought forth and reëxamined to see whether they cannot be so modified as to be applicable to present conditions. Sometimes they have been found impracticable as at the B'wana M'Kubwa copper mine, in northern Rhodesia, where it was proposed to erect a Siemens-Halske plant to recover the copper in the tailing from wet concentration. Various difficulties developed, chief among which is the discovery that the ore reserve was neither so large nor of so high a grade as expected. At the mine of the Bechuanaland Copper Company, also in Rhodesia, it is likewise proposed to use the Siemens-Halske process on the recommendation of Messrs. Hooper, Speak & Company. The Siemens-Halske process consists essentially of leaching the roasted ore with ferric sulphate solution, producing ferrous sulphate and copper sulphate. The solution is drawn off and electrolyzed, precipitating the copper. Though apparently simple, almost unsurmountable major difficulties arise, not to mention a number of annoying minor ones. It seems impossible to discover a satisfactory substance from which to make the anode, and in addition the ferrous sulphate is oxidized to ferric at the anode and reduced to ferrous sulphate again at the cathode, thus consuming much electrical energy to no purpose. This can be in part prevented by the use of a porous diaphragm, but this increases the resistance of the cell, and it is also difficult to find a satisfactory substance to form the diaphragm. The most important experiments made with this process in this country were those made at the Ray mine by Mr. W. Y. Westervelt, of which an account was given in our January 3 issue. The process has also been tried in Spain and elsewhere without success, and the results attained in Africa will therefore be awaited with interest. The most recent information is that the use of the Siemens-Halske process has been given up at the B'wana M'Kubwa, and it is now proposed to use the MacKay process, which has also been suggested as a possibility for the solution of the difficult metallurgical problem at the Tanganyika. The MacKay process as originally devised consisted in the production of a FeCl_3 solution, leaching the ore with this, forming FeCl_2 and CuCl_2 . This solution is run over scrap iron, precipitating copper and regenerating the FeCl_3 . During the

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Alaska's Opportunity Arrives

At last the way to the development of Alaskan coalfields is opening. The first great need is transportation. A bill providing for a system of government owned railroads in Alaska has passed the Senate and is now before the House of Representatives at Washington. It is expected to become a law shortly, and without material changes in form. Following its enactment, a law providing for the leasing of the coal lands is on the Administration program, and a bill for such an act has already been introduced in both House and Senate. After years of stagnation and conversation, something is finally to be done.

The railroad bill is a good one in most particulars. Whatever differences of opinion as to government ownership of railroads may remain, the system affords the only way out as conditions now exist, and if the Government is to build railroads in Alaska or elsewhere we think that public opinion is unanimous to the effect that the organization and control of the work should be as much like that obtaining at Panama as possible. There, Colonel G. W. Goethals and his associates made a success because of the recognition of the fact that, if the Government is going into business, it must recognize business principles. In particular, authority must go with responsibility and a definite plan must be formulated in advance. In the new bill the whole authority and responsibility for building the proposed railroad lines is lodged in the President, and adequate funds are made available from the first. Plans can be made, and contracts can be let, with full assurance that the money will be forthcoming at the time and in the amounts needed. This will avoid the greatest source of loss and waste incurred in river and harbor work where an irregular and unsystematic method of appropriating has resulted in the minimum of efficiency in plant and organization. It is further provided that the Government may buy or lease existing lines, and we are glad to see that some return, at least, is to be made to the pioneer railroad builders of Alaska who have every justification for complaint at the change in the rules of the game that was made after their work began. We believe in the active development of the territory. We see no reason why another Scandinavia with its vigorous civilization may not be added to the world, and we consider it a proper public enterprise to open the way to such a development. There is just one feature of the new law that appeals to us as particularly bad; that is the provision that no engineer may

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Following the railroad bill is one providing a leasing system for the coalfields. We are already on record as favoring such a plan. There are many who honestly oppose it, but it is now generally conceded that such a system is inevitable, and we believe those now in opposition will ultimately find its disadvantages fewer and less important than they now fear. We are glad to note that an indeterminate period of lease is provided, as was urged by the Mining and Metallurgical Society. The proposed leases are to be for the whole of the coal in the ground, and the lessee continues in possession so long as he fulfills the stipulated conditions. Certain rights of revision at intervals of 20 years are reserved to the Secretary of the Interior, and this is as reasonable as the usual right to revise rentals in the case of ground leases in cities. The amount of royalty, above a minimum of two cents per ton, is fixed by the lessee through competitive bidding. A small but increasing acreage tax applies during the period that the land lies idle before operations begin, and all funds arising from these leases are to be applied to the development, improvement, and betterment of Alaska, including railroad building. All this is excellent. We like less the restriction on acreage, though an allowance of 2650 acres is more liberal than the old 640-acre limit of the general coal land law. The most important feature of the law to which we would take exception is that making stringent provision against any possible consolidation of claims. In our issues of September 11 and 30 of 1911, we gave in detail our reasons for holding that such restrictions are unnecessary and undesirable. It would probably be impossible, however, to obtain any legislation at this time which did not include some such provision, and it is better to have a way open than to wait indefinitely for the best way. The system proposed is workable. It has many good points, and we hope it will be promptly put in operation. Alaska has been too long neglected. If the new legislation does not bring immediately the full prosperity for which our friends in the Far North hope, it will at least start the current in the right direction, and we confidently anticipate a time when people will wonder as much at the delay in opening the country as we now do at the difficulties anticipated when it was first proposed to build railroad lines to the Pacific Coast.

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Mining in the Belgian Congo in 1913

By SYDNEY H. BALL and MILLARD K. SHALER

In Belgian colonial circles the financial depression caused by the break in rubber prices has been partly offset by the progress made in mining in the Belgian Congo. Although the gross mineral production in 1913 was but some \$3,000,000, it was, nevertheless, more than double that of 1912. The increase was due to a larger production of copper in the Katanga region, and a fair increase in the gold output. The year was further marked as the first in which the colony produced diamonds on a commercial scale. The past year has seen, as forecasted as probable in this review last year,¹ a start toward a lowering of the draconian mining taxes. These taxes must be further reduced, however, and in other ways mining offered governmental support, if the industry is to flourish in the colony. It is hoped that the acute labor situation in the Katanga, in particular, will be relieved.

The Congo has the reputation of being a land of cheap labor, and so it is per man per day, although the item of labor is not low. To one traveling through the country the labor supply would appear relatively abundant in some regions, but the unwillingness of the untutored native to work, causes a greater or less shortage of labor throughout the colony. New railroads and additional river steamers are locally reducing the number of porters and canoemen, a gain, however, much more than counterbalanced by new or growing enterprises. In the Katanga, where the largest mining operations exist, the labor situation is acute, and the future expansion of the enterprise may be affected. The determination of the value of many mineral discoveries made in that region, as well as railroad construction, is retarded. At present some 31,000 blacks are employed by various industrial concerns in the colony; of these, 9000 are in the Katanga, about one-third the number in reality needed.

Katanga Region

The mining region of the Katanga is sparsely populated and food is scarce. The country to the north, which has or had a fair population, is ravaged by sleeping sickness. Men recruited in more equatorial portions of the Congo are unsatisfactory, as they stand the—for them—rigorous climate poorly; further, they are needed for private and public enterprises nearer home. The Congo itself, then, cannot supply the demand. To the south and east lies Rhodesia, with at least a fairly large population, and this British possession has in the past supplied, and is now supplying, a considerable portion of the labor for the Katanga activities. Rhodesia, however, has industries of her own, and in fact is now suffering a dearth of labor which in the future is sure to increase. Moreover, it

is possible that the Rhodesian government may at some future date prohibit the emigration of its natives to the Congo, as it temporarily did in 1910, the pretext at that time being the danger of spreading the sleeping sickness. Portuguese Africa supplies a few laborers, and although the South African mines draw, in part, their labor from these colonies, it is believed that a considerable labor force may be obtained from Nyassaland, Portuguese East Africa, and Angola. Whether Africa, however, can or cannot supply to the Congo an adequate labor supply, is a moot question. The Bourse du Travail du Katanga (Katanga Recruiting Agency), founded under royal patronage on September 12, 1910, was expected by some to solve the labor situation, but up to the present time it has been unable to meet the requirements of the different companies.

If African sources fail, there appears to be but one way in which the Katanga can rank as the copper-producing region its resources apparently warrant—namely, by the importation of Chinese labor. The Belgians are by no means novices in handling such labor, for it will be remembered that some of the more important Chinese railways have been built by Belgian engineers with Belgian capital. Further, in 1893, some Chinese labor was used in the construction of the Lower Congo railroad. A year ago an attempt was made to import Chinese to work the tin deposits of Kasonso (Katanga), but unexpected obstacles rendered this impracticable.

What are the difficulties in obtaining for the Katanga these patient, industrious, Asiatic laborers? It will certainly be expensive, for the importation and repatriation of each coolie in South Africa costs about \$85; the corresponding figure for the Lower Congo railroad laborers was \$160. Each Chinaman traveling by way of Beira, the most practical route to the Katanga at present, would presumably cost the companies \$100. The initial outlay, while great, would perhaps in the long run be found to be well expended. Possibly the Rhodesian government would not permit these laborers to pass through her borders. In South Africa there is a strong sentiment of 'South Africa for the whites,' and public opinion would be strong against the introduction of Asiatics, even into the Katanga. This difficulty could, however, probably be surmounted if the Belgian colonial government would assure the British authorities that the number to be imported was comparatively small, and that adequate measures would be taken to prevent the coolies filtering across the frontier into Rhodesia. Mine managers, however, feel that prior to the introduction of Chinese or other foreign labor, the colonial legislation which practically makes the 'boy' master of all situations, must be modified. The final solution of the

¹*Mining and Scientific Press*, April 19, 1913.

question, however, naturally depends on the adaptability of the coolie to the climate. The Katanga copper belt, situated some 11° from the equator and being almost a mile above sea-level, does not suffer from a particularly trying climate. The establishment of absolutely sanitary compounds and the recruiting of

themselves. Such taxation, however, is the very warp and woof of colonial administration. Theoretically, the Congo native now pays his taxes in money, to obtain which he must labor, but in reality the proportion of natives who pay their taxes is decreasing. Ready money being unnecessary, the natives are losing



TRANSPORTATION ROUTES AND MINING DISTRICTS IN THE CONGO.

particularly robust coolies, perhaps from South China, should, however, be factors of such importation.

Taxation

Some two years ago, when trading in the colony became general and the state no longer collected the taxes in rubber and other products, laws were passed which decreased the labor efficiency of the blacks. Ethically, neither England, Germany, the United States, nor any other power, has the right to tax natives who, if their wishes were consulted, would prefer to govern

the incentive to work, and those employed are less efficient through having no fear of losing their jobs. Laws recently passed and their interpretation have diminished the prestige of the whites to an alarming degree. Their exaggerated clemency means to the natives weakness on the part of the whites, and results in lack of discipline, even where the intent is to safeguard the natives' health. As an example, from December 1, 1912, to May 1, 1913, 595 natives broke their contracts and deserted, at Elisabethville alone. Of these natives, but 30 were condemned, and most of

these spent but seven days in—to them—comfortable quarters, with labor to perform less onerous than that of the mine. Due to the shortage of labor, many 'boys' naturally desert, with the perhaps natural purpose of obtaining a bonus for re-engagement elsewhere. Legislation recently passed may in the end be beneficial, though, in addition to legislation, its enforcement is essential to cause the native to respect his contract.

Facilities are being, and should be, further extended to enforce the young native to school himself, not only in the common branches and trades, but also in the belief that manual labor is honorable and necessary. The native is by no means hopeless, but to become, in the European sense, a good citizen, he must be considerably transformed both intellectually and morally, and such transformation will require decades, if not centuries.

Since last reviewed,² transportation facilities have been extended and bettered. The railroad from Elisabethville to Kambove, a large copper mine some 100

Boma, Lower Congo (89 miles built, 71 miles operated).

The Congo river fleet has been added to during the past year, and harbor and river improvements continued. Both the colony and private interests have roads under construction. Wireless telegraphy advances, and not only have Elisabethville and Boma talked with one another, but it is stated that the latter town and Brussels have signaled one another.

The Union Minière du Haut Katanga, in which company, it will be remembered, the Tanganyika Concessions, Ltd., has considerable holdings (about 42%), satisfactorily operated its copper mines in 1913. The production for the year was almost three times that of 1912. Although for the time being the fuel and ore supply problem appears to be solved, very rapid expansion is, as noted above, temporarily blocked by the present labor shortage. In his annual report for 1913, Jean Jadot, general manager for the Union Minière, presented the following table:

	No. days working...	Ore smelted, tons...	Content of ore, %...	Tons of ingot Cu produced	Copper in ingots, %.	Tons of Cu matte...	Matte Cu, %.....	Production of tons Cu per working day
1911	88	10,300	12 to 13	786	90	...	...	11.3
1912	171	20,900	13 to 15	2404	95	88	65	14.0
1913 (11 mo.):								
first furnace	208	48,500	15 to 16	6240	96	130	65	{15.6†
second furnace	90							{33.4†
†With 1 furnace operating.								
‡With 2 furnaces operating.								

miles distant, was completed on June 24, 1913, and a semi-weekly service established. Leaving the port of Cape Town Tuesday at 11 a. m., Kambove is reached at 7 o'clock the following Monday evening. Grading at both ends of the railroad from Kambove to Bukama, on the Congo river (190 miles), the last link in an all-rail and steamer route from Cape Town to the Atlantic ocean at Matadi, has been commenced. This road presumably will be finished in a couple of years.

The German Dar-el-Salaam-Lake Tanganyika railroad has just been finished, and the Belgian road from Kabalo on the Congo to Albertville on Lake Tanganyika was, on October 1, 1912, 45 miles from the lake. With the completion of the latter railroad, which should take place some time late in the spring of this year, there will exist an all-rail and steamer trans-African line from Dar-el-Salaam on the east to Matadi on the west coast. The distance is about 2980 miles, a little over one-half being by railroad. The Benguela railroad, traversing Portuguese West Africa and heading toward the Katanga copper field, has as its rail head Bihe, 323 miles from the Atlantic ocean. The Mayumbe railroad is slowly being extended north from

The total production for 1913 approached 7200 long tons of crude copper, with a copper equivalent of about the same number of short tons. In 1914 the production should be some 9000 or 12,000 short tons of copper. Analyses of shipments follow:

	April 1912.	July 1913.
	%	%
Copper	94.15	93.85
Cobalt	2.80	3.25
Iron	0.92	1.80
Sulphur	1.20	0.80

The Star of the Congo mine, situated near the smelter, produced monthly in 1913 about 15,000 tons of ore, of which 7000 tons was sorted and in part stock-piled for possible future treatment. Two steam-shovels to strip the overburden will soon be in operation. Early in 1913 two small sizing and washing plants were installed at the mine, and a set of log washers to enrich the talcose ore was to have commenced operation about the first of the present year. Formerly all ore had been obtained from this one mine, but early in June 1913 the railroad reached Kambove, and since August the smelter charge has consisted of sorted ore from the Star of the Congo mine, screened ore from the Kambove mine, and briquetted ore from the Laushia

²Transportation Facilities in Central Africa, S. H. Ball and M. K. Shaler, *Mining and Scientific Press*, April 12, 1913.

mine. Kambove furnishes about 600 tons of ore per week. At present the ore is being extracted in an open cut and dropped to a haulage tunnel, but in 1914 steam-shovels and open-cut mining are to be introduced. The Luushia mine, situated on the Elisabethville-Kambove railroad, at a distance of 56 miles from the smelter, can furnish daily 100 tons of pulverulent ore. During the year development was done at the Lukwishi, Likasie, and Chituru mines. The Union Minière employs at present about 200 whites and over 2000 blacks.

There was installed at the smelter in August a 6-press briquetting plant with capacity of 250 tons per 20 hours. No binder is used. The briquetted ore, especially that of the Luushia mine, is said to be excellent for smelting. The necessity of more extensive concentrating plants is recognized, and the question is being studied.

Consumption of Coke

Up to the end of 1912 European coke only had been used, but at that time Wankie (Rhodesia) coke began to be employed, and in 1913 constituted the only fuel. At first the coal prior to coking was not washed, and the coke, being high in sulphur and ash, was of poor grade. A coal washery has since been established, and partly due to this the average fuel consumption per ton of copper has fallen as follows:

		Tons.
European coke	1911	3.44
European coke	1912	3.00
Wankie coke, unwashed (first half-year).....	1913	3.44
Wankie coke, washed (second half-year).....	1913	2.90

A contract has been made with the Wankie Colliery Co. for 1500 tons of coke per month. In addition, one set of 22 Coppée coke-ovens, with monthly capacity of from 1500 to 1750 tons, was completed at the smelter in December 1913, and a second similar unit will be ready early in 1914. These are to use Wankie coal, the gases being used to fire boilers.

The two water jackets have worked fairly continuously since April 1913, and it is hoped that in 1914 they will work even more satisfactorily. A third water jacket has been sent to Africa and when this is installed at least two can presumably be kept in continuous commission. Mr. Jadot reports that during the months when the two water jackets were working simultaneously, using coke from the washed Wankie coal and Kambove and Luishi ore, the cost on board train at the smelter was about 700 francs per ton (this figures to about 6½c. per pound). The freight to Antwerp is about 300 francs per long ton, the copper costing a little over 9c. per pound at Antwerp. In 1912 the cost was about one cent per pound higher. In this figure neither general expenses nor marketing charges are included, and the average price of the copper produced during 1913 was somewhat above these figures, as the two furnaces were not running continuously. With a larger production, better ore dressing, and with coke made at the smelter, the cost should be somewhat further reduced.

In 1913 most of the copper was sold to the highest bidder in the Antwerp market, but a part of the product is said to have gone to Swansea, England. Cobalt, in addition to copper, is sometimes paid for. The production of 1914 has been contracted to the Frankfurt Metall-Gesellschaft, at prices varying with London quotations.

D. A. Lyons and M. R. Keeney, in the August 1913 *Bulletin* of the American Institute of Mining Engineers, pages 2134-5, give an interesting extract from an article by Stephan, who conducted at UGINE, France, experiments on the electrical smelting of the Katanga ores. Negotiations with the colonial government as to the formation of a subsidiary Belgian company to develop electric power in this part of the Katanga have been carried on, and it is possible, if financial conditions warrant, that such a company will be formed in 1914. It is of interest to note that the Belgian administration has had P. K. Horner, an American, as manager in Africa, and that recently A. E. Wheeler, the former superintendent of the Great Falls smelter, has been appointed consulting engineer.

Gold Mines and Production

The gold production increased satisfactorily in 1913, the output, if the state's forecast for the Kilo and Moto mines is correct, being some 1380 kilograms, valued at about \$828,000. In midsummer there were widespread reports of sensational gold discoveries in the Belgian Congo. These appear to have been without foundation. Fair alluvial ground has been discovered during the year at several places in the Uelle and in the Katanga, and some gold quartz in the Kilo region, but none of these are, as yet at least, known to be of much importance. Those at the head of Kibali river, southwest of Moto, appear most promising.

The four producing gold placers in the colony are situated in the northeastern part of the colony, a region of ancient rocks which have been deeply eroded. Beginning with January 1, 1914, the state will turn over to the Grand Lakes Railroad Co. the two larger placers of this region, Kilo and Moto. The profit beyond a certain amount, however, is to be divided between the colony and the railroad. In return for these and certain extensions to its prospecting rights, the Company relinquishes some 8,000,000 hectares of forest land. The Kilo placer is worked by primitive sluicing methods, although there is also a giant at work. About 30 whites and 2600 blacks are employed. The natives are paid a minimum wage of about 4c. per day and are, in addition, given food, lodging, blankets, etc. The gold is said to cost about \$347.40 per kilogram, and to be worth about \$579 per kilogram (or \$18 per ounce), silver being the chief impurity. Some \$7,250,000 of gold-bearing gravel is supposed to be blocked out. At Moto, where sluicing began in 1911, seven white men and 1350 natives are employed. Gravels containing gold valued at \$500,000 have been proved to date.

In the parliamentary discussions preceding the transfer of these placers from the colony to the Grand

Lakes Railroad Co., the following figures were presented regarding the operating of the Kilo and Moto placers, under state regime:

Year.	Cost of exploitation, francs	Sale of gold, francs.	Gold product of Kilo and Moto, kg.	Production.	
				Kilo	Moto
1908	559,000	981,424.27	311	311	...
1909	886,440	1,896,955.90	656	656	...
1910	1,165,950	2,520,903.47	876	876	...
1911	1,963,063	2,360,216.71	645	639	6
1912	2,052,262	2,834,551.83	984	740	244
1913	2,380,815*	1,767,863.36†	1360‡	...	...

*About.
†Incomplete.
‡Estimated.

Prior to 1908 the Kilo production was: 1905, 21 kg.; 1906, 212 kg.; 1907, 328 kilograms.

The Kanwa placer, owned by the Belgian-American company, Forestière et Minière du Congo, has added a small quota of gold, and the Babeyru placer has just started production.

Diamond Production Increases

To date diamonds have been found at the following places in the Belgian Congo: (1) in the gravels at many localities in the vast area lying in the triangle between the Kasai and Lovua rivers and the Angola (Portuguese West Africa) frontier; (2) as alluvial stones in the Mandoko zone in the extreme southwest part of the colony; (3) alluvial diamonds in Mutendola river, Katanga, a tributary of the Lualaba, and in that river itself above the rapids of Nzila; (4) in pipes in the Kundelungu mountains; and (5) at certainly three, and probably five, of the gold placers in the northeast part of the colony, as a by-product of gold placer mining. Of the latter, a few stones were obtained from the now abandoned state placer of Nebula-Bokwama, and several stones have been found at Kanwa and at least one at Babeyru, both placers being the property of the Belgian-American Société Internationale Forestière et Minière du Congo. The finding of several stones is also reported from the gold gravels of the Nizi river near Kilo, and of one at the Moto placer. Of these diamondiferous regions the Kasai and Kundelungu appear most promising. The Kasai² is presumably by far the most important of these diamond regions, and its gravels, at least in part rich, are now being exploited on a small scale. Exploitation began the past summer, the product for the last half of the year being some 15,000 carats. *The stones are of good water, but comparatively small, the grade being about that of the German Southwest African stones prior to the exploitation of the Pomono field.

² See S. H. Ball, 'Diamonds in the Belgian Congo,' *Eng. & Min. Jour.*, Feb. 3, 1913.

By a royal decree dated May 27, 1913, the Mandoko diamond zone was opened to general prospecting, as was a portion of the Kundelungu plateau region. In the latter region, however, the diamond concessions, covering some 250,000 hectares, or about 875 square miles, held by the Kundelungu company (the Katanga Special Committee and the Tanganyika Concessions, Ltd.), and by the Katanga Special Committee, were excepted. Within this area are the pipes now being investigated by these organizations. The pipes of the former company, which petrographically quite closely resemble those of South Africa, are eight in number (Talala, Louanza, Kogwama, Katipa, Maipaslu, Kambeli East, Kambeli West, and Shipuka), and the Katanga Special Committee owns four (Kataloi, Shilunga, Katwe, and Mafua, all on the Luizi river). The Kundelungu company began in the latter part of 1912 exploration of the Luanza pipe, and to the end of that year had found some 120 small stones. They averaged about one-sixth of a carat apiece, the largest being of about 3½ carats. At that time, about 4 whites and 60 to 70 blacks were employed. Since October 1912, from 250 to 380 cu. yd. of 'yellow ground' has been washed each month, containing a certain number of diamonds, from 30 to 40, according to some reports. A collection was exhibited in the Congo section at the Ghent Exposition the past year. In 1913 the same Company commenced preliminary work on the Msi-pashi pipe, which is connected with Elisabethville by motor route. Although the work at Luanza has not as yet shown it to be exploitable, the Company believes the work to be encouraging.

In the same region the Belgo-Katanga and the Industrielle et Minière du Katanga (recently amalgamated into the Société Belge Industrielle et Minière du Katanga) claim to have discovered 17 pipes of similar rock. These vary in size from 10 to 45 acres. The Company has taken as a prospecting concession one block of 200,000 hectares (772 square miles), and a number of smaller blocks. The 'ground' resembles closely the diamondiferous pipes of the Katanga Special Committee. In one area of about 10 acres, 80 bore-holes all struck 'blue ground' at about the same depth. It is stated that during the coming dry season (May-June 1914) testing will be begun on two or three of these pipes to determine whether or not they are diamondiferous.

Tin

But little advance was made in the past year in the Katanga tin region. At Muika, where both stream and lode tin occur, the Société de Recherches Minières du Bas Katanga has a small 5-stamp battery and concentrating plant. The cassiterite being rather coarse and the gangue light, milling is reported to be easy. The first concentrates reached Brussels in January 1913, and the monthly production in 1913 is reported to have been about ten tons of cassiterite. As a result of the excessive freight to Antwerp (over \$95 per ton of concentrate), and other high costs, the Company

has requested that the colony's allotment of profit be reduced, which presumably will be granted. A company is to be floated to exploit the 285 square miles of country at present held by the parent company. A plant to work the Union Minière du Haut Katanga tin deposits at Kasonso and Busanga was shipped from Europe in June. Up to early winter it had not as yet reached the mine.

Coal and Bituminous Shale

The coal reported to have been found last year on the Lukuga river near Lake Tanganyika and near the line of the railroad between Lake Tanganyika and the Congo, appears to cover a considerable area, the beds being traceable for some 12 miles. Some five slightly inclined beds occur at short vertical distances from one another. They vary in thickness from 2 to 6½ ft., and, taken together, are said to be some 16 ft. thick. The coal is sub-bituminous, hard and light, and some of it of brilliant lustre. It contains from 28 to 45% volatile matter, and 18 to 20% ash, and it has a calorific power of from 6500 to 7000 calories. For certain industrial purposes it will doubtless be a fair fuel. At present several white men and 200 negroes are prospecting the find, and if the royalty and taxes now claimed by the colonial government are reduced, a company will be formed to exploit it. In the vicinity of Ponthierville, on the Congo river, the Grand Lakes Railroad Co. estimates that there are available for quarrying 1,500,000 tons of bituminous schist, carrying from 60 to 100 litres of oil per ton.

The Congo copal, although in part fossil, does not perhaps strictly come within the province of this review. It is gathered from the surface by natives and by them sold to traders. The value of the product for 1910, 1911, and 1912 was, respectively, approximately \$250,000, \$635,000, and \$1,232,000.

General Prospecting and Mining Laws

Prospecting has been pushed throughout the colony during the past year although no startling discoveries have been reported. Up to June 30, 1913, in the Katanga, 369 locations had been made, of which 66 were for copper and the others for iron, manganese, gold, silver, platinum, tin, coal, bismuth, petroleum, diamonds, bituminous schist, cobalt, nickel, lead, and salt. During 1913 the Belgian-American company, Société Internationale Forestière et Minière du Congo, was given for 99 years the right to exploit its discoveries south of the fifth parallel south. The claims, chiefly for diamonds, gold, iron, and asphalt, cover about 4400 square miles. In 1912-13 the colonial government did a little drilling for salt near the salt springs in the Nyangwe region (upper Congo); no important discoveries resulted.

Several of the Katanga companies created in 1910 were in the past year in a position to begin exploitation, but they found the 33% of the gross production due by the colony, according to their charters, prohibitive. The matter has been taken up with the colonial

government, and a special committee has advised a considerable reduction in the taxes and royalties.

During the past year several of the Katanga prospecting companies have consolidated, and the stock of others has changed hands. In certain cases these companies, like the Grand Lakes railroad, have acquired an extension of their prospecting rights. During the latter part of the year some five companies asked for, and presumably will be given, prospecting rights south of the fifth parallel south, outside the blocks reserved by the Belgian-American company mentioned above. It is interesting to note that at least two of these are strong rubber companies, which, prior to the fall in the price of rubber, made large profits by trading in this region.

Mine Signal Codes

Following trips of the U. S. Bureau of Mines rescue car in the Lake Superior iron districts, some of the range associations of mining men are considering the changing of the signal code in general use to one which is simpler. The change is recommended by the officials of the mine rescue car on the ground that the simpler the code the safer and more effective it will be. The objection to changing is, of course, that accidents might result by confusing the new signals with the old; and, on account of the number of ignorant foreigners now working in the iron mines, it would take quite a long time before everyone entirely forgot the old signals and got accustomed to new ones. Under the old system generally in use, one bell is to stop hoisting or lowering, two bells means lower, and three bells means hoist. The new signals recommended would have one bell mean stop if in motion, hoist if at rest; two bells, lower; three bells would denote 'men on, run slow,' and the hoisting or lowering signal (one or two bells) would also be given.

The recommendations as given by a committee of the Gogebie Range Mining Association are as follows:

One bell: stop if in motion; hoist if at rest.

Two bells: lower.

Three bells: men on, run slow. Before men get on cage, ring three bells. The engineer replies with three bells if the return signal system is in use; if not, he replies by raising and lowering cage about six inches. When men are on cage, give hoisting or lowering signal (1 or 2 bells).

Nine bells: danger signal. Ring 9 bells, then station signal where danger exists, then repeat 9 bells. All hoisting must instantly cease, until verbal notice to engineer or by ringing of 15 bells releases the danger signal.

Fire signal: ring danger signal two or more times.

Station signals: shaft collar, 2-1 or 1 long.

First working level, 2-2 or 1 long and 1 short.

Second working level, 2-3 or 1 long and 2 short.

Third working level, 2-4 or 1 long and 3 short.

Fourth working level, 2-5 or 1 long and 4 short.

Fifth working level, 2-6 or 1 long and 5 short.

The committee recommended that in the interest of safety and efficiency, telephones should be installed at each working level.

Program of A. I. M. E. Meeting

New York, Tuesday, February 17, 1914

10 a.m.—Annual business meeting.

10:30 a.m.—Mining and Mining Methods in the Southeast Missouri Disseminated-Lead District,' by H. A. Guess; 'The Mill and Metallurgical Practice of the Nipissing Mining Co., Ltd., Cobalt, Ontario, Canada,' by James Johnston; 'The Disposition of Natural Resources,' by George Otis Smith.

2 p.m.—'Use of Electricity at the Penn and Republic Iron Mines, Mich.,' by William Kelly and F. H. Armstrong; 'The Application of Electric Motors to Shovels,' by H. W. Rogers; 'Electric Traction in Mines,' by Charles LeGrand; 'Safeguarding the Use of Electricity in Mines,' by H. H. Clark; 'The Safety of Underground Electrical Installations,' by C. M. Means; 'The Injection of Cement Grout into Water-Bearing Fissures,' by Francis Donaldson; 'Drilling Performances at the Kensico Dam, Catskill Aqueduct System, New York,' by W. L. Saunders; 'The Work of Crushing,' by Arthur F. Taggart.

Wednesday, February 18

10 a.m.—'Notes on the Plastic Deformation of Steel During Overstrain,' by H. M. Howe and A. G. Levy; 'Notes on Some Heating and Cooling Curves of Prof. Carpenter's Electrolytic Iron,' by Albert Sauveur; 'The Influence on Quality of Cast Iron Exerted by Oxygen, Nitrogen, and Some Other Elements,' by J. E. Johnson, Jr.; 'Research with Regard to the Non-Magnetic and Magnetic Conditions of Manganese Steel,' by B. Hopkinson and Sir Robert Hadfield; 'Manganese Steel, with Especial Reference to the Relation of Physical Properties to Micro-Structure and Critical Ranges,' by W. S. Potter; 'The Heat Treatment of Steel Castings,' by C. D. Young, O. D. A. Pease, and C. H. Strand; 'Notes on an Iron-Ore Deposit near Hong-Kong, China,' by C. M. Weld; 'Why the Mining Laws Should be Revised,' by Horace V. Winchell; 'Comparison of Mining Conditions Today with those of 1872, in their Relation to Federal Mineral-Land Laws,' by R. W. Raymond; 'Objections to the Apex Law in Mining Practice,' by C. F. Kelley; 'Should the Apex Law be Now Repealed?' by Charles H. Shamel; 'The Apex Law in the Drumlummon Controversy,' by Charles W. Goodale; 'The Classification of Public Lands,' by George Otis Smith.

2 p.m.—'American Steel Rail Situation,' by R. W. Hunt; 'Manganese-Steel Rails,' by Sir Robert Hadfield; 'Notes on Blast-Furnace Operation with a Turbo Blower,' by S. G. Valentine; 'Data Pertaining to Gas Cleaning at the Duquesne Blast Furnaces,' by A. N. Diehl; 'Pig Steel from Ore in the Electric Furnace,' by Robert M. Keeney; 'Notes on the Utilization of Blast-Furnace and Coke-Oven Gas for Power Purposes,' by Heinrich J. Freyn; 'Notes on Conservation of Lake Superior Iron Ores,' by Charles K. Leith;

'The Need of Uniform Methods of Sampling Lake Superior Iron Ore,' by C. B. Murray; 'Sound Ingots,' by Sir Robert Hadfield; 'The Segregation and Classification of the Natural Resources of the Public Domain,' by Frederick F. Sharpless; 'The Initiation of Title to Mineral Lands,' by Albert Burch; 'Good Ideas in the Mining Laws of British Columbia and Mexico,' by F. L. Sizer; 'Provisions for Judicial Review of Land Office Decisions,' by M. D. Leche; 'The Apex Law Illustrated by Decisions in the Cocur d'Alene,' by F. T. Greene; 'Uniform Mining Legislation in all States Based on Federal Acts,' by C. L. Colburn; 'Location of Mining Claims Upon Indian Reservations,' by Will L. Clark; 'What is Mineral Land,' by Grafton Mason; 'Mining Law Revision—How to Obtain It,' by E. B. Kirby.

Thursday, February 19

10 a.m.—Discussion on the question: (1) To what depth below the surface do the standing groundwaters extend? Opened with a paper by Alfred C. Lane. (2) To what extent is chalcocite a primary, and to what extent a secondary, mineral in ore deposits? (3) To what extent are the contact zones, often called garnet zones, produced by intrusive rocks from limestone walls, due to recrystallization of matter original with the limestones; and to what extent are they and their associated ores due to contributions from intrusive rocks? Opened with papers by Waldemar Lindgren and C. K. Leith. 'The Anticlinal Theory of Oil Accumulation,' by H. A. Wheeler; 'Scientific Installations for the Economical Burning of Liquid Fuel of Any Specific Gravity,' by W. N. Best; 'The Use of Petroleum in Dust Prevention and Road Preservation,' by W. W. Page; 'The Killing of the Burning Gas Well in the Caddo Oilfield, Louisiana,' by C. D. Keen; 'An Oil-Land Law,' by George Otis Smith.

2 p.m.—'The Equilibrium Diagram of the System $\text{CuS-Ni}_3\text{S}_2$,' by Carl R. Hayward; 'Cyanidation of Silver Sulphide at Ocampo, Mexico,' by Robert Linton; 'The Genesis of the Mercury Deposits of the Pacific Coast,' by J. Allen Veatch; 'Ore Dressing at the Morning Mill, Mullan, Idaho,' by Rush J. White; 'A Proposed New Converter, and the Application of the Bessemerizing Process to the Smelting of Ores,' by Herbert Haas; 'Milling and Hand Sorting of Lead Ore,' by R. S. Handy; 'Nickel Deposits in the Urals,' by H. W. Turner; 'The Burning of Coal Beds in Place,' by Alexander Bowie; 'The Use of Oxygen Helmets in Mine Fire,' by E. P. Dudley; 'Geology and Ore Deposits of the Bully Hill Mining District, California,' by A. C. Boyle, Jr.; 'Cementing Oil and Gas Wells,' by I. N. Knapp; 'The Age and Manner of Formation of Petroleum Deposits,' by E. T. Dumble; 'Geology and Technology of the California Oilfields,' by Ralph Arnold and V. R. Garfias; 'Water Intrusion and Methods of Prevention in California Oilfields,' by Franklyn W. Oldman; 'Chlorides in Oilfield Waters,' by Chester W. Washburn.

Mining Methods in the Bering River Coalfield, Alaska

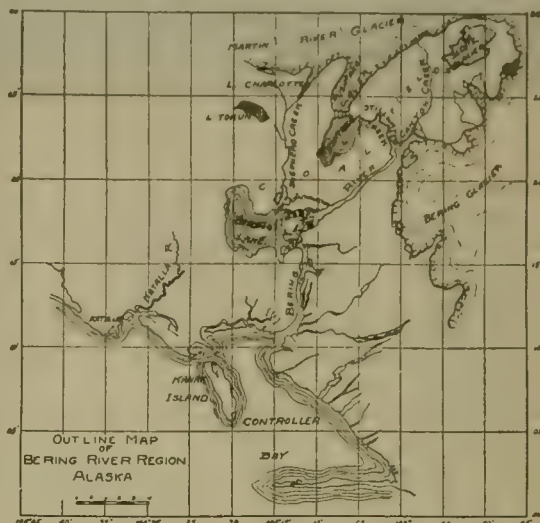
By W. R. CRANE

Work in the Bering River coalfield has, taken as a whole, proceeded little further than the location of claims. Of the five districts into which the field may be divided, namely, Carbon Mountain, Cunningham Ridge, Kushtaka and Carbon ridges, Bering Lake, and Lake Tokum, the largest amount of work has been done in the Kushtaka and Carbon ridges district. The Cunningham district probably stands second, while Bering Lake and Carbon Mountain occupy the third and fourth places, and the Lake Tokum district the last. From the standpoint of actual mining or extraction of coal, there is only one property in the region in which coal mining has been attempted, namely, the McDonald property, situated in the Bering Lake district. While considerable coal has been mined on various properties, it has practically all come from development work, such as the driving of drifts and tunnels.

Following the location of the outcrops of coal beds, development was begun. Camps were built at the most advantageous points on the creeks and as close to the work as possible in order to facilitate the handling of supplies and labor. The majority of the openings are adits which were driven into the coal beds from the outcrops. Occasionally an adit has been driven with the expectation of discovering a coal bed, the structure of the ground having indicated that it might be reached more expeditiously by an adit from the point chosen.

In the table below are given data regarding practically all drifts and adits at present in the Bering River field.

A number of the openings here listed are marked



'caved'; there were others in similar condition, but in such shape that no attempt was made to collect data regarding them. It is a fair and reasonably close estimate that not less than 4500 ft. of exploratory pas-

No.	Location.	Tot. length including No. laterals, of lat- ft. ersals.	Kind of opening.	Air connection.	Size, ft.	Remarks.
1.	Carmon Mt., near Hunts' cabin...	550	2 drift	Inclined shaft	7 by 7	1 in rock, 1 in coal.
2.	Clear Creek, below falls.....	8	none drift	None	8 by 7	In coal.
3.	Clear Creek, above falls.....	125	none drift	None	8 by 7	Ended in rock.
4.	Clear Creek, 2nd above falls.....	51	none drift	None	8 by 7	Part rock, part coal.
5.	Trout Creek, next to cabin.....	12	none adit	None	8 by 7	In rock.
6.	Trout Creek, below No. 5.....	355	3 drift	Connects with No. 7	8 by 7	1 caved, 1 in coal, 1 in rock.
7.	Trout Creek, above No. 6.....	214	2 drift	Connects with No. 6	8 by 7	1 in coal, 1 caved.
8.	Trout Creek, below 6, across creek.	31	none drift	None	8 by 7	No coal.
9.	Trout Creek, across from No. 8...	36	none drift	None	8 by 7	Caved.
10.	Trout Creek, below No. 9.....	466	5 drift	Air flue	8 by 7	3 in rock, 1 in coal, 1 caved.
11.	Trout Creek, below No. 10.....	29	none drift	None	8 by 7	Caved.
12.	Trout Creek, below No. 11.....	28	none drift	None	8 by 7	Ended in rock.
13.	Trout Creek, above cabin.....	72	none drift	None	8 by 7	No coal at end.
14.	Kushtaka Lake	360	none adit	None	9 by 10	Small bed crossed.
15.	Kushtaka Lake, north of No. 14...	50	none drift	None	8 by 7	Partly in coal.
16.	Lake Charlotte	30	none drift	None	8 by 7	In coal.
17.	On Grade Trail	71	none drift	None	8 by 7	Ended in rock.
18.	Carbon Creek, farthest south.....	469	none adit	None	8 by 7	No coal.
19.	Carbon Creek, north of No. 18....	147	2 drift	None	8 by 7	1 in coal, 1 in rock.
20.	Leeper Creek	50+	. drift	None	8 by 7	Caved.
21.	Bering Lake, McDonald mine.....	750+	none drift	Air-way	7½ by 8¾	Part coal and rock (rooms turned).
22.	Bering Lake, south of No. 21.....	100	none drift	None	8 by 7	In coal.
23.	Bering Lake, Poul Point.....	25+	. drift	None	8 by 7	Caved.
24.	Bering Lake, Powers creek.....	109	3 drift	None	8 by 7	In coal.
25.	Bering Lake, above No. 24.....	...	. drift	None	8 by 7	Caved.



FIG. 6. INTERIOR OF TUNNEL, KUSHTAKA LAKE.

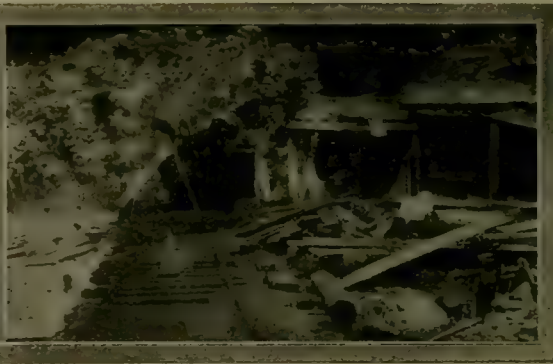


FIG. 7. TUNNEL ENTRANCE AND FAN, M'DONALD MINE.

sages has been driven in this field.

It is but natural that horizontal openings should be employed in the development of the coal beds of this field, and, owing to difficulties of transportation, the openings have been made along the course of the streams. Practically no development has been attempted on the outcrops situated on the slopes and summits of the mountains.

Adits, drifts, and slopes will be the commonly employed openings for the mines, the working of the coal lying above and below the adit and drift levels being accomplished by winzes or slopes. When slopes are driven from the surface the usual method of driving headings will be followed. Vertical shafts might be employed to advantage in some instances, but it is probable that an attempt will be made to keep the openings of the mines at as low a level as possible and to work from below upward as far as may be found practicable. All of the advantages of working with horizontal openings can be secured as a result of the nature and topography of the country and should result in a material reduction in cost of producing coal. The development of coal beds of more or less uniform dip which extend over considerable areas presents no serious or extraordinary problems, except when such beds are variable in thickness or are cut and disturbed by faults. The development of coal beds occurring in basins of varying widths and dips and pitching at various angles is quite a different matter. In the case of the regularly dipping beds the main haulage and air-ways would be driven down or up the slope, depending upon whether the beds were inclined below or above the level of the openings, headings and air-ways being turned off the main passages at such angles as to maintain proper grades for handling the coal.

Arrangement of Development

In basins the regularity and systematic arrangement of the development work possible in regularly inclined beds is largely lacking, and the headings or gangways follow the sides of the basins, maintaining such grade as is found desirable for haulage and drainage. Pro-

vided there are no faults in the beds, or counter folding does not exist, a more or less definite and regular arrangement of workings may be had in coal beds of uniform inclination or in basins. However, as faults, folding, and counter folding are prevalent in this field they will have to be provided for in the scheme of development adopted. Careful and systematic prospecting will indicate the existence of such irregularities so that they can be anticipated. The development of parallel beds, which are frequently found in this field, will require careful and systematic work, although owing to the fact that in many cases the beds stand almost vertically the conditions of support will be much less difficult than would be the case were they more nearly horizontal.

Rate of Driving Adits

The rate of driving drifts and adits in the Bering River coalfield varies largely with the character of material encountered, and the position of the strata, that is, whether the openings are driven parallel with or normal to the strata. Work done on Trout and Clear creeks and the Kushtaka and Carbon ridges district gives an idea of the usual rate of advance. Two men being employed in each instance, the rate was as follows:

Time, days.	Advance, feet.	Average per day, feet.
20	102	5.1
20	88	4.4
26	100	3.7
26	44	1.6
3	16	5.3
12	39	3.2
20	88	4.4

Average advance for 2 men per day, 3.9 or 4 ft. in 8 by 7 ft. drifts.

About half of this work was done in coal and half in rock, either alternating solid coal and solid rock or a combination of the two. The rate of advance was, of course, more rapid in coal than in rock, and therefore exceeded 4 ft. Owing to the broken condition of the coal little or no powder was required in breaking it and pick work was all that was necessary. The ad-



FIG. 8. TUNNEL AT KUSHTAKA LAKE.



FIG. 9. TUNNEL AT CARBON CREEK.

vance when working regularly averaged about 5 ft. per day. In rock work blasting was required, the holes being drilled by hand and the advance was about 3 ft. per day.

The steel used for drills was $\frac{7}{8}$ -in. with 1-in. cutting edge. Hercules, and Judson No. 2, 40% powder was used. Holes were placed in such manner as to secure the best results and not according to any definite arrangement. The holes varied in depth from 2 to $3\frac{1}{2}$ ft. The charge of powder employed varied from 1 to 2 sticks. The usual practice was to drill four holes to the round, although occasionally five and six were necessary. For a round of holes to make an advance of 3 ft. five holes were required, using $7\frac{1}{2}$ lb. of powder.

The cost of driving in rock and coal is \$4.50 and

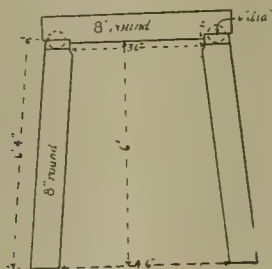


FIG. 1.

\$1.44, respectively. Should it be necessary to employ powder in working coal, an amount not exceeding two charges would be used which would average $1\frac{1}{2}$ lb. per hole, or 3 lb. per round. The cost per foot of advance would then be \$1.49. The timber for support of drifts and tunnels costs nothing except for labor of felling trees, cutting sets, and placing them. Two men can cut and place three mine sets, together with lagging, in a day. The cost would then be \$8 per day, or \$2.66 per set. The sets are placed 5 ft. centre to centre and give support to 15 ft. of drift, at a cost of 53c. per ft. The cost of a passage excavated in rock and supported would be \$5.03; in coal, with and without the use of powder, \$1.97 and \$2.02 per foot of advance.

Usually no drainage ditches are made, which is

particularly true when wheelbarrows are employed, but also when cars are used, care being taken to keep the bottom of the passage on one side of the ties free from coal and dirt. This is not always the case, however, for in the adit driven near the camp on Kushtaka Lake (See Fig. 8) a large drainage ditch was maintained on one side of the bottom of the adit. (See Fig. 2.) No record of work done in this tunnel is available but it would not be difficult to estimate the additional cost.

The adit on Kushtaka Lake mentioned above is

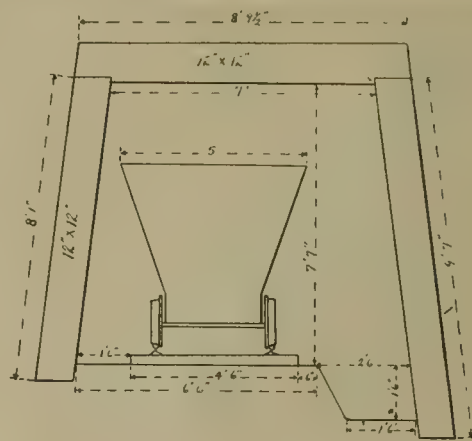


FIG. 2.

unusual in that there are four sections of different size in its 350 ft. of length. These are given below, the measurements given being from inside of sets:

Section.	Length. ft. in.	Height. ft. in.	Width of	Width of
			top.	bottom.
1st	38 6	7 7	9 11	11 8
2nd	156 6	7 7	7 0	9 0
3rd	48 0	7 4	4 0	5 0
4th	117 0	7 4	6 8	9 0

A sketch of the set used in the first section is shown in Fig. 3. This entire section was timbered with sets placed side by side, making a closed lining (see Fig. 6). In the other sections the sets were placed 4 ft. centre to centre. A standard set for drifts and tunnels is shown in Fig. 1.

The rock section of this tunnel will average about 8 ft. high by 12 ft. wide at the bottom. The timbers are hewn, which would increase the cost to practically that of sawn timber. There is only one other adit in the field that approaches the one mentioned above in size and cost. This is No. 18, as given in the list of adits and drifts. (See Fig. 9.) The two adits were driven by the same company, the Alaska Development Co., with holdings in the Kushtaka and Carbon ridges districts. Exploratory drifts have been driven in coal in a number of the mines in order to determine the thickness and extent of the coal beds in certain directions. These passages are usually as small as it is possible to conveniently work in, being 3 ft. wide and 6 ft. high.

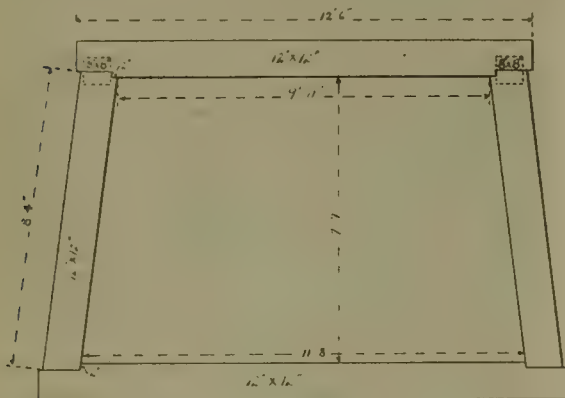


FIG. 3.

As previously mentioned, the McDonald property on Bering Lake is the only one in the field in which sufficient development has been done to warrant calling it a mine. An airway has been driven in this mine paralleling the main drifts and haulage way, at the mouth of which a mine fan is installed. As the dip of coal bed in which the main drift is driven is rather high, over 50°, it is necessary to carry the workings up the dip. To accomplish this, raises were driven in the coal directly up the dip at intervals of about 100 ft. These raises are 50 ft. long, 6 ft. wide, and vary from 4 to 6 ft. in height being carried the full height of the coal bed. They are timbered with posts and caps placed 6 ft. centre to centre and are divided into two compartments by a centrally placed row of props. On the right side, looking up the raise, is a chute boarded up to a height of 2 ft. with 2-in. plank. The remainder of the passage is used as a manway. The chute is 2 ft. 6 in. wide, and the manway is 3 ft. 6 in. wide. (See Fig. 4 and 5.)

At the end of the raises chambers are turned off and driven at right angles with them and are consequently parallel with the main drift below. These chambers are in reality only drifts, being 6 to 7 ft. wide and carried the full height of the coal bed. The chambers are supported by posts and caps, as are the raises. A row of props is placed in the chamber about 2 ft. from the posts on the right side, looking toward the working

face. Canvas is tacked to this row of props to form a brattice in order that air may be conducted to the face of the chamber. The airway paralleling the main drift has a section of 7 by 7 ft. and is placed 12 ft. to the right, on the raise side. From the airway raises are also driven connecting with a passage joining the chambers, which is in reality a continuation of the chambers, but the space between them is walled up and reinforced by small sets consisting of posts and caps, forming a passage 2 ft. square. This passage acts as a regulator and controls the amount of air entering the chambers. The coal mined at the face of the chambers is carried to the top of the chutes in wheelbarrows and is drawn off below through an ordinary chute with a wooden gate. The object in driving the chambers horizontally is to facilitate handling in wheelbarrows and to reduce breakage which would result were the chutes closed and permitted to stand full of coal. As it is, a large percentage of the coal is almost too fine for use by the time it is delivered to the coast. The employment of battery breasts is therefore out of the question.

In moderately dipping coal beds of sufficient size to warrant extensive development, the chambers could readily be increased both in width and length. By opening parallel chambers or driving additional raises the use of brattices could be largely obviated, thus increasing the convenience and decreasing the cost of mining and coal. Cars could be substituted for the wheelbarrows, reducing cost and breakage.

Cost of Mining Coal

The cost of mining coal by the method described, which really consists in driving, would closely approximate the costs previously given for driving. The work of breaking down the coal is largely done by picks, although in order that the coal may be mined in as large pieces as possible it is preferable to employ a number of charges of powder for each advance. One man can readily advance a 6 by 6 ft. chamber 5 ft. in 8 hr. As no lagging is employed in the chambers one man can make and place one set and extend the brattice in half a day. The cost of support would then be equivalent to the cost of a half day's labor. The cost of breaking down coal in a chamber per day of 8 hr. would then be \$6.41, or \$1.28 per foot of advance.

Assuming that the specific gravity of the coal is 1.3, the 180 cu. ft. of coal in place would weigh 7.31 short tons, which is the amount of coal produced in advancing the 6 by 6 ft. chamber 5 ft. The cost would then be 87c. per ton. As only one vertical shaft has been sunk in the field, the Grade Trail shaft south of Lake Charlotte, and as that one is partly filled by a fall of earth from the outcrop, no data could be secured relative to the cost of the work.

There is little hope that the comparatively high cost of development and mining can be reduced so long as the present high price of supplies is maintained, which is due in large part to the high cost of transportation.

The building of one or more lines of railway into the field and the establishment of steamship communication with the large cities of the Pacific coast will bring the needed relief and place the field on a competitive basis with other operating fields.

A majority of the drifts and adits of the field have

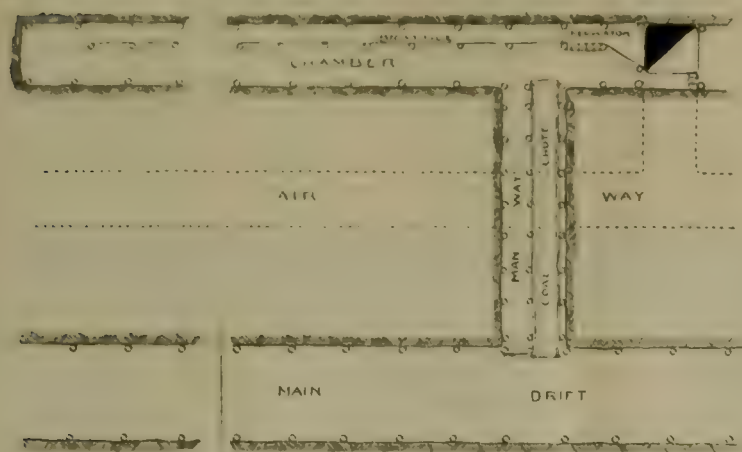


FIG. 4.

not attained sufficient lengths to make artificial ventilation necessary. Several of the openings have, however, been provided with means of insuring adequate ventilation. The means employed are: air shafts; raises connecting workings at different levels; air flues; and, in one case, an independent airway provided with a mine fan. An air flue is used in Trout Creek tunnel, and in Fig. 7 is shown the fan situated at the drift entrance to the McDonald mine. In the McDonald mine the fan can be employed either to force the air into or exhaust it from the airway, simply by reversing the direction of rotation. When used as a pressure fan the air currents first pass through the chambers, being discharged through the raises into the main drift; when employed as an exhaust fan, air entering the main drift is drawn through the raises and chambers and thence through the airway to the surface. A wooden box conductor is run along the top of the main drift and extends to within 20 ft. of the face, making connection with the airway by means of a diagonal offset at a point about midway of the drift. By this conductor the air at the face of the drift is kept fresh.

With respect to the dip of the coal beds there is nothing to prevent the application of the same methods of working that are in common use in the coal mines of other fields; and, owing to the fact that the coal beds of this region have the full range of inclinations from the horizontal to the vertical, an unlimited variety of methods could be employed each suited to a particular condition. There are, however, two conditions that will probably seriously interfere with and limit the application of any mining method to these coal beds, namely, the badly broken condition of the coal and poor top formations. The former will be of minor im-

portance provided the coals are used in making coke or for briquetting, but for steaming and other commercial purposes the prevention of undue breakage by handling will be a serious problem. Poor top formations will of necessity require narrow work or extensive and systematic support, in either case causing materially increased cost of production.

Owing to the position of the coal beds and the character of the country, the drainage of the mines is likely to prove a difficult task, particularly in those properties where inclined and vertical shafts and slopes are used. In the majority of the mines the openings, as previously pointed out, will be drifts and adits, in which case almost any quantity of water can be handled readily and at small expense. The drifts and adits at present driven discharge all water entering them, and that too without, except in one or two instances, drains being provided. Drains of ample section and special openings driven for drainage purposes alone would easily handle all the water that could reasonably be expected to enter the mines.

By adapting the coals of this region to the use to which they are best fitted by their chemical and physi-

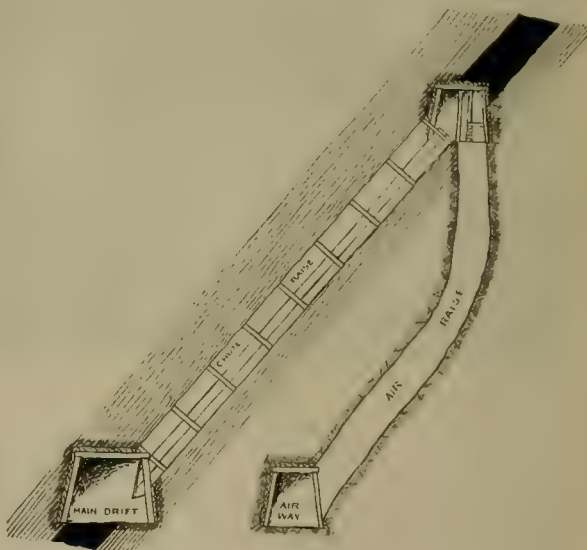


FIG. 5.

cal properties there is little doubt but that they can be mined and marketed in competition with the coals of any other locality in North America.

Flotation of ores by the Minerals Separation process in 1913 was responsible for the treatment of approximately 3,000,000 tons of zinc, lead, and copper ores. During the current year the Company figures on its processes treating 4,000,000 tons.

Pis Pis Mining District

The concession originally granted James Deitrick in 1902 and subsequently acquired by the United States & Nicaragua Co. has since served to cast a cloud over mining titles in the Pis Pis district. The *American*, published at Bluefields, printed the map reproduced below, January 28, and in that connection stated that "it has been a question since the granting of this concession as to whether the mines in operation in the Pis

Great Falls, a water power that was almost conceded to it, is fully three miles to the eastward of the line.

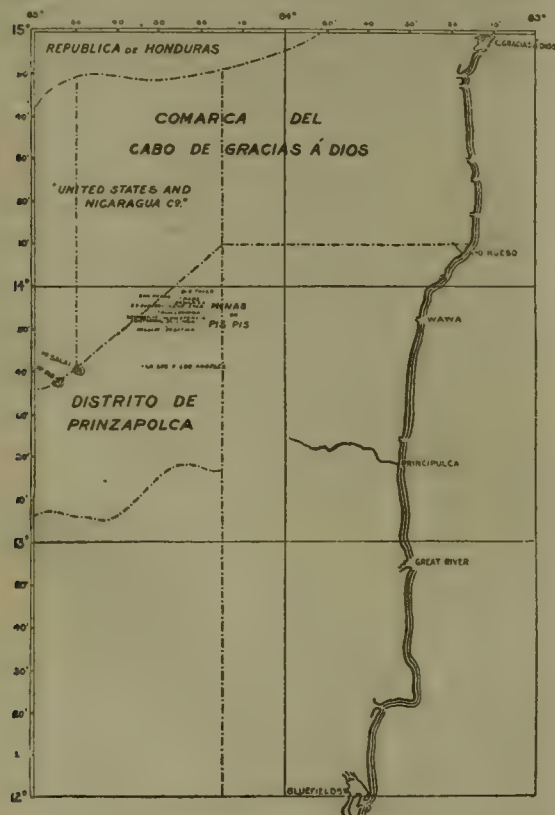
"While it is apparent that the concessionaires never had any intention of developing the territory, relying on the possibility that prospectors would locate claims which would accrue to them without the labor and expense attendant on intelligent prospecting, certain it is that they have suppressed the development of that immense territory, estimated at 7000 square miles, known to be the richest in all of Central America, for nine years, outside of creating apprehension on the part of legitimate miners in the Pis Pis district and preventing investment by capitalists who were anxious to safely establish themselves there."

Industrial Accidents Under Compensation

The Nevada Consolidated C. Co. and the Steptoe Valley S. & M. Co. have recently made public comparative figures of the number of industrial accidents in their plants before and after the Nevada industrial insurance law went into effect. The table below is summarized from these figures as published in the *White Pine News*. The first period was from January 1 to July 27, 1913, while the companies were carrying their own risk. The second, for which the figures are set in italics, was from July 28 to December 31, after the new law went into effect. Of the total number of accidents, 52.7% happened to the 'American' and 47.3% to the 'foreign' laborers. The second period showed a net decrease of 32% in time lost.

Nevada Con.	Total shifts.	No. of accidents.	Total disability.
Veteran mine:			
American	13,740	9	56
	<i>6,120</i>	<i>4</i>	<i>30</i>
Foreign	55,530	41	299
	<i>34,110</i>	<i>12</i>	<i>210</i>
Steam-shovel:			
American	53,340	36	703
	<i>42,270</i>	<i>22</i>	<i>246</i>
Foreign	61,830	79	1217
	<i>51,540</i>	<i>37</i>	<i>355</i>
Steptoe Valley:			
American	209,700	46	493
	<i>138,060</i>	<i>27</i>	<i>617</i>
Foreign	131,070	41	774
	<i>91,320</i>	<i>30</i>	<i>207</i>
Totals	525,210	252	3542
	<i>363,420</i>	<i>132</i>	<i>1665</i>

Large deposits of iron, copper, chrome, and other ores occur in the mountainous district of Asia Minor. Few mines have been developed, although a number of prospecting permits have been granted by the Turkish government. The Caramanian Iron Co. produces 20,000 tons of ore per year. Austrian and German mining engineers and promoters have recently visited this region with a view to purchasing some of the mines mentioned, but no definite transactions have been reported as yet.



MAP OF PIS PIS DISTRICT.

Pis district were included within the limits claimed by the concessionaires. The concession owners promptly laid claim to the district and the Government supported them by refusing to accept denouncements in the disputed territory. The mine-owners were very busy people during the first years, struggling with a high-grade ore and bad transportation; consequently nothing was done to settle the question nor to ascertain the exact position of the existing mines. The owners of the concession were not compelled by the Government to run their lines, and they have not yet done so. Recently the mine-owners arranged with William Pfaeffle, who is well known as an exact and careful engineer, to make the surveys necessary to determine the exact latitude and longitude of each of the mines, with the result of determining that not one of the properties in the Pis Pis district are within the boundary claimed by the United States & Nicaragua Co., and that even

Hydro-Electric Power in Chile and Peru

By LEWIS R. FREEMAN

*Fall, volume, and continuity of supply are the three prime essentials in the generation of electricity from water-power, and, except in the pampas country and the rainless district of northern Chile, these are to be found in almost every part of South America. From a mere physical standpoint, probably the finest opportunities for power development on the continent, if not in the world, are to be found on the eastern slopes of

the eighth parallel, north of which to the Peruvian line are the rainless deserts of the nitrate provinces, south to Tierra del Fuego and the Strait of Magellan, there is not a city, village, or hamlet that can not be cheaply and efficiently served with electricity generated, in many instances, within 10 and in no case over 20 miles from its centre. And few, indeed, are the towns and cities of Chile which could not, between lighting, trolley



LAJA FALLS, CHILE.

the cordilleras of the Andes in Peru, Bolivia, and Ecuador, where the moisture-laden clouds from the Amazon valley dissolve into rain upon the cold slopes of the great mountain barrier. Here, lofty mountains and tropical rainfalls form a number of river systems which for waterfalls, cascades, and torrential rapids, are unrivaled in the world, save where the monsoon from the Indian ocean precipitates its moisture upon the southern slopes of the Himalayas. Unluckily, in this region there is not at present any market whatever for this power.

For easy and comparatively inexpensive hydro-electric development, Chile, with the possible exception of Switzerland and Kashmir, is the most favorably situated country in the world. From about the twenty-

lines, mines, sawmills, and general manufacturing, find the use of such power to its economic advantage. The narrow strip of Chile between the cordilleras and the coast is, for a considerable part of its length, as densely populated as Switzerland, and, with a people scarcely less industrious than the Swiss, there is no reason why the water-power possibilities of the Andes should not be turned to good account industrially here as in central Europe.

There are several hydro-electric installations, building or projected, in Chile at the present time; and though many of these are of greater magnitude, it is not likely that any of them will be begun at so fitting a time properly to impress the people with the possibilities of hydraulic development as happened in the instance of Valparaiso's first hydro-electric plant, when

*Abstract from the *Bulletin* of the Pan American Union.

there was a serious shortage of coal in Chile. Chile's finest power project is that of harnessing the magnificent falls of the Laja, sometimes called the Niagara of South America. The Laja is the main branch of the Rio Bio-Bio, which flows into the Pacific near Concepcion. The latter is the largest of the rivers of the southwest coast, and the Laja probably has a flow little less than that of the Hudson at Albany. The falls are over 100 ft. high, with the physical conformation of the banks of the river ideal for economic installation. Unluckily, this splendid fall hardly lies within practicable transmitting distance of the region where power is most needed, Santiago, Valparaiso, and the valley of the Aconcagua. Concepcion, Talchuan, Chillan, and the populous intervening country, with several hundred thousand inhabitants in all, will reap full benefits of Laja power, however, and several divisions of the government railway, with their branches, may be operated.

Opportunities for Development

Southern Chile, from the Bio-Bio to the Strait of Magellan, with its rolling hills, rich valleys, and heavy winter rainfall, has more water-power than it will know what to do with for some decades to come. Swift perennial streams flow from the mountains every few miles, and there is not a village in this part of the country that could not be served from two or three different sources. What is probably the finest opportunity for power development in this region occurs on the Rio Choshuenco, where that fine stream, in its 1200-ft. drop from Lake Perihueco to Lake Panguipulli, falls nearly 150 ft. at one point. Upward of 25,000 hp. could be developed there at a comparatively small cost, but the ideal installation would be an intake at Lake Perihueco with a power-house, 10 miles away and 1200 ft. below, on Lake Panguipulli. This would be an inexpensive piece of work; yet there are few other points in the world where 200,000 or 300,000 hp. could be developed at an equal cost. The fact that this power-site lies in the pass of San Martin, which, on account of its low altitude, will undoubtedly be chosen as the route of South America's first broad-gauge transcontinental railway, makes it certain that a considerable market for power will be created for 200 miles east and west.

Chile's great power market lies in the cities of Santiago and Valparaiso and those of the populous Aconcagua valley, all of which are within practicable transmitting distance of each other and of a number of possible sites for development of hydraulic energy. The most comprehensive projects are those which plan to develop at a number of sites on the Colorado and Aconcagua rivers and transmit it to the various cities in the valley below. The Aconcagua is the fine stream which the railway follows down the Chilean side of the Uspallata pass, and the Colorado is its main branch. Both rise on the western watershed of the great Aconcagua, the highest peak in the Western Hemisphere, and are, therefore, drawing their flow from a storage unrivalled save by that of the Himalayas.

There are few sheer falls of great height on either river, but for 50 miles or more of their courses each of them is a torrent of cascades and rapids where a fall of 300 or 400 ft. may be obtained in a mile or two at almost any point. The minimum flow of these fine streams, if utilized only in such plants as are already projected, will furnish power for the most populous section of Chile for many years to come. There are a number of other good power sites within economical transmitting distance of Valparaiso and Santiago, but the Aconcagua-Colorado projects will probably fulfill the demands at the least cost.* The hydro-electric installations which supply power in Peru are, perhaps, the most notable completed to date in South America. The largest of these is at Chosico, 25 miles from Lima, where a fall of 125 ft. has been secured in a short distance with a flow of five cubic metres per second. The current is transmitted to Lima at 33,500 volts. The Polovora plant in Lima utilizes a fall of about 80 feet. Another station at Chaora Sana, 3 miles below that of Chosico, utilizes the same waters, that of the Rio Reisano, to develop 6000 hp. By going farther afield, the power supply of the Lima district may be augmented greatly, and as plans for extending the interurban lines and electrifying the steam lines are being energetically carried out the local power demand is likely to prove very considerable.

At Charcano, 8 miles from Arequipa, 1000 hp. is developed at a station which receives its water through 1¼ miles of canal. The flow of water is 4 cubic metres per second, and the fall about 90 ft. Several other towns have modest hydraulic installations, as have also a number of mines, sugar plantations, etc. A hydro-electric station, which, with the Oroya railroad is the highest in the world, is at the Alpamina mine, at an altitude of over 16,000 ft. above sea-level. The electricity is generated direct at 3000 volts and transmitted about 5 miles. At this station, as well as those of the Cerro de Pasco mines, which lie at an altitude of over 13,000 ft., great precautions have to be taken to avoid the interference of static electricity, always a troublesome factor at great heights. In all, between 75,000 and 100,000 hp. has already been made available in Peru by hydro-electric installations.

The Power Market

A lack of demand, rather than of a potential supply, may be also ascribed as the reason for the fact that little has so far been done in hydraulic development in Bolivia, Ecuador, Colombia, Venezuela, and Paraguay. The three countries first named are especially well watered, while their physical conformation leaves little to be desired from the standpoint of the hydraulic engineer. Population and industrial development are conditions precedent to a demand for power at whatever cost, and until this demand is created hydraulic development will be confined to the vicinity of a few of the larger cities and the more progressive mining districts.

A Coeur D'Alene Electric Plant

By GIRARD B. ROSENBLATT

The electric equipment of the property of the National Copper Mining Co., 4 miles northeast of Mullan, in the Coeur d'Alene district of Idaho, constitutes one of the most interesting that has been made in that district for some time. Power will be purchased from the Washington Power Co. under a contract which makes it desirable for the mining company to maintain as high a power factor on its load as possible. The mining company has water rights from which approximately 600 hp. can be developed and it was determined to utilize this to supply part of the power requirements of the mine and mill, and at the same time to use these generating stations to improve the power factor as much as possible. Accordingly two hydro-electric plants will be built on Dead Mans creek situated so as to secure the maximum amount of power from the available water. In each plant there will be installed an impulse type water-wheel driving a 200-kw. 3-phase, 60-cycle generator. These plants will be connected to the load in parallel with the power supply of the Washington Water Power Co. No attempt will be made to regulate the load taken by these plants, and as a consequence the water-wheels will not be supplied with governors of the ordinary design. They will, however, be supplied with overspeed governors which will deflect the water-wheel nozzles in case, through any accident, the load on either or both of the plants is disconnected, which would tend to allow the water-wheel to race. When the machines are connected in parallel with the power company's lines, the frequency delivered will necessarily fix the speeds at which the generators can run and they will take as much of the mining company's load as the water running through the water-wheels will permit. They will, therefore, always be developing as much power as possible, yet their speed will be fixed and held constant by the frequency of the power company's supply lines. The fields of these generators will be so designed that, by adjusting their excitation properly, a high power factor on the entire load will be secured.

One of these hydro-electric plants will be designed for operation in the usual manner by an attendant in the station. The other plant is designed to run without attendance and the generator may be connected to or disconnected from the load from a distant point (the compressor station at the mine) by means of electrically operated switches. The governor on the water-wheel will be also controlled by the same mechanism which operates the switches and the plant will be stopped or started without anyone going near it. The installation at the mine will consist of approximately 300 hp. in induction motors, the largest being a 200-hp. Westinghouse motor driving an air-compressor.

The mill, which has been designed and is being built by the General Engineering Co. of Salt Lake, will be

driven by approximately 600 hp. of induction motors. Each department of the mill will be driven by a separate motor, the two largest individual machines being a 300-hp. motor on the Hardinge mill department, and 200-hp. for the dry-crushing department. All the motors will be equipped with suitable protective apparatus to cut them off from the supply lines in case of overload or in case of failure of power.

Electric haulage will be used underground to handle the ore, and the ore will be transported from the adit mouth to the mill over an electric railway, which is unique in some of its features. The run from the adit to the head of the mill is about 10,000 ft. and in this distance there is a drop of 450 ft. in elevation, necessitating a grade of $4\frac{1}{2}\%$ on the railroad. The railroad is built along the side of Dead Mans gulch and has a 24-in. gage and is laid with 30-lb. rails. The ore will be transported down this railway in trains of 8 to 12 cars, each car carrying 4 to 5 tons of ore. The equipment is designed to handle 500 tons in two shifts of 8 hours each. The average haul within the adit will be about 5000 ft. and the grade on this inside run will only be $\frac{1}{2}\%$ per cent.

From this it will be seen that a comparatively light locomotive would handle all of the work inside of the adit but that a locomotive of about 8 tons in weight on drivers would be required for the work on the electric railway from adit mouth to the mill. It was, however, considered undesirable to have two different types of locomotives which could not be used interchangeably, and this was particularly so in view of contemplated extensions underground, which might require the service of an additional locomotive. Accordingly it was decided to standardize on a four-ton locomotive, which could be used independently underground, but which could be consolidated into an 8-ton tandem unit for haulage over the electric railway. This arrangement is of particular advantage in that it reduced the number of motormen required. Other advantages are that a double 4-ton tandem unit is easier on the rails than a single 8-ton unit would be, and also that with the gage in use adequate motor capacity of good design can be placed between the wheels of the locomotive. It is estimated that the tonnage handled can be doubled by adding another 4-ton locomotive at a later date, and arranging motors so that the two locomotives used underground can be used alternatively as the following unit of a tandem couple with a third locomotive operated only on the outside haul.

It was originally intended to construct a gravity tram to take care of the transportation of the ore from the adit to the mill, but a careful engineering investigation proved that an electric railway would handle the ore considerably cheaper, even on the steep grade involved. In fact a careful analysis which was made before a decision was reached indicated that the saving of the electric railway over the tramway would amount to several cents per ton handled. The installation cost of the railway is a little less than the esti-

mated installation cost of an aerial tramway. The saving in operating cost is effected by obviating the necessity of handling the ore at the adit mouth, and by reduced labor charges at the mill. With the present installation, the trips will be made up at the ore-chutes in the mine, and the complete train as made up at that point will proceed out through the adit over the railway to the storage bins at the mill, where the same crew, consisting of a motorman and a trip man, who came out with the train will see to the dumping of the ore.

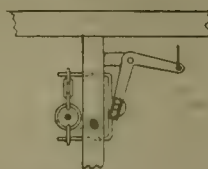
All of the electrical equipment for this installation is being furnished by the Westinghouse Electric & Manufacturing Co. The electrical design for the mill equipment is in the hands of the General Engineering Co. and the electric haulage system is the work of F. Cushing Moore, chief engineer for the National Copper Mining Co., who worked in conjunction with the engineers of the Westinghouse company.

Counterbalancing Hoists

The Balliet system of hoisting in balance was described in our issue of December 13 but owing to restrictions incident to patent proceedings it was impossible at that time to give full details as to the method of adding the counter load. The figure herewith printed makes this matter clear. In addition to the ordinary counter-weight a series of chains are used as shown. These are of different lengths and hung from different points in the shaft so that it is possible by choice among them to balance the hoist at any level from which it is proposed to hoist. Details of operations at Tonopah, Nevada, are given below, the figures being taken from the annual report of the Buckeye Belmont Mines Co., for 1913:

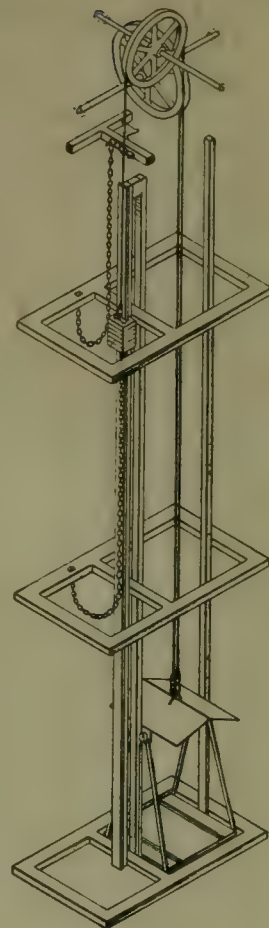
	Un-balanced.	Counter-balanced.
Hoisting speed feet per minute.....	700	700
Depth of shaft (hoisting feet).....	1200	1200
Weight of 1250 feet hoisting cable....	1160	1160
Weight of empty skip.....	1600	1600
Net load of ore or rock hoisted.....	1500	3000
Weight of counterbalance cable.....		744
Weight of cast iron counterbalance....		500
Continual balance weight (chain)....		1768
Deadweight (skip down plus hoist cable)	2760	1236
Gross load, 1500 lb. rock to hoist (lb.).	4260	4236*
Computed power hoisting deadweight (hp.)	59	27
Actual peak or starting torque (hp.)..	211	160
Computed hp. ignoring friction for gross load	90	90
Computed hp. for 1500-lb. net load...	31.7	63.6*
Power actually used (meter reading) hp.	161	120
Percentage of Power Used—	Per Cent.	Per Cent.
Computed to handle deadweight.....	37	24
Net load 1500 lb.....	20	53*
Balance 71 hp. charged to friction...	43	23†
Total per cent.....	100	100

*With 3000 lb. 730 hp. charged friction.



Allowing two minutes time for starting, hoisting, and stopping, at 4c. per kw. hour, and the cost of rock hoisted is 20c. per ton unbalanced, and 8c. per ton when hoisted in balance. The theoretical horse-power required to raise one ton 1200 ft. in two minutes would cost 4c. at the rate of 4c. per kw. hour. Therefore these figures show that unbalanced the efficiency is 20%, while with the counterbalance the efficiency is increased to 53%, or in other words two and one-half tons is hoisted for what one ton formerly cost. There are some slight variations in these figures, apparent inaccuracies, which were unavoidable for the reason that in figuring horse-power a known load is

supposed to have been hoisted in order to compute theoretical horse-power, instead of average load of rock, and absolute accuracy would be essential in the weight of the cable and empty skip. A few feet in length of the cable makes a difference in the meter reading, likewise a little dirt sticking in the empty skip would make a difference, while the load used in making the figures was the average hoisting load.



The Supreme Court of Ontario, on December 19, delivered a judgment of considerable importance to mining prospectors. This was in the suit of Perron v. Hurd. They were prospectors in the Kirkland Lake district. In measuring his claim, Perron staked a length of 22 in place of 20 chains, and Hurd's claim, adjoining, consequently overlapped it by two chains. Perron contended that he had complied with the requirements of the law, to the effect that the measurements were to be "as accurate as could reasonably be ascertained," urging that it was practically impossible to give exact measurements. The Court decided that all claims registered, to be valid, must be accurately measured, and that no prospector could claim anything more than 20 chains each way.

Copper Production of Japan in 1913

From the returns of important mines, it has been estimated that the total production of copper in Japan in 1913 would be approximately 72,000 tons, the most important mines having made the following outputs:

	Tons.
Ashio	10,600
Kosaka	9,000
Hidachi	9,500
Besshi	8,500
Other mines	34,400
Total	72,000

The production of copper in 1903, ten years ago, was only 32,000 tons, and that in 1912 was 65,000. Thus the copper production of Japan has been steadily increasing, and probably will continue to do so.

The Ashio mine stands first in output, not only in Japan, but in the Far East. The recent improvements of the mines and the works, and the completion of a railroad to the mine have made possible a marked increase and great economy. The future of the property is bright. A fire visited the property late in December, resulting in about 80 houses being burned near the Tsudo adit. No damage to the mines themselves occurred. The production of copper from Besshi is expected to increase hereafter steadily and the mine has large reserves. The Kosaka and Hidachi mines stand high in total production, but partly because of the smelting of custom ores from several mines. The Ashio and Besshi are the producers of copper from their own ores.

For many years Japan was an exporter of copper to the foreign countries, but this condition is now changing. The rapid development of wire making and manufacturing of electrical machinery is making Japan a user of copper as well as a producer. The amount of copper consumed at home in 1913 has been estimated at 35,500 tons; that is, about one-half the amount of the whole production. Estimates of this consumption are as follows:

	Tons.	Per cent.
Copper wire	14,500	40.8
Copper articles	2,500	7.1
Brass making	18,000	50.7
Naval and army purposes	500	1.4

The exports of copper for the 10 months ending with October were as follows:

	Tons.
China	10,300
England	6,360
France	4,650
Hongkong	3,900
India	1,500
Germany	1,200
Others	5,290
Total	33,200

In the last two months the exports to China amounted to about 2000 tons, and to other countries about 1300 tons. The total may have reached about 36,500 tons.

Rulings of the California Accident Commission

The Commission holds that chauffeurs, private or otherwise, come under the compensation provisions of the act without any election on the part of the employer being necessary. It has also expressed itself as being of the opinion that the reasonable cost of necessary transportation immediately connected with the injury is a proper charge for medical treatment under the compensation act. It has ruled that members of voluntary fire departments, operating without remuneration, and public officers, who serve without remuneration, are entitled to medical and surgical benefits, but are not entitled to any other compensation benefits. In the case of farm employees, it expresses the opinion that work done on a farm by employees of the farmer for the maintenance and operation of such farm, is excluded from the compulsory provisions of the compensation law, but that such farm employees can proceed against their employers by means of a suit for damages, said suit being filed under the first two sections of the Roseberry act. The Commission has also stated that it will assume jurisdiction where employers residing in California and employees residing in California make a contract of hire in California, without reference where any accidental injury or death may take place. In each case of seasonal employees the Commission holds that it will seek to ascertain the average annual earnings by testimony showing the earnings throughout the year of the individual concerned. The Commission will be glad to receive and answer inquiries regarding interpretation of the law.

Cost of Hauling by Motor Truck

At one of the small lead mines in the Mississippi Valley a 3½-ton motor truck is used to haul concentrate from the mine to the railroad, a distance of two miles. On the return trip the truck hauls coal and supplies to the mine. The original dirt road was improved by adding crushed rock in places and a top dressing of 'chats' to make it suitable for hauling by motor trucks. The Company has kept accurate records of the expense of operating the truck so that it is possible to calculate the exact cost per mile and per ton-mile. The labor employed consists of a driver, a helper, and three loaders. The truck usually makes from seven to nine round trips in a day, and hauls a load of 3½ tons of coal or concentrate.

The records for the month of September, 1913, show that the truck ran 888 miles, and transported 1095 tons. It used 301 gal. of gasoline and 36 gal. of oil. The cost of labor for the month was \$256.35, which includes the wages of the driver, helper, and loaders. The cost of repairs was \$9.58; tires, \$39.96; road work, \$63.44; and unloading coal, \$2.80. The total operating expense was \$442.59, and the cost per mile was 49.82c. The cost per ton was 40.4c., and per ton-mile 20.2 cents.

Discussion

Readers of the MINING AND SCIENTIFIC PRESS are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment. Insertion of any contribution is determined by its probable interest to the readers of this journal.

Solution Control in Cyanidation

The Editor:

Sir—The publication of my contribution on solution control has evidently displeased James S. Colbath, whose criticism appeared in the October 11 issue. In his reply, Mr. Colbath utters a protest against an article which contained a résumé of the details of zinc precipitation, a discussion and a new definition of available cyanide, the results of a large number of experiments and tests, results showing the effect of the addition of acid to a normal cyanide solution, the results of experimental work dealing with the question of acidity and regeneration, and extensive arguments and details of tests intended to prove the absence of regeneration with alkali in plant solution under normal conditions. Under examination the 'protest,' as such, turns out to be little more than an apparent objection to details of tests intended to prove the absence of a recognized method of direct testing for free cyanide. In support of his attitude on the question he neither mentions nor does he discuss the arguments and proofs I brought forward in support of my contention; neither does he adduce one single argument or proof in corroboration of his own impressions. His attitude is inexplicable. He has evidently not taken the trouble to read the article he attempts to criticise.

LEIBIG'S METHOD

Mr. Colbath makes a definite statement that: "Most working solutions permit of a single determination of free cyanide by direct titration with silver nitrate regardless of the alkalinity." I most emphatically disagree with him in the expression of a timeworn theory. My article contained much argument and the results of numerous tests disproving this; and Mr. Colbath is not likely to advance his position one iota by the mere statement, even though it be associated with a 'protest' against any effort to throw more light on the matter. In the presence of zinc compounds there is no definite end point to be observed and, even if the results were approximately reliable, this fact would make the method unsuitable for routine control in the plant. Clennell states:* "The method works admirably with pure cyanide solutions, but gives very uncertain and inaccurate results in presence of some of the impurities which are generally introduced during treatment of ores."

"The method," Mr. Colbath continues, "depends on the presence of zinc, which acts as an indicator, and

in addition the solution must be perfectly clear, as well as the flask in which the titration is made." The use of zinc as an indicator is, as far as I know, quite new. In what form and quantity is it used, and what compound of zinc and silver nitrate is responsible for the opalescent end-point mentioned? Or does Mr. Colbath refer to a zinc compound in the solution when he mentions zinc? In any case, further details would be of interest. As regards the precautions which are insisted upon against an attempt to titrate with a cloudy solution and an opaque flask, these are elementary.

After quoting the generally accepted theory as to regeneration with alkali, Mr. Colbath continues: "The above method * * * will indicate decrease of free cyanide during precipitation, in contradiction of Mr. Allens' experiences, but in accord with the principles of chemistry." My statements on the subject were accompanied by definite and carefully checked titration results and referred to the instance, as I stated at the time, where there was an excess of free cyanide and a moderate alkalinity in the incoming solution. With a high alkalinity the whole of the cyanide both as free and combined would be indicated in the result of a simple titration test, using potassium iodide as indicator; and there should be no difference between the free cyanide content at the head or tail of the box, as indicated by this method. The initial alkalinity, plus the alkalinity formed during precipitation, would regenerate free cyanide from the double cyanide, according to the theory subscribed to by Mr. Colbath. Upon what reaction or evidence does he base his insinuation that my experiences are against the principles of chemistry?

Mr. Colbath next deals with the chemistry of the cyanide process and tells us that: "* * * it is sufficiently well understood for its intelligent application, so that the well-informed operator can usually determine free cyanide with more certainly and almost as simply as one whom I knew to determine alkalinity by feeling with his fingers." I have only one remark to make to such an unscientific statement, and that is—he may think he can.

EFFECT OF ZINC IN SOLUTION

Mr. Colbath is inclined to believe that I overrate the evils of zinc in solution. He tells us that he has never thrown away a ton of solution in twelve years on account of fouling with zinc. This may mean that he has thrown it away to prevent fouling, which would have been a wise precaution. Or he may wish us to understand that he has never thrown away a ton of solution at all. If the latter is the impression he wishes to convey, then it is obvious that his residues during those twelve years have not contained a total of one pound of cyanide, so perfect has been the displacement of cyanide solution from residue. Such a contention is too great a tax on our powers of credulity.

As regards the immunity which Mr. Colbath has

*"Chemistry of Cyanide Solutions," p. 7.

enjoyed from the effect of zinc in solution, I must refer him to the article which he criticises, but which he evidently has not read. I stated: "The loss of zinc from plant solution is a mystery which has yet to be solved. * * * Whatever the cause, it is evident that the automatic reduction of zinc content prevents the fouling of cyanide solutions in the great majority of cases." Mr. Colbath's experience, as well as my own under many other circumstances, may well be included under "the great majority of cases." I then continued: "Under other conditions, however, as in the present instance, the reaction stops at a certain point, after which active measures must be taken for the removal of an undesirable accumulation of zinc. The strength of the cyanide solution entering the zinc-boxes must often be increased in proportion to the amount of zinc in such solution; and an unnecessary consumption of both solvent and precipitant results from an endeavor to effect satisfactory precipitation from foul solution." In a criticism protesting against an article containing such direct statements as these, Mr. Colbath's advice that "such troubles are usually due to insufficient free cyanide" is offensively gratuitous.

GOLD VERSUS SILVER SOLUTIONS

Still another reason to account for Mr. Colbath's immunity from trouble in connection with the presence of zinc in plant solution may be found in the fact that his experience may refer to the cyanidation of silver ores. Again I must repeat myself: "Satisfactory precipitation, from an economic point of view, is more a question of ultimate value than actual metal content. The 'barren' solution after gold precipitation may contain a few grains per ton as compared to the corresponding 'barren' solution after silver precipitation which may contain as many pennyweights. Each may be referred to as the residue after satisfactory precipitation, but it is evident that the question of zinc content is more important in the case of the treatment of gold ores where a complete or nearly complete precipitation is essential, a small percentage of the metal representing a high money value." In other words, a solution which under other conditions may be considered hopelessly foul may still be productive of good results in the treatment of a silver ore. Foulness is a relative term and not a definite one, and the whole aspect of the case is governed by the value of the metal being recovered. Zinc was abandoned at Nipissing in favor of aluminum on evidence of the loss of solvent power in the solution due to the accumulation of precipitant compounds. We learn from E. M. Hamilton's article† that the ordinary solution after zinc precipitation carried 0.8 oz. silver per ton. This is an amount largely in excess of the quantity of metal usually found in the highest grade gold solutions *before precipitation*. The fact that the tailing solution has since been reduced to 0.05 oz. is one of the strongest reasons, in my opinion, why more attention should be drawn

to a method of precipitation which Mr. Hamilton has described and the extension of which he advocates in his usual lucid and scientific manner.

AMOUNT OF FREE CYANIDE

Mr. Colbath next refers to two remarks I made in connection with a statement of trouble with cyanide solution. The first was to the effect that routine titrations by the ordinary method had been made regularly and showed no material alteration in the composition of the solution. The second stated that an analysis of the solution revealed a high zinc and copper content. After a statement of these two facts, Mr. Colbath adds: "It is quite evident that free cyanide must have been very low." In fact, and for some time previous to the successful removal of the copper, the amount of free cyanide was so high that the copper accumulated in the solution to the detriment of gold precipitation; and cyanide 'drips' at the heads of the boxes were without good effect. The subsequent variations in free cyanide content in order to precipitate the copper, and finally to allow for the removal of the excess zinc, have been fully described, and indicate the method by which a return was made to normal cyanide consumption and satisfactory precipitation. Mr. Colbath, in his discussion of the matter, omits all reference to the elimination of the copper and refers to the success following the adding of excess cyanide to the solution.

In the next paragraph Mr. Colbath commits another error. "I cannot accept Mr. Allen's statement in regard to function of hydrogen in precipitation. The liberation of hydrogen is sometimes incidental and not the cause of precipitation." In no part of my article did I say that hydrogen could cause precipitation. I said that it was an essential element in the reaction, and I have no hesitation in reaffirming such a statement. Mr. Colbath's remark that hydrogen is sometimes incidental to precipitation is interesting, but will he enlighten us as to the reaction when it is not? The fact that precipitation may be good without visible liberation of hydrogen does not support his contention, since the correct amount of hydrogen may be absorbed as soon as formed.

Mr. Colbath concludes with the following significant remark: "It appears to me that the solutions in question were saturated with zinc to the extent of having all the cyanide combined, * * *" The italics are mine and serve to draw attention to the implication that cyaniding operations were being carried on with an ignorance of the elementary conceptions of the process. Such an insinuation is as ill-judged as the statement itself lacks verisimilitude. Assuming that it were possible to obtain, under ordinary working conditions, a solution saturated with zinc salts to the exclusion of all free cyanide, what is Mr. Colbath's remedy? The addition of more cyanide involving a further fouling of the solution, and an increased consumption of chemicals. Again assuming

†Eng. & Min. Jour., May 10, 1913.

an ordinary alkaline working solution in such a condition, how does Mr. Colbath propose to test for cyanide content? By the adoption of a method which assumes the regeneration of free cyanide by the combination of zinc salts and alkali; and where the result would indicate a free cyanide content which, even according to Mr. Colbath, did not exist.

The inconsequent nature of the criticism is very manifest when Mr. Colbath's inference as to the saturated condition of the solution is compared with a previous statement suggesting that I had overrated the evils of zinc in solution. It is also obvious that he has no faith whatever in his own convictions on the question of regeneration of cyanide. When all the cyanide had been combined with zinc, why was not free cyanide regenerated by the alkali obviously present in the solution?

The ineptitude of Mr. Colbath's 'protest' is singularly well illustrated by the fact that his own professed views do not even persist to the length of his extraordinary letter; and he concludes with an inadvertent admission of the claims of my contention against alkaline regeneration.

A. W. ALLEN.

Lonely Mine, Rhodesia, November 21, 1913.

Balliet System of Counterbalancing

The Editor:

Sir—My attention has been drawn to the advertisements of the Balliet system of counterweighting hoists. This system is claimed to have originated at Tonopah, and has just been patented. Several mines have been willing to accept the claims for originality of the device and it is announced that they are 'licensed' to use it. It is my belief that the inventor is sincere in believing that his device is new in principle, but a comparison between the Balliet device and similar ones that I have seen is sufficient to show that it is not new and properly unpatentable.

There is the usual auxiliary drum over which the counterweight rope is hung. One end of the rope descends the main haulage or hoisting compartment, and this end is fastened to the skip, as is also the main hoisting rope. The other end of the counterweight rope enters the manway side over the auxiliary sheave and is fastened to the counterweight. "To the bottom of the counterweight is fastened a chain or flexible weight which is half the length of the shaft" (the quotation is from the Balliet literature) "this chain is called the counterweight tail line." Mr. Balliet fastens one end of the chain half way down the shaft to the timbers. Then follows a very excellent description of the method of working and the saving effected.

"This method of counterweighting is so simple that it is a wonder that it has never been thought of before." It has, and I have seen it; also, it is mentioned in principle in standard works, as in Ihleng's 'Manual of Mining' pages 148, 149, under the title 'Chain Counter Balance', also in that of the Despre method.

In fact with the Koepe, Whiting, and Camphausen systems it is difficult to put out anything that is not some modification. The Balliet safety chain also mentioned in the device I have never before seen, and to me, at least, is new. I am curious to hear from others on it. This safety chain is apart from what has been described above.

That Mr. Balliet may obtain a patent is by no means improbable. From times 'way back miners were used to set an auxiliary door in the head-frame and cut a notch in the centre of one end. Then on their bucket bottom they hung a short chain and on the end of the chain an iron ball. Up comes the bucket and passes the auxiliary door now standing vertical and above the collar. The door is let fall at a fixed angle, the bucket lowered and joggled until the iron ball caught in the notch, the main cable loosened, the bucket dumped over the inclined door used as a chute and shaft-closer. The bucket was again jerked up and free, the door raised by the engineer who dropped it, and the bucket descended into the shaft. Some man came here from the prairie, thought it rather clever, and got a patent on it!

OPERATOR.

Cripple Creek, January 29.

Stirling v. Babcock & Willcox Boilers

The Editor:

Sir—There are some calculations, the value of whose results would not be one whit affected whether a 5-in. or a 5-mile slide rule were used in working them out. If the assumptions and premises are wrong, accuracy in the figures counts for naught. This is the trouble with Mr. Gulick's letter in your November 29 issue on waste heat boilers in reverberatory furnace flues. It seems to be "a very interesting example of" partly digested reading, and of taking up the rôle of critic without making sure of one's facts.

His "per horse-power" figures mean nothing, or rather they are quite misleading. The description of the boilers showed that they were all of the same nominal horse-power, namely, 400, so the evaporation duty of the two types under the given conditions of service were approximately as 1.37 to 1 per unit of heating surface for the B. & W. and Stirling types respectively. Moreover, the proper unit for a basis of comparison is not the horse-power, but the furnace. My notes were to show, and I still think do correctly show, which of two types of boiler attached to similar smelting furnaces saved most money per furnace under similar conditions, over similar periods.

S. SEVERIN SÖRENSEN.

Braden Copper Co., Chile, January 5.

The Woolworth building is 750 ft. (51 stories) high, and weighs just 250,000 tons. It has 2000 offices, and F. W. Woolworth expects to realize in rentals \$2,500,000 per year. The total sales at the Woolworth '10-cent' stores throughout the United States amounted to \$66,000,000 in 1913.

Concentrates

Most of these are in reply to questions received by mail. Our readers are invited to ask questions and give information dealing with the practice of mining, milling and smelting.

Loss of power due to belt driving even under ideal conditions is appreciable, and may amount to as much as 5 per cent.

Combination charges of black powder and some high explosive in a hole to be blasted should not be permitted about mines.

A larger quantity of explosives is required in machine-drill stopes than in hand labor stopes to break a ton of ore on the Rand. This amounts to as much as 8 to 10c. per ton.

Ash from boilers fired by wood contains a high percentage of lime, and at the Messina copper mine, Transvaal, the boiler ash is being used as a flux in the furnaces for smelting ore.

Cost of shaft-sinking, station cutting, and cross-cutting at the Buckeye-Beimont mine, Tonopah, Nevada, in 1913 was \$37.68 to \$40.30, \$20.03, and \$10.09 to \$20.02 per foot respectively.

Fire clays may be tested by means of an ordinary blow pipe. Most varieties melt and ordinary impure clays fuse readily into a dark glass. Good fire clays do not fuse—though the smaller pieces may show a rounding of the edges.

Dredging ground near Dowden Falls, Jackson county, Oregon, includes a large apple orchard, which is to be dredged. The Washington and Oregon owners of the ground state that the entire orchard will be restored after being worked.

Flotation at Cobar, New South Wales, was found to be successful only on sulphide ores, and more particularly on sulphides exposing freshly broken and unoxidized surfaces. The presence of carbonates or sulphates was extremely obnoxious, decreasing the percentage of recovery, according to F. Danvers Power.

Stream line is a term originally used in hydraulics by ship builders and designers of turbines and signified the path of least resistance, which is followed by a water particle when it is forced or deflected by an object. A stream line automobile body is so shaped as to cause the least resistance of the air when a car travels at high speed.

The use of 'permissible explosives' is rapidly extending as the result of thorough investigations by the Bureau of Mines. Where the risk of gas or dust explosions in coal mines is a serious one, these explosives

are now used only. During 1912 more than 18,000,000 lb. of such material was used in the coal mines of the United States. Manufacturers report an increase of 50% in the sales of permissible explosives.

Bore-hole coefficients in drilling gravel deposits are often unreliable. In the report of Charles M. Rolker, on operations at the Lena Goldfields, Siberia, during the past year, he gives data regarding the unreliability of a bore-hole coefficient. On the Big Dogaldin claims, 25 drill-holes were put down. Of these, 11 holes gave a total average of 18 dwt. per cubic yard. If a 50% boring coefficient is assumed, this would indicate a value of 9.068 dwt. per cubic yard, a very satisfactory yield. These holes cover a stream length of about 3920 ft. It can hardly be said that these are sufficient drill-holes to give an average gold content and stream width for this distance, but Mr. Rolker based his Dogaldin estimate on them.

The specific gravity of a coin 900 fine in gold and 100 fine in copper is 17.29 when the specific gravity of gold is taken at 19.32 and copper at 8.92. Actual experiment on a \$20 gold piece gave the value 17.20 at 20°C., in terms of water at 20°C. as unity. If the weighings are reduced to vacuo, and the unit of specific gravity is changed to water at 4°C., the value becomes 17.15. This is the density at 20°C. in grains per cubic centimetre, according to S. W. Stratton of the Bureau of Standards at Washington, D. C. Gold coin is made up of 9 parts of gold and 1 part of copper, but not by volume. United States statutes, section 3514, relative to the weight and fineness of gold coins, is as follows: The standard for both gold and silver coins of the United States shall be such that of 1000 parts by weight 900 shall be pure metal and 100 of alloy. The alloy of silver coins shall be copper; but the alloy of gold coins shall be of copper or of copper and silver; but in no case shall the silver exceed one-tenth of the whole alloy.

Depression of the Atlantic coast region has long been believed to be in progress. The evidence that this region has sunk in comparatively recent geological time is unchallenged, but D. W. Johnson and others have been led to doubt the assumption that it is still sinking. To uphold the inferences drawn from a study of the geological phenomena, Mr. Johnson has recently brought forward the results of tidal observations and precise leveling in the vicinity of New York City. Tidal observations extending over a period of a quarter of a century show that the mean tide-level has not changed perceptibly in that time, and a series of precise level determinations in two areas show that the differences in elevation, as determined twenty-five years ago and during the past years are less than the probable error of the measurements. There thus seems to be no evidence that the coast is either sinking as a whole, or that there exists any of the differential warping which might be expected to accompany regional subsidence.

Special Correspondence

DENVER, COLORADO

THE ROLLINSVILLE DISTRICT, ITS PRESENT CONDITION, EFFORTS MADE TO REVIVE IT, AND POSSIBILITIES.—THE GOLD DIRT, PERIGO, AND GOLDEN FLINT MINES.

The mining district of Rollinsville, in Gilpin county, originally known as the Perigo camp, is not dead, but in a sad state of hibernation. The mines, which once made the place a prosperous one, are the Gold Dirt, Perigo, Golden Flint, and several smaller properties such as the War Eagle, Blaine, California, and Mountain Chief. The camp languishes, not because all the orebodies have been discovered and mined, or that the ores are refractory and cannot be treated, but because the men who control the greater part of these mines, and who in the early days, by their enterprise, developed the camp, have grown rich and are simply sitting back, playing a waiting game. These men own over 100 patented lode claims, all the available placer ground in Gamble and Moon gulches, and the ground in South Boulder gulch from a mile above Rollinsville to Pactolis, besides other property termed ranch lands because of small alluvial deposits upon them. On all these lands the company pays taxes and has other expenditure. This sort of thing is enough to break the spirit of any camp. Up to the present time the waiting game has been played in one of three ways: to sell outright the developed workings for their full value; to work the developed properties by the leasing system, leaving the lessees to keep up the ground; or, when this ruinous policy could no longer be carried out, to amply capitalize the whole proposition, retain the bulk of the stock, and sell the remainder to raise enough money to put the properties back on a paying basis. The first two methods of procedure have proved more or less successful, the last a dismal failure.

To show the ruinous results of this procedure, it need only be stated that at the present time the old Gold Dirt mine stands idle and full of water, and its machinery rusting in spite of the fact that the property is equipped with a complete 50-ton modern milling plant and thousands of tons of profitable ore lies broken in the stopes. The Perigo mine is closed, although it produced \$7,000,000 above the adit-level, a distance of less than 700 ft. According to the report of Mr. Snyder, of the Colorado School of Mines, made since the workings were closed down, there is still \$600,000 net to be recovered from the old stopes. Because these workings make considerable water, no attempt has been made to mine below the adit-level.

The value of these properties now being withheld from production is well shown by the fact that the Golden Flint mine, considered one of the smaller properties, has, within one year of the time of its sale to outside people, been developed into one of the best mines of the district. Under the able management of James Elspass, of Denver, sufficient ore has been developed to warrant the erection of a modern 100-ton milling plant, now completed.

The final effort to put the old properties on a productive basis was made when a development company known as the Bellevue company was organized, Charles Knight, of the Rexall company of Leadville, undertaking the promotion of the deal. The plan was to develop the placer ground first; but the ultimate aim was to develop the whole of this large property. All parties to the contract seem to have acted in good faith. The investment was an attractive one, and shares should have sold well, and the final result undoubtedly would have been beneficial to shareholders and district alike. But an unfortunate quarrel between the owners and the promoters disrupted the whole affair, threw the properties into

the hands of a receiver, to be finally bought back by the original owners at a sheriff's sale last fall. It is needless to say that the camp has lost faith in these old timers, who should be the chief developers, and feel that the only hope for existence lies in the newer properties, and this hope is surely not without foundation. The Golden Flint, if its present efficient management continues, is bound to prove satisfactory. The Smuggler, the only other producing mine in the district, is just now recovering from two years of litigation. This was the result of a prospector adjoining deciding he had the apex of the Golden Flint lode. This mine will also make good, not only because there is ore in it, but because in George Ashmore, the superintendent and one-third owner, the company has a man who has great faith in the mine. The Smuggler is equipped with a 10-stamp, amalgamating and concentrating plant, simple in construction and operation, but makes a fair recovery—just the sort of mill one usually finds at the smaller paying mines in the Gilpin district. Besides these two mines, there are a number of prospects upon which considerable work has been done, and which will probably be good producers in the



THE PERIGO MILL.

future. The best ones are the Sea Bird, Siren, Diamond Bill, and Gold Queen, and also a number of smaller properties.

Some years ago there was begun in South Boulder gulch, about two miles above Rollinsville, an enterprise, which, had it been completed, would have made the camp one of the good ones of Colorado. The company was known as the Golden Sun company, and its idea was to drive a cross-cut adit, south about 20° east, to intersect all the main veins of the district. The ultimate aim was the Perigo vein, which, it was claimed, would be cut at a vertical depth of 700 ft. The other good veins would have been cut at depths ranging from 300 to 1000 ft., which is sufficient depth for all practical purposes at the present time. This adit would have afforded drainage for the various mines, a tramway to the Moffat road, while South Boulder creek would supply sufficient water for milling purposes. The trouble was that when the adit had reached a distance of 2465 ft., the promoters decided that a 50-ton modern mill was necessary. All efforts to resuscitate have proved futile. This is the situation in north Gilpin county at the present time, but there surely is a better day coming, as there are good veins and excellent ore all along the north and eastern slopes of Jumbo and Tip Top mountains and the ranges branching from them. When the Moffat road was built through this part of the country an immediate revival of mining was anticipated, but for reasons given above results have so far been discouraging.

PLATTEVILLE, WISCONSIN

OPERATIONS IN THE ZINC-LEAD DISTRICTS IN JANUARY.—WORK SUSPENDED AT MANY MINES.—DISTRICT OUTPUTS AND NEW WORK.

The month of January, 1914, in the Wisconsin zinc-lead field, was filled with incongruities. Not so many years ago operators stated that zinc ore must be on a basis of at least \$40 per ton assay of 60% zinc, in order to make a profit. Spelter remained in advance of \$5 in January on East St. Louis quotations, closing the month at \$5.20 per cwt. Spelter ore ranged during the month from \$39 to \$41 per ton, basis, and yet the field witnessed a period of depression almost bordering on panic. Several of the best producers suspended operations indefinitely, while nearly every camp in the field witnessed large cuts in the wages of miners, breast and machine men, which resulted in many men leaving. On top of all this, however, it was seen after the reports for the month were well in hand, that January would be an exceptionally strong month from the standpoint of production. Ore buyers showed no strong desires to get into the field and bid. Two modern mining equipments in process of construction were shut down, and the men at this work dismissed. Separating plants at three different points kept going without time restriction, and made a fair turn-in of high-grade ore, one plant obtaining premium prices. Lead ore was in better demand, but there seems to be a concerted plan to hold this grade of ore until prices are better, and shipments were light. Production was fair, while the output of iron pyrite fell under the usual output. 'Dry-bone' producers in the northern camps were actively engaged all the month, but no market was afforded this grade of material, and several hundred tons of ore, ready for delivery, was carried over.

On the whole, the month compares favorably with the output for the summer months of 1913. Prospecting was continued vigorously at one or two points in the field, with excellent results. Leading mine managers declare that advances will be made in the price of ore, but that high prices are out of the question for this year.

Production by districts for January is shown in the following table, the separator product being included.

Camps.	Zinc, pounds.	Lead, pounds.	Sulphur, pounds.
Benton	5,210,000	.....	3,352,800
Hazel Green	3,430,000	126,000	.....
Galena	2,730,000	.....	.....
Linden	2,370,000	231,440	598,890
Livingston	2,356,000	.....	.....
Cuba	2,102,000	.....	687,320
Platteville	1,718,000	.....	.....
Harker	1,542,000	.....	.....
Shullsburg	1,014,000	.....	.....
Highland	768,000	.....	.....
Montfort	324,000	66,000	.....
Mineral Point	48,000	.....	.....
Totals	23,612,000	432,440	4,639,010

The bulk of the shipments from Benton came from the Frontier, Fox, Fields, Ewing, and Martin; Hazel Green, the Kennedy and Cleveland; Galena, the Black-Jack, Vinegar Hills, and Federal; Linden, the Ross, Glanville, Optimo, and Saxe-Pollard; Livingston, the Grunow, Peacock, Peni, Lucky Six, Coker, Ellsworth, and Rundell; Cuba, the Masbruch mine and National Separating Co.; Platteville, the East End, Enterprise, and Empire roasters; Harker, the Miffin; Shullsburg, the Winskill property only; Highland, the New Jersey Zinc Co. only; Montfort, the O. P. David mine; and Mineral Point, from small local producers.

Briefly stated, the more important happenings for the month are as follows: Local producers in the Highland dis-

trict were left out by ore buyers, and no deliveries of ore were made, 1000 tons of mine product being carried over. Linden showed new ore discoveries in Optimo mine No. 1, and a heavy production from No. 2. The Miffin district returned two producers, after an idleness of months. The Peacock Mining Co. was held liable for injuries to one Dolphin, a miner, by the higher court and judgment awarded for \$11,000. The Grunow, Shamrock, and Biddick mines suspended operations indefinitely. Platteville experienced an off month. The East End mine, the leading producer, was down for two weeks. Enterprise Mining Co. operated in the top flats with fair results. The Wilson mine at Potosi remained shut down. The Khar-Piquette failed to resume operations. At Cuba, the National Separating Co., affiliated with the Vinegar Hill company, made a large turn-in of high-grade ore but no effort to increase capacity. The Roosevelt mine, idle for years, was again placed on a producing basis. The Masbruch mine shipped steadily. The Benton district made a good showing. The Martin mine resumed operations after remodeling jigs. Heavy pump equipment and 250-hp. electric motors was installed at the Bull Moose mine, and initial shipments of zinc ore made. Building operations on a new plant for the Iowa Mining Co., were halted. Mining operations on the North Blende were suspended, pending the installation of new high-pressure boilers. The San Souci Mining Co., operating a new plant, stored ore in bins. Drilling operations continued for the Wisconsin Zinc Co., on the Robbins and Champion with astonishingly good results. A new 250-ton power and milling plant will be provided without delay. The Minnie Mining Co.'s plant is being dismantled and removed. The Calvert Mining Co.'s plant has been dismantled and removed to the Galena district. Longhenry Bros. suspended mining operations. In the Hazel Green district the management of the Cleveland Mining Co. suspended building operations on two new mining plants, one on the new Lawrence mine and the other on the Scrabble Creek property. The Northwestern Zinc Co., one of the heaviest shippers of this district during 1913, suspended mining operations, placed a new superintendent in charge, and began prospect work with drills. The famous Vinegar Hill mine, producing steadily and in volume since 1905, began removing pillars, evidence that the end of the big ore runs had been reached. Prospect work with drills on the Unity for this Company proved successful. The Federal mine operated double shift most of the month, turning in four cars of concentrate weekly. The famous Black-Jack mine, the property of the New Jersey Zinc Co., was down part of the month while repairs were made to compressors. Shipments of ore are being made weekly. The Brown, Merry Widow, Betsy, Indianapolis, Ryan, Glen Ridge, and Pittsburgh mines were all idle during the month. Low prices of ore on the medium and inferior grades is given as the reason for the suspension of operations.

BOSTON

SHARE TRANSACTIONS.—TONOPAH STOCKS IN BOSTON.—TENNESSEE COPPER.—RESERVE BANKS AND MINING STOCK.—MOHAWK DIVIDEND PASSED.—F. A. HEINZE LITIGATION.—MAYFLOWER AND OLD COLONY MINES.

The Boston Stock Exchange has recently broadened in activity, getting back to approximately 50,000 shares per day, the largest volume since June, when dealings covered upward of 50,000 shares at times. The Curb on some days does over 20,000 shares, whereas a few weeks ago, when business was almost at a standstill, the day's volume often fell to 3000 or 4000 shares. The creation of an 'Admitted Department' on the Curb has served to help out the representation, as some of the industrial shares traded in on the New York Curb have had a little market here through being quoted and dealt in under this new head. Up until recently Tonopah stocks received but scant mention and even less attention in Boston,

joined, as it has been, to its copper idols. But last year the Curb governing board created the 'Admitted Department,' and under this head a number of Tonopah stocks have been quoted, and news is being freely printed about them. The time is coming when Tonopah will no longer be a closed book to Boston, and operations of Tonopah Belmont, Tonopah Mining, West End Consolidated, and others in that district will be read about as eagerly as some of those from Arizona, Butte, and the Lake.

Boston is taking considerable interest of late in Tennessee Copper Co.'s stock and believes it is being accumulated by inside interests. The Company's acid department is on a stable basis, and between the copper and acid the Company is expected to pay this year in dividends 10% net on the present selling price of the stock.

The President's trust message was well received by Boston stock market interests, who believe the Administration is making a strong effort to conciliate business interests and that it will be successful in doing so. Boston is now unanimous for a regional reserve bank, and it is understood that the city will get one without opposition. It is predicted that the placing of a bank here will bring the local coppers into more favor and result in a broader market. Perhaps there will be no better concrete evidence of credit expansion under the new currency law than will be provided in the case of mining stocks, which have until the last year or two been under the ban by the banks as to loans. With a regional reserve bank here, the banks of Boston will be tempted to loan more freely at the higher rates which mining securities offer, and send their commercial paper at a lower rate over to the regional reserve bank to be rediscounted. Senator Weeks, formerly a member of Hornblower & Weeks, has been very influential through the stand he has taken in crystallizing New England sentiment in behalf of the currency bill.

The well known porphyry copper banker, Charles Hayden, heads a group of Boston men interested in the building of the cup defender *Defiance*, which is now being built in Maine.

Strike conditions forced the Mohawk company to pass its semi-annual dividend, as did the Wolverine. These are what is known in Boston as the 'Stanton properties,' and in a preceding generation were looked upon as being soundly conducted. Extreme conservatism has always marked the management of both properties.

The suit of F. Augustus Heinze against A. D. F. Adams and other brokers for alleged conversion of Ohio Copper, Davis Daly, and other securities pledged by him with Adams, and repledged by Adams to eight or ten other persons in Boston, still drags along, and promises to rival the Thaw case in the raising of technical points and the protraction of litigation. Not long ago the court here handed down a decision that Heinze could not maintain his original charge of conspiracy against the brokers in whose hands his hypothecated securities were finally lodged, but intimated that he might hold some of the brokers separately for conversion, the suggestion being that Heinze's bill be amended from the allegation of conspiracy to that of conversion. The face value of the securities pledged by Heinze amounted to about \$350,000. Mr. Adams, the man with whom the securities were placed as collateral for loans, is now 'doing time' in the state prison at Charlestown. Some of the brokers have effected settlements and been released from litigation, and others have left the country. Henry Hovey Love, one of the indicted men, is understood to be living somewhere in the Northwest, having left Boston immediately after Heinze began his suit.

The recent strength of Greene Cananea is taken as an index of quieter conditions in Mexico. The Company has an immense property, but has never had the opportunity of operating in a stable manner and demonstrating what it could do in the way of costs.

It is reported lately that there has been some selling of Alaska Gold stock by one of the syndicate principals which

first brought the company to public attention. It is stated, however, that this selling is not from the estate of the late A. F. Holden, one of the engineers who examined and reported upon the property for the banking interests which have campaigned on the market. Mr. Holden, in his will, left specific instructions enjoining the executors of his estate from selling the securities of mining companies with which he had been identified professionally and financially. Under the terms of this injunction, it is understood that the Holden estate is not a seller of Alaska Gold.

When normal conditions are restored at the Lake district, we may expect some sensational news from Mayflower and Old Colony. As matters stand at present, there are reports of developments from both properties by drilling, but it looks like wasted ammunition to put it out with the continuance of the strike at the Lake. The latest news is that Old Colony's No. 27 drill has cut the Mayflower lode at a depth of 1796 ft., continuing to 1893 ft., a width of 93 ft. This compares with 77 ft. in the No. 26 drill. The latest showing is considered to be the best in the Old Colony territory. Besides, it has significance by way of extending the proved mineralization of Old Colony still farther to the south. It looks now as if the next market sensation at the Lake, *ex* the strike, will break out in the Mayflower-Old Colony quarter, and it may be that another swift campaign resembling that of a few years ago on Lake and Indiana may be pulled off.

TORONTO, CANADA

INDUSTRIAL DISPUTES LEGISLATION.—CANADIAN COAL & COKE CO.—NEW OIL REGULATIONS.—EIGHT-HOUR DAY EXEMPTIONS.—CANADIAN VENEZUELAN ORE COMPANY.

It is stated that, at the present session of the Dominion parliament, further legislation for the purpose of extending the scope of the Industrial Disputes Act will be introduced. This legislation for the prevention of industrial warfare will be more advanced than any similar legislation in any other country. At the present time the Industrial Disputes Act affects only those employees engaged in work on any public utility, and it is the intention to extend this act to take in all branches of labor, both public and private. The present act was designed to prevent strikes and lockouts until the matter under dispute had been considered and a finding arrived at by a board of conciliation and arbitration. Neither employers nor employees are bound to abide by the decision of the board, but the findings of the board in many cases have effected harmonious agreements and largely reduced the number of strikes and lockouts in the Dominion. The Minister of Labor states that much good can be accomplished by extending the scope of the act to include all labor. If this legislation comes into force, all public and private enterprises will be conducted under the jurisdiction of the department, and in case of a dispute arising, no strike or lockout will be permitted until a report has been made by the board of arbitration. Under the terms of the act, no employer will be allowed to dismiss or refuse to employ a man on the ground that he is a member of a labor union, nor will labor unions be allowed to call a strike on account of the employment of men who do not belong to unions. Severe penalties will be exacted in the case of employers or employees who do not live up to the provisions of the act.

The financing of the recently organized Canadian Coal & Coke Co. is making satisfactory progress, and it is expected that the Company will shortly be in a position to complete development work on the various properties and put them on a profitable operating basis. The temporary financing, which will provide sufficient funds for the payment of outstanding liabilities, and for putting three of the properties in full operation, is practically completed. For the permanent financing, an issue of \$3,000,000 14-year 6% serial bonds dated December 1, 1913, will be issued. To enable the Com-

pany to retire the bonds, a sinking fund will be started in 1915 which will be sufficient to redeem the entire issue by 1927. These bonds will constitute a first mortgage against all the properties of the Company. Reports of independent engineers acting for the bankers who are to undertake this financing, have placed a total value of \$17,900,000 on the plants and properties of the consolidated company. The proceeds of the bond issue will be utilized to retire the temporary financing and to provide working capital and funds for the extension of the plant. When all the necessary expenditures for plant and equipment have been made, it is estimated that the Company will have working capital amounting to \$250,000, in addition to an emergency fund of \$350,000. The different collieries are at present capable of producing 1200 tons per day, but when the new development has been finished and the new equipment installed, an output of 8000 tons per day can be attained.

The new Dominion oil regulations which have been prepared by the Hon. Dr. Roche, have been approved by the cabinet council. In these regulations there are several clauses of an imperial nature, which are intended to conserve the oil resources of Canada for the use of the British Government in time of war and emergency. One regulation requires that any company holding a lease on oil lands shall always remain a British company, registered either in Great Britain or Canada, and having its chief place of business in His Majesty's dominions. The chairman of the company and the majority of the directors shall always be British subjects, and the company shall not at any time become either directly or indirectly controlled by foreigners or a foreign corporation. The clause will enable the Crown to obtain in time of war, a reliable supply of oil fuel and also prevent speculators from taking advantage of an emergency to put a prohibitive price in force. Another section of the regulations gives the Crown power to assume control, in time of emergency, of any lease or works and to operate and maintain them, the compensation in such case to be fixed by the exchequer court. A further proposed clause prohibits all exports of oil from Canada in time of war. This clause, however, will necessitate a change in the export act by parliament, and the necessary legislation will probably be passed.

Following the report of the Minister of Mines, the Moose Mountain, Helen, and Magpie iron mines, in northern Ontario, have been exempted from the provisions of the eight-hour day which came into force on January 1, 1914. An investigation of these properties by the mine inspector showed that the conditions regarding safeguards for insuring the comfort, safety, and health of the miners were of a higher standard than in any other mines of the province. These three mines are the only ones which have been exempted from the provisions of the act.

At a meeting of the bondholders of the Canadian Venezuelan Ore Co., held in Montreal on January 20, a resolution was passed authorizing the recently appointed bondholders' committee to serve the trustee with notice of default on bond coupons due at the beginning of the month, the trustee for the bondholders being the New York Trust Co. This step is preliminary to winding up proceedings by the trust company. According to the provisions of the trust deed, the property will revert to the bondholders 60 days after the serving of the notice, unless in the meantime arrangements are made to pay the overdue interest. There was no discussion at the meeting of any plan for financing the Company, and as the bondholders and shareholders are practically identical, it is altogether probable that liquidation proceedings will be allowed to take their course. When the property has reverted to the bondholders, it is probable that some decision as to the future will be made. A drop in the market price of ore, and a serious decline in the grade below that estimated by the Company, is stated to be responsible for the Company's financial difficulties.

SALT LAKE CITY, UTAH

MILL CONSTRUCTION AND METALLURGICAL WORK AT PARK CITY.
PROBABLE SUCCESS OF A CHLORINATION PROCESS. PLANTS
IN OPERATION IN THE DISTRICT

The current year will be a busy one in mill construction at Park City, Summit county. The erection of two new plants has been decided on, a third is probable, and an old plant, long idle, is to be restored to activity. The management of the American Flag has decided on chlorination as the process for treating its non-shipping ore. E. A. Wall is planning a mill for the Daly Mining Co. The old Glencoe property has been acquired by a new company which proposes to revamp the mill and operate it for the zinc and silver-lead content of the ore. A milling plant has come to be regarded as an indispensable adjunct of a successful mine at Park City. Even those which have large bodies of high-grade ore to draw on find that the production of a considerable tonnage of mill ore is inevitable in the course of development. The American Flag is the latest of the big mines to follow the fashion. The management estimates a reserve of more than 50,000 tons of \$10 gold-silver ore, and the daily production of 25 tons of mill ore removed in prospecting. G. H. Scibird, a metallurgical engineer, has been employed for the last six months in experimenting with the ore and investigating treatment methods. The first step taken in the investigation was to decide, once and for all, that no process would be considered which had not been carried to a successful and practical stage by others. Hence the work was confined to narrow limits. While it had been known for some time that the mill ore, constantly being added to by development, was peculiarly amenable, both physically and chemically, to the new chlorination process, yet this method of treatment was not looked upon with favor, because it was until recently in an experimental stage so far as successful appliances were concerned. While a description of this new process is not permissible at this time, it is a matter of common knowledge that it is a modernization of the old Augustin process, wherein the metals are converted to chlorides and subsequently leached with suitable solvents. The process as now perfected, notably by Theodore P. Holt, has overcome the previously existing difficulties in volatilization, low extractions, and high costs. While the management of the American Flag was watching the development of the chlorination process, it was carefully studying the results to be obtained by concentration, and concentration followed by cyanidation. Without going into detail in regard to the tests, it was found that concentration alone was unsatisfactory, and that a recovery of 36% of the silver, 49% of the gold, and practically all the lead was the best that could be expected. A combination of concentration and cyanidation gave a final extraction of 92% of the gold and 74% of the silver, consuming 3.4 lb. cyanide. Leaching with sulphuric acid before cyanidation also gave a fair recovery, with a reasonable cyanide consumption. Chlorination promises a recovery of 92% of all the metals at a lower cost than any of the other processes, and since this method of treatment is in practical operation, its adoption has been decided upon. As an original mill unit, to take care of the mill ore that is actually being broken each day in the process of developing the first-class ore, a plant of about 25 tons per day capacity is being considered. The mill will be regarded as experimental and to demonstrate the possibility of milling the ores, and will be so designed that its enlargement later may readily be accomplished. Its first cost is estimated at \$15,000 and the cost of treatment is placed at \$3.50 per ton. The choice of the Daly West in the matter of milling equipment has not been announced, and probably has not been made. The active mills of the camp at present are the Silver King Coalition, Daly-Judge, Mines Operating, and some small jigging plants along the stream running from the Daly-Judge mill.

JOHANNESBURG, TRANSVAAL

GOLD OUTPUT IN NOVEMBER.—LABOR SUPPLY.—THE PAST YEAR
A DISAPPOINTMENT.

November gold returns as published by the Transvaal Chamber of Mines were quite disappointing. The total working profits fell to £970,623, a lower figure, excluding the strike month, than has been reached for many years. The tonnage crushed was only 2,006,507, compared with 2,347,929 tons in January 1913. The most remarkable feature of the month was the reduction of working costs from \$4.36 to \$4.34 in November as compared with the first month of the year, in spite of the smaller tonnage milled. The fall in value of the output was from £3,353,116 in January to £2,860,788 in November, so that the decline in aggregate profits is easily explained.

Throughout the whole length of the reef there are complaints of the chronic scarcity of native labor, and several of the mines always hitherto popular with the natives are now considerably short of their full complement. It was anticipated that the new year would witness an improvement in the labor conditions in the Transvaal, but all these hopes have been clouded by the railway strike which commenced on January 8. The strike may not be altogether a general one, but some difficulty must result from only a partial service of trains, and the effect on the native labor supply will be anything but encouraging. The year 1913 has been a disappointing one for the gold mines all around, but 1914 promises to be even worse, the comparison with a year ago as shown above being distinctly disappointing.

KALGOORLIE, WESTERN AUSTRALIA

GREAT FINGALL DEVELOPMENTS.—THE LANCEFIELD TO HAVE ANOTHER CHANCE.—DIAMOND-DRILLING AT FRASER'S.—VICTORIOUS MINE.—DEVELOPMENTS IN THE HORSE-SHOE AND IVANHOE.

The Great Fingall mine, according to Hope Nicolson, the manager, is looking as well as it ever did. The peculiarity of the mine is that the ore is in lenses with intervening blanks. The first lens produced 30,000 tons yielding \$375,000, and cut out at an incline depth of 300 ft. The second lens extended from 460 to 1370 ft., and produced 1,822,500 tons, yielding \$23,165,000, out of which \$8,734,900 was distributed in dividends. The third lens was opened at 1900 ft., and is still going strong at 2500 ft. An internal shaft has been sunk from No. 13 level, 1500 ft. incline, and is now below No. 18 level, 2400 ft. incline. This shaft has been fitted with a 40-ft. head-frame, and hauling will be done by an air winch. At No. 15 level the ore-shoot is 144 ft. long and assays \$10.46 over a width of 6 ft. At No. 16 level the shoot has lengthened to 400 ft., and assays average \$10 for the width of the drift, 6 ft. At No. 17 level the shoot extends for 300 ft., averaging \$10, also for the full width of the drift. At No. 18 level, assays average \$11.20 for a length of 430 ft. Several winzes have been sunk below this level, and prove that good grade ore continues still deeper. The upper levels of the mine are practically depleted, but ore from the new lens will be available for treatment early in 1914, and it is anticipated that the mine will then resume regular dividends.

The Kalgoorlie & Boulder Firewood Co., which, with the West Australian Bank, was the largest creditor of the defunct Lancefield company, has taken over the mine, and put John Dustan, at one time metallurgist of the Associated mine, in charge. Mr. Dustan has since been inspector of state batteries, and recently mining superintendent and traveling inspector of the many mining interests of the Western Australian Mining Corporation, Ltd. The Lancefield mine is equipped with a practically new 40-stamp mill and plant consisting of Krupp ball-mills and Edwards roasting furnaces.

This has proved a failure owing to the presence of arsenic and graphite in the ore, the high cost of fuel, and the long distance it has to be carried by tram, as nothing but small mulga, a hard native tree with great heating capacity, is available. The mine has produced \$4,140,000 from 540,000 tons, or \$7.67 per ton, yet the whole of this sum, as well as \$500,000 working capital and \$200,000 of borrowed money, has been spent on the property. The ore reserves are estimated at 187,300 tons, assaying \$8.40 per ton, but this grade of ore has proved unprofitable under the old conditions. Firewood alone costs \$2.50 per ton of ore treated, owing to its scarcity and its quick-burning nature. Unless the treatment can be radically improved and cheapened, the new owners are unlikely to make the mine a commercial success. The lode on the property is 25 ft. wide, but, unfortunately, like the Gwalia Consols at Wiluna, and the Transvaal at Southern Cross, contains arsenic and graphite, and this makes its successful economic treatment difficult. The mine is opened by eight levels, the deepest being 1000 ft. on the incline, and when the whole ore-shoot is blocked out, it is estimated there will be 100,000 tons of ore at each level. The lode strikes northeast and southwest, and dips east at the flat angle of 40 degrees.

Diamond-drill boring at Fraser's mine at Southern Cross still continues under government supervision, and already four bores have been completed, the deepest to a depth of 1160 ft. Every bore has passed through lodes, but no details of the assay value of the ore has been published. No. 5 bore is now being drilled to cut the main lode at 400 ft. W. J. Loring, who took an option on the property before leaving for London, in May 1913, has given up the option owing to the unsatisfactory state of the London stock market. The Western Australian Government has already spent \$35,000 in boring, and is hardly likely to abandon the work unless it sees no hope of a successful issue.

Late developments at the Victorious mine, at Ora Banda, have not been satisfactory, and, so far as tested, the ore-shoot is short and far from fulfilling expectation. The lode was cut at 22 ft. from the shaft, instead of 50 ft. as anticipated, and the cross-cut is being continued to see whether it is the same lode or a new one. Winzes have also been started from No. 5 level to settle this point. Owing to the results, the price of shares is weak.

Early in December the east cross-cut at 2780 ft. in the



GOLDEN HORSE-SHOE MINE.

Horse-Shoe mine cut No. 4 lode, which proved to be 16 ft. wide, worth \$14 per ton. At the Ivanhoe a diamond-drill hole has been put in east from the 2870-ft. level station, at a depressed angle of 40°, to test the country surrounding the east lode. At a depth of 250 ft. in the hole the porphyry dike was cut and continued to 521 ft., when the quartz-dolerite was entered. The east lode was cut in the porphyry at a point equal to 263 ft. east of the shaft, and 3067 ft. in depth. It was 8½ ft. wide, 2 ft. of which assayed \$2 per ton, and the balance traces.

General Mining News

ALASKA

FAIRBANKS

The annual meeting of the Newsboy Mining Co. was held at Fairbanks on January 18. Leslie M. Drury, the manager, stated that there was enough \$20 ore in sight to last three months. Some of it being mined was worth \$150 per ton. Work continues at the 100 and 300-ft. levels. Mining cost \$5 and milling about \$2.50 per ton. Wood at \$14.50 per cord makes the milling expensive, two cords per day being consumed. He proposed to install a 30-hp. gasoline engine for \$1500, and so reduce costs by 75%. Revenue from gold was \$36,979, and other receipts \$15,368. The surplus is \$18,864.

ARIZONA

COCHISE COUNTY

The annual report of the Employees' Benefit Association of the Copper Queen company shows the following data: Contributions from members, \$25,816; from Copper Queen company, \$8027; balance from 1912, \$21,334; total receipts, \$55,177; accidents on duty, 492; claims paid, \$5945; accidents off duty, 62; claims paid, \$1996; natural deaths, 9; claims paid, \$9675; sickness claims, Bisbee and Douglas, claims paid, \$15,557; and surplus at end of 1913, \$17,503.

GILA COUNTY

(Special Correspondence.)—The Inspiration flotation plant continues to work full time, and nine carloads of concentrate have already been shipped to the Cananea smelter. The Oliver filter is doing good work, and a Trent machine is to be tested. Retaining walls at the concentrator site are still unfinished. On the road to the property is another locomotive from the H. K. Porter Co., 32 gondola ore-cars from the Pullman company, and the large General Electric transformers.

During January an advance of 2057 ft. was made in the Miami mine, mostly in the Captain orebody. There was 102,522 tons of ore mined last month, and 102,497 tons milled, yielding 3,258,650 lb. of copper in concentrate. A pump has been installed to return water from the tailing area, to prevent the residue from flowing down the creek and interfering with irrigation.

Miami, February 14.

The Old Dominion Copper & Smelting Co., at Globe, will add to its electric mine equipment a 225-hp. induction motor from the General Electric Company.

The road between Globe and Copper Hill, a distance of three miles, is in a bad state, and taxpayers are asking for a new road to cost \$3000.

GRAHAM COUNTY

The Shannon Copper Co. reports as follows during the last quarter of 1913:

Ore treated, tons	72,617
Copper output, pounds	3,403,853
Gold, ounces	588
Silver, ounces	25,836
Average price received for copper, cents per pound ..	15.216
Net profits	\$101,638
Net assets, not including the railway	396,255

The Shannon-Arizona railway made a net profit of \$6006 above bond interest requirements.

PINAL COUNTY

Gold-bearing ore has been discovered between Globe, in Gila county, and Ray, and the new camp has been named Gold Creek.

YAVAPAI COUNTY

(Special Correspondence.)—The Prescott Chamber of Commerce has prepared a complete list of properties in this county being worked, and prospects requiring capital, and will send this information free to anybody interested in mining. The list includes about 160 groups of claims, with information which might be of benefit in securing money for their development. Some properties are developed enough for the interests of capitalists, others are in the early stages of development, and the remainder are mere prospects which indicate good possibilities.

Prescott, February 11.

CALIFORNIA

AMADOR COUNTY

In a raise 200 ft. north of the west cross-cut on the 2600-ft. level of the Keystone mine, at Amador City, 6 to 8 ft. of good ore has been opened. The shoot is in slate, near the greenstone contact. A drift is being driven at 1200 ft. to cut a vein opened at 900 ft. About 20 in. of high-grade ore has been opened at 2100 ft. in the Bunker Hill. Prospecting at the Alpine, at Plymouth, is encouraging, and 3 ft. of ore has been opened. A new signaling device has been installed at the Argonaut, at Jackson, the invention of John Rule, superintendent.

ELDORADO COUNTY

(Special Correspondence.)—The Georgia Slide mines, at Georgetown, have been bonded to H. K. Montgomery. The property consists of five patented claims, the Brattle, Parsons, Pacific, Blue Rock, and Hanson, which have been worked continuously for 60 years. The dump of 3,000,000 tons will be drilled and sampled.

Georgetown, February 18.

INYO COUNTY

There is some activity in Death Valley at present, and the camp of Carbonite has sprung into existence. Developments to 300 ft. in the Carbonite mine, the principal property in the district, have proved ore containing gold, silver, lead, and copper. A wagon-road has been cleared across the south end of the valley, 41 miles to the Tonopah & Tidewater railway at Zabriskie. Sixty mules and a 25-ton traction engine are hauling ores for shipment to smelters.

NEVADA COUNTY

At the Premier mine, north of Grass Valley, an adit is in 800 ft. at a depth of 122 ft., and it is figured that another 150 ft. must be driven to cut the vein. Some rich quartz stringers have been cut in a cross-cut. Jesse R. Butler is superintendent.

PLACER COUNTY

The Placer County Land Co., of Auburn, has bonded 2½ miles of the Bear river bed to W. F. Englebright, of Nevada City, for \$50,000. The property will be drilled for gold for probable dredging operations.

Two and a half tons of black powder was exploded by electricity at the R. H. Genung gravel property, near Iowa Hill, on February 14. About 10,000 cu. yd. of gravel was loosened ready for sluicing. This district is showing increased activity.

SHASTA COUNTY

The Oro Water, Light & Power Co. is negotiating for the sale of several ranches below Redding for dredging purposes. Prospecting by drills has proved a large area of 10-cent gravel. The Field process plant at Redding is to be given a good trial. Rich gold ore has been opened at 200 ft. in the Silver King mine, in the Centerville district, four miles west of Redding.

SISKIYOU COUNTY

Forty-one tons of ore from the Osgood mine yielded \$2000 in January. Eleven men are employed. The Commore mine

has been reopened, and a 3-ft. shoot is being worked. It is hoped to start the old mill in April. The Siskiyou Mines Co. is to extend its ditches for water-supply. These are 16 miles long at present, and four giants are in operation.

TRINITY COUNTY

(Special Correspondence.)—At the Enterprise mine, under lease to R. A. Skinner and others, 10 stamps are crushing ore from the lower level. The vein is 30 in. wide, and yields \$20 per ton by amalgamation. Prospects at this mine are good. Ten men are employed. Recent floods carried away part of the lower dam, necessitating the mill being connected with the pipe-line from the upper flume, which has been used exclusively for electric light and air-compressor. There is plenty of snow in the mountains, and a long season is expected. The Hoodoo property, adjoining the Enterprise on the south, owned by Grant Day and James McLane, is under bond to Eastern people, who will commence further development soon. Some good ore has been produced from this mine, and the new work should open more orebodies.

Helena, February 15.

TUOLUMNE COUNTY

The Springfield Tunnel & Development Co.'s adit, 8 by 8 ft., is in 450 ft., and is being advanced 5 ft. per day. Twelve men and two Damas machine-drills are employed each 8-hr. shift. Rich ore has been opened in the Caverone mine, 4 miles East of Columbia, by Plummer brothers.

COLORADO

CLEAR CREEK COUNTY

(Special Correspondence.)—The Dorrit mill, situated on Chicago creek, is to be provided with a cyanide plant. F. L. Patrick, the manager, states that the improvements will be made inside of 60 days. The new cyanide mill near the Saratoga mine dumps is nearing completion, and ore treatment will be started by March 1. S. S. Rowe is in charge. It is stated that a 50-ton electric smelter is to be constructed at the New Era mine at Freeland. H. A. Mills is in charge. Mrs. H. Ettie Minier, manager of the Little Giant G. M. & M. Co., states that work will be started during the next month in the construction of a large mill. The plant will be situated near the portal of the Commodore adit at Lawson. Ores will be treated from the White-Little Giant group of mines, situated on Red Elephant mountain. There was an increase of production in the Idaho Springs district for January of 35% over that of the same month of a year ago. The increase of tonnage was ten cars. A. H. Parker, of Denver, is now in charge at the Argo mill. The machinery is running two 12-hour shifts, and an average of 150 tons of ore is being treated per day. The Newton mine, on Chicago mountain, operated under lease by E. Smythe & Co., is the scene of a rich discovery. The orebody is 2 ft. wide, and was cut in the east drift driven from the bottom of the shaft. Assays show \$100 per ton in gold and silver.

Idaho Springs, February 3.

Construction work at the Edison mill, at Silver Plume, will probably be finished at the end of February. A new cable is to be fitted to the aerial tramway. Work has been resumed at the Centennial mine by the owner, David Kennedy, who intends to erect a 50-ton concentrating plant in the spring. The storage-battery locomotive installed at the Capital mine is working satisfactorily. Brandstetter and Moscript, Hummer and son, De Manters and Oldfield, and Oliver, lessees at the Capital, are busy prospecting and mining ore. A modern concentrating plant of 50-ton capacity is to be erected at the Centennial mine. The ore contains from \$3.60 to \$12 per ton in gold.

GILPIN COUNTY

The first shipment of pitchblende from the Central City district, a car of 12 tons, valued at \$144,000, arrived at Denver on February 17, consigned to the local representative

of Alfred I. Dupont of New Jersey. The ore is to be treated at a Denver testing plant before starting for New York, its final destination. The car was guarded by an armed escort on its journey to Denver. The mines from which the ore was taken were described by Forbes Rickard in this journal of June 7, 1913.

LAKE COUNTY (LEADVILLE)

The shipment of low-grade zinc ores from this district has always been unprofitable, and the want of a local plant to treat them has been often discussed here. Augustine and Jones, of Oklahoma, who are interested in zinc smelting in that state, have decided to erect a 50-ton smelter at Leadville as a first unit. They state that ores containing from 14% zinc upward will be received, but they must contain a certain percentage of iron. The Star claims, on Carbonate hill, are producing up to 1000 tons of ore averaging 7 to 10 oz. silver and 40% excess of iron per month. From the Waterloo, iron, lead, and carbonate of zinc ores are being shipped regularly.

OURAY COUNTY

Shipments of concentrate and crude ore from Ouray mines in January were as follows: Camp Bird, 540 tons; Wanakah (outside), 379; Wanakah (Brown mountain), 1325; Atlas, 176; Cumberland, 70; Barstow, 27; Bachelor lease, 42; San Juan Metals Co., 11; and Arps Krisher, Wedge lease, 47 tons. The smelter shipped 178 tons of matte and 12 cars of limestone was sent to the smelter from the Ouray quarry.

SAN JUAN COUNTY

Shipments of ore from the Dives, Arastra Leasing Co., E. Fiant, Gold Tunnel, Mayflower Leasing Co., Aspen, and Primrose Leasing Co. properties, at Silverton, during the first 25 days of January, amounted to 575 tons; while concentrates from the Gold King, Iowa Tiger, Sunnyside, and Intersection totaled 775 tons. Sampling the Green Mountain mine by H. B. Barling and G. A. Jahn, Jr., of New York, is finished. A large tonnage of low-grade ore has been opened.

TELLER COUNTY (CRIPPLE CREEK)

Good progress is being made in sinking No. 1 and 2 shafts of the Portland mine. They are down 1625 and 1730 ft., respectively, the latter being deepened about 130 ft. in three weeks. A company, to be called the Mineral Hill Ore Reduction & Leasing Co., is to be formed by A. H. Heller, for the purpose of securing leases and erecting a cyanide plant in the district. Options have already been acquired, and a site for a mill chosen. New rolls are being installed in the Gaylord mill. The Isabella Mines Co. held its annual meeting at Colorado Springs on February 4. The superintendent, John T. Hawkins, who recently resigned, reported that the Comet vein has been opened 125 ft., where it is 4 ft. wide of oxidized ore. On No. 9 level an ore-shoot has been opened, and the drift and raise are in granite breccia worth \$8 to \$12 per ton. Revenue during 1913 was \$254,165, and net profit \$7129. There are 31 sets of lessees working, who shipped 18,288 tons of ore worth \$243,252. It is reported in Colorado Springs that the Portland company may erect an electric power-plant on its property on Battle mountain. The Elkton company is to lease certain blocks of ground from No. 11 level to the surface. According to the superintendent, R. P. Windsor, royalties will be as follows:

Value of ore per ton.	Per cent.
\$10 and under	10
\$10 to \$20	15
\$20 to \$30	20
\$30 to \$50	25
\$50 to \$80	35
\$80 to \$100	40
\$100 and over	50

This property has produced nearly \$11,000,000 and paid \$3,279,460 to date. At the annual meeting of the Company, held on February 10, the question of extending the Roosevelt

drainage tunnel was discussed. It was proposed to drive it a farther 2200 ft., but only 5 by 6 ft. in area. At this point a hard basalt dike would be opened, allowing of rapid drainage of the mines west of the dike.

IDAHO

SHOSHONE COUNTY

A new shoot of copper sulphide ore has been opened by a raise from the 200-ft. level of the National mine, near Mullan. The ore contains 6 to 8% copper, and good silver content. The annual meeting of the Tamarack & Custer Consolidated Mining Co. was held last week at Wallace. The ore goes to the Tacoma smelter, and shipments in 1913 were worth \$366,072. Operating and construction expenses totaled \$303,308. Cash in banks amounts to \$64,601. Retimbering the Frisco mine, after its being unwatered, is finished, and overhauling the mill is nearly complete.

ILLINOIS

The petroleum production of this state in 1913 was estimated to be 21,600,000 bbl., against 28,601,308 in 1912, according to Raymond S. Blatchley, of the State Geological Survey. The total since 1904 is 208,112,868 bbl., valued at \$153,431,078. The decline in output, which began in 1913, seems to correspond with the decrease in new development in the deep Lawrence county pools. The sands of this district have a good staying quality, and are expected to yield abundantly for many years. The present rapid drop in their yield is normal, and later the decline should continue at a much lower rate. About September 1, 1910, stocks of oil in the state amounted to 29,289,164 bbl. The decrease in this surplus has been about 16,000 bbl. per day since February 1913, against 19,500 bbl. until August 1912 and 23,400 bbl. to February 1913. A general advance in prices of Illinois oil has accompanied the decreased output and surplus, due chiefly to the demand for motor fuels and other economic conditions. The present price is \$1.45 per barrel against 67c. in January 1912. There were 1439 producing wells in 1913.

MICHIGAN

Houghton County

At the Calumet & Hecla, 27 stamps are working, crushing 9000 tons per day; five at the Osceola, crushing 3000 tons; two at the Ahmeek, handling 1300 tons; and five at the Quincy, treating 3200 tons.

MONTANA

SILVERBOW COUNTY

During January, the Butte & Superior mill treated 33,520 tons of ore, yielding 11,117 tons of concentrate, containing 51% zinc, with a recovery of 90.67%. The results in this month of 1912 were 18,400 tons, 5604 tons, 46.36%, and 66.77%, respectively. The cost of mining and treatment during the past six months of 1913 was under \$5.50 per ton, and the net operating profit over \$5 per share per year.

The Anaconda Copper Mining Co. has ordered one 35 and three 75-hp. motors. The East Butte Copper Co. has ordered a 150-hp. induction motor. The Butte Duluth Mining Co. will place in operation in its power-plant a 1250-kva., two-unit, three-bearing, synchronous motor-generator set, three 150-kva. transformers, and a switchboard, also seven motors ranging from 5 to 150 hp., all the apparatus having been ordered from the General Electric Company.

NEVADA

CLARK COUNTY

(Special Correspondence.)—The St. Anthony Mining Co. is operating a mine in the Yellow Pine district, 2½ miles west of Good Springs. The property consists of about 140 acres, and ore shipments from December 26, 1912, to January 7, 1914, were 897 tons yielding net returns, after paying freight and treatment charges, of \$27.75 per ton. The principal work of

late has been at the east end of the Columbia claim. The incline shaft is down 175 ft., and a crosscut at 150 ft. has produced most of the ore. Development at present shows 6 to 15% copper ore, there being 8 ft. of 12% ore at 150 ft. depth. The shaft will be sunk to 200 ft., and crosscutting done. Several years ago the old workings yielded ore worth \$30,000, and this part of the mine has been equipped for production. A compressor, machine-drills, auto-truck and 5-ton trailer, and other equipment are necessary for a further reduction of costs. The 900-ft. aerial tramway reduced ore transport by 75c. per ton. Joseph Dederichs is general manager.

Other regular shippers at Yellow Pine are the Yellow Pine, Monte Cristo, Potosi, Anchor, Bullion, Singer, Hooster, Keystone, Porter-Palace, and Frederickson.

Good Springs, February 5.

HUMBOLDT COUNTY

According to Joseph Nenzel, the Mexican company, operating at Virginia City, will not erect the proposed mill at Rochester. Reasons for this are stated to be doubt as to ability to secure 90% of the silver in the ore, and the company will not make any contract which might be hampered by litigation.

LINCOLN COUNTY

A bonus system to aid shaft-sinking at the Amalgamated Ploche has given good results. For each foot over 21 ft. sunk each week the men get \$1, and if over 100 ft. in a month an additional similar amount per foot. The shaft is down about 1350 ft. Lessees in the Ploche district are busy shipping ore.

LYON COUNTY

The Mason Valley smelter received only 2671 tons of ore during the week ended February 14, and shipped four cars of blister copper. Two men were injured in furnace explosion Feb. 15. The tonnage shows a considerable falling off of late. Most of the ore being shipped from the Nevada-Douglas property comes from the Casting Copper claim, which averages 7 to 8% copper. Diamond-drills have proved three new orebodies in this part of the mine. The Ludwig produces a carload of 10% ore per day. Experiments being made on the ore at Denver, Colorado, will be finished by March.

NYE COUNTY

Ten mines at Tonopah produced 10,995 tons of ore worth \$264,440 during the week ended February 14. In January, the Belmont mill treated 15,009 tons, yielding 333,083 oz. bullion, with a net profit of \$150,288. Work on the new vein on No. 12 level opens about 3 ft. of rich ore. The Tonopah company's mill at Millers treated 12,255 tons, yielding 221,146 oz., and concentrate worth \$42,460. The net profit was \$119,423. The Jim Butler company's January profits were \$14,375. Six feet of ore is being opened in a winze below the West End 600-ft. level. In the Extension a raise above the 950-ft. level and a winze below it are opening good ore in the Murray vein. One stope on the MacDonald vein, in the Montana-Tonopah, is 60 ft. long and 8 ft. wide. This ore has a high gold content, the concentrate averaging 20 oz. per ton, and the mill bullion being much higher in this metal than the usual ratio of 950 to 10 or 15 per 1000 parts in this district. No. 3 shaft of the Buckeye-Belmont is making 17,000 gal. of water per 24 hours. A triplex electric pump is to be installed.

Ten stamps at the War Eagle mill, at Manhattan, are working, and the new equipment of ore-bins, 10 stamps, tube-mill, and copper plates is to be started in a few days. A large tonnage of ore has been proved in the Mustang, which is sending it regularly to the War Eagle mill. There is an increasing quantity of the Maris chalcidony being quarried and used in tube-mills in Nevada mining districts. A machine has been installed at the quarry to wear off the sharp corners of the rock before shipment. Better weather has resulted in a resumption of work at the placer areas.

A herd of 1800 sheep was grazing at Millers, 12 miles from Tonopah, last week, when they drank some water flowing from one of the treatment plants or tailing areas situated there, resulting in the death of 1200, worth about \$4800.

STOREY COUNTY

In a raise above the 2400-ft. level in the Ophir mine, 6 ft. of \$56 ore has been opened. Shares rose in price considerably as a result. T. F. McCormick is superintendent. The water in the joint Crown Point and Belcher incline winze was 135 ft. below the 1500-ft. level last week. Byron Jackson pumps are employed in unwatering.

WHITE PINE COUNTY

It is said that the Ruth mines may be reopened, and ore extracted by steam-shovels, although up to the present the property has been mined by underground methods.

NEW MEXICO

GRANT COUNTY

The Chino Copper Co. reports as follows for the last quarter of 1913:

Overburden removed, cubic yards	934,088
Ore milled, tons	512,450
Average copper content, per cent.	2.08
Recovery, per cent	65.54
Copper output, pounds	13,970,438
Copper on hand and in transit, pounds.....	20,844,497
Profit	\$812,087
Dividends paid	645,405

Of the ore treated, 76.6% came from the southeast, 16.7% from the northeast, and 6.7% from the northwest orebody. A more uniform character of ore can now be mined. The concentrate cleaning plants were completed, producing a bet-



CHINO MILL WHEN BUILDING.

ter smelting quality. The water-supply is now satisfactory. Bonds were retired during the quarter, and those outstanding will be called in by July 1, 1914.

VALENCIA COUNTY

(Special Correspondence).—A leaching plant of 100 tons capacity is to be built in the Zuni mountains near Sawyer, New Mexico, to treat copper carbonate ore. The process has been demonstrated in a small plant, and, if it is satisfactory in the unit now planned, a larger mill will be built.

Las Vegas, February 10.

OREGON

BAKER COUNTY

The Cornucopia Mines Co., at Cornucopia, will install two 75-hp. motors and controller recently ordered from the General Electric Company.

JACKSON COUNTY

(Special Correspondence).—The Beaver Portland Cement Co.'s new plant to manufacture cement from the limestone

deposits near Gold Hill, is making good progress. Machinery is arriving, and is being installed. The rotary kiln is 20 ft. long and 10 ft. diameter. Five large 'slurry' tanks, 20 ft. high, being built from native fir, will hold the pulverized kiln feed from the crushers. Work at the quarry continues. The Company has several contracts for cement highways in the state.

Philomath, February 13.

SOUTH DAKOTA

LAWRENCE COUNTY

The State Tax Commission has issued a statement showing the taxes paid by the Homestake Mining Co. during the years 1905 to 1913, inclusive, which are as follows: \$76,987, \$76,512, \$72,837, \$80,430, \$92,617, \$96,261, \$103,939, \$108,482, and \$200,072.

TEXAS

EL PASO COUNTY

The El Paso smelter is being enlarged at a cost of about \$250,000. The present plant consists of six furnaces for lead ores, with a capacity of 200 tons each, and three furnaces for copper ores with a capacity of 300 tons each per 24 hours. The matte and slag from the copper furnaces flows into 14-ft. settlers, the slag being taken by a tram to dumps. Improvements are being made in the slag department. There are five 22-ft. diameter Wedge roasting furnaces in the copper department, each with a daily capacity of 200 tons. Three more Wedge furnaces, with two more hearths, making five each, are being installed. In the reverberatory plant are two oil-fired furnaces, each 19 by 95 ft., with a capacity of 350 tons each per day. Oil consumption is 300 bbl. each daily. Seven steam locomotives and about 50 cars are used about the plant. The power house contains all the necessary steam, electrical, and blowing machinery, while a machine shop is fully equipped. Over 10,000 determinations are made in the laboratory each month. At present about 1100 men are employed, including 200 to 300 on new work. The monthly payroll is over \$75,000, about \$60,000 is paid to El Paso houses for supplies, and the railroad companies receive from \$80,000 to \$100,000 for freight according to the *El Paso Herald*. A complete hospital is maintained at the smelter. The plant is operated by the American Smelting & Refining Co., and ores are received from all parts of Arizona and Mexico.

UTAH

JUAB COUNTY

Ore shipments from Tintic during the week ended February 13 were as follows: Mammoth, 33 carloads; Centennial-Eureka, 24; Chief Consolidated, 21; Eagle & Blue Bell, 17; Iron Blossom, 15; Grand Central, 12; Gemini (Keystone), 7; May Day, 5; Beck Tunnel, 5; Gold Chain, 2; Colorado, 2; Minnie Moore lease, 1; Uncle Sam, 1; Victoria, 1; Showers lease, 1; and Bullion Beck, 1; a total of 148 carloads.

SUMMIT COUNTY

Concreting the Silver Hill underground station, in the Alliance adit of the Silver King Coalition, is well under way. A motor weighing 11 tons, to be used in this station, is at the mine. By April sinking the shaft should be started. Ore shipments from Park City during the past week were as follows: Silver King Coalition, 1050 tons; Daly-Judge, 435; Silver King Consolidated, 198; American Flag, 57; and Daly West, 50; a total of 1790 tons.

WASHINGTON

FERRY COUNTY

(Special Correspondence).—The Republic Mines Corporation, which owns the Surprise, Lone Pine, and Pearl mines, at Republic, has been declared a bankrupt in the federal court at Spokane. The Knob Hill company produced ore netting

\$140,000 in 1913. The Belcher Mining Co., of Belcher camp, has been shipping 24 cars of ore per week from above the 300 ft. level. Thirty men were employed, but some have been laid off, as the smelters are not able to take all the ore. The British Columbia Copper Co. is sending a car of ore per day from the Lone Star and Washington mines, in the north end of the county, to its smelter at Greenwood. The Laurier Mining Co., in the Orient district, has completed its adit to the vein, 150 ft. farther than the pitch of the vein in the shaft indicated. A good body of ore has been developed in the Iron Creek mine, 40 miles south of Republic, and a shipment is being made to the Trail smelter.

Republic, February 10.

OKANOGAN COUNTY

(Special Correspondence.)—J. L. Harper, former general manager in Republic, of the Republic Mines Corporation, the Imperator-Quillp, and North Washington Power & Reduction companies, has secured control of the Golden Chariot mine, on Kruger mountain, and is negotiating for two other groups adjoining it. He is employing eight or ten men and getting out ore for shipment.

Oroville, February 12.

STEVENS COUNTY

(Special Correspondence.)—The Silver Queen mine, at Turk, is to be reopened. The ore is worth \$30 per ton, but it costs \$21 to send it to the Tacoma smelter. Good copper ore has been opened at 18 ft. in the Lena mine, near Rock Cut. At Chewelah, the Security Copper Co. has resumed work and will sink its shaft to 400 ft. A smelting plant to cost between \$35,000 and \$50,000 will probably be erected by the Copper King company.

Chewelah, February 11.

WYOMING

Reports are to hand of the discovery of very rich gold-bearing ore in the Snowy Range district. Assays, up to \$19,833 per ton, are so high as to warn miners from rushing to the place.

LINCOLN COUNTY

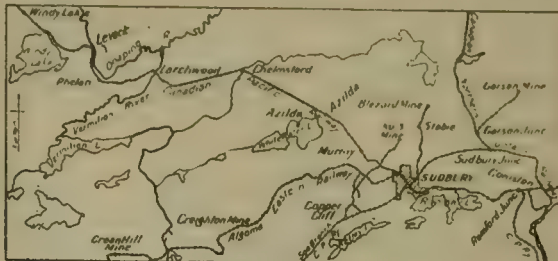
The new 50-ton mill of the United States Phosphate Co., at Border, in the Bear River valley, and one mile from the

valley in Utah, Idaho, and Wyoming. The largest and most easily worked deposits are said to be in Rich county, Utah, but as the distance to the railroad is greater than in Wyoming and Idaho more development is being done in the other two states.

CANADA

ONTARIO

Rich ore has been opened on the 200-ft. level of the Peterson Lake company's Kerry claim. Sixty men are erecting the transmission line from the power-station at Charlton to the Tough-Onkes mine at Kirkland Lake. The contract calls for the delivery of 800 hp. on May 1, and the work is being financed by the mining company, to be paid back by a rebate on power consumed. The annual report of the Dome Lake Min-



SUDBURY DISTRICT, ONTARIO.

ing & Milling Co. shows that 4645 ft. of development was done, of which 926 ft. was in ore. There are two ore-shoots on the 180-ft. level, 60 and 50 ft. long, 23 and 20 in. wide, worth \$17.96 and \$18.80 per ton, respectively. The 150-ft. level shoot has been opened 100 ft., assaying \$22.80 per ton. Ore treated during 1913 was 3717 tons, yielding \$18,762 by amalgamation, and \$5607 by concentration. The 10-stamp mill worked three months. A sorting table is to be installed, and so increase the value of the ore.

Monthly returns from the Dome mine have had the following averages since April last: \$13.11, \$13.68, \$8.69, \$6.81, \$6.31, \$6.50, \$9.56, \$8.76, and \$7.93 per ton.

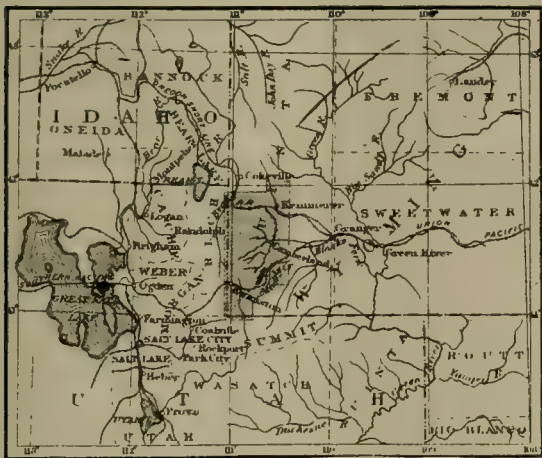
A scheme to provide the towns of Copper Cliff and Frood with water at a cost of \$200,000, and provide for a population of 17,000 people, has been completed by the Canadian Copper Co. Three lakes, known as Meat Bird, Peggy, and Leach, near the Creighton mine, contain good water, and a watershed of 2660 acres surrounding the lakes has been secured. Pipes of 10 and 11-in. diameter will carry the water, by gravity, to Copper Cliff, where there will be a 100,000-gal. storage tank. Lady MacDonald and Clara Belle lakes have hitherto supplied Copper Cliff, but will supply the Company's smelting and refining plants in future, although both systems may be connected at any time. Whitson lake, 4½ miles northeast, will supply Frood. A watershed of 12 square miles has been secured around it. A 10-in. pipe, 22,000 ft. long, will carry the water to a 100,000-gal. tank. This supply must be pumped the whole distance.

CHILE

The Braden mills treated 98,000 tons of 2.15% copper ore in January, with 72.7% recovery, yielding 2,430,000 lb. of copper.

COSTA RICA

The Abangarez Gold Fields company reports as follows for December 1913: Ore treated, 7541 tons; gold recovered by amalgamation and cyanidation, \$53,828; profit, \$2343; expenditure on plant, etc., \$3987. The past year resulted in the treatment of 69,346 tons of ore, yielding \$579,236, and a loss of \$22,040. Betterment expenses were \$72,733. In 1912 the loss was \$128,683, and betterment expenses \$222,781.



MAP SHOWING PHOSPHATE AREAS OF IDAHO, UTAH, AND WYOMING.

Idaho boundary line, is ready for work. So far, crude ore has been shipped to Los Angeles, California; but it was found necessary to produce proper shipping material, so the mill was built. The Company is working a large phosphate deposit. There are other known deposits, mostly in the Bear Lake

DUTCH GUIANA

(Special Correspondence.)—The government of this colony has recently published the gold output for 1913, which amounted to 856,768 gm. (27,640 oz.), against 716,487 gm. (23,110 oz.) in 1912. About 90% of this gold was produced by hand methods. At present there is one small Chilean mill and one small dredge working in the colony. There will be another boat operating early in March. All gold produced in this country must pass through the government, which collects 5% of it. The figures given are quite reliable.

Paramaribo, January 20.

MEXICO

Of over 30 mines belonging to the American Smelting & Refining Co. in this country, only about five are being worked at present. Conditions in northern Mexico are improving.

AGUASCALIENTES

The American Smelting & Refining Co. has two blast-furnaces, or 50% of the total capacity, in operation at the Aguascalientes plant.

CHIHUAHUA

The Chihuahua smelter is working at 50% capacity again. Railroad communication is improving, but there is difficulty in procuring cars. Most of the ore being smelted is from the American Smelting & Refining Co.'s mine at Santa Eulalia.

SAN LUIS POTOSI

The American Smelting & Refining Co. has been trying to start its Matahuela smelter, but has not succeeded so far.

SONORA

Exports of ore and concentrate from this state in January, through the 'port' of Agua Prieta, were as follows: From Nacozari, 12,690 tons; El Tigre, 164; San Ygnacio, 55; Santa Rosa, 62; El Temblor, 17; Mina Cobre, 11; La Union, 16; San Jose, 32; La Caridad, 29; La Sonora, 51; Alemanita, 26; San Cristobal, 2; El Carmen, 22; San Francisco, 21; and Cobre Verde, 18; a total of 327 cars equal to 13,216 tons. The estimated value of the exports in Mexican currency was: copper \$1,984,800; silver, \$617,500; and gold, \$208,900; a total of \$2,811,200.

Several hundred armed Yaqui Indians are said to be wandering around the Arizpe and Sahuaripa districts, and molesting people in many ways. One treatment is to strip their victims naked and force them to enter the nearest pueblo.

NICARAGUA

The Tonopah Mining Co., of Nevada, has taken an option for a year on a property in this country. It has been favorably reported on by J. E. Spurr, the Company's consulting engineer. The Eden Mining Co. will be formed to develop the area.

PERU

Trials made of the new hydro-electric power-plant of the Cerro de Pasco Mining Co. are reported to have been satisfactory. Water is obtained from the Montaro river, and is conducted through a ditch and pipe about 12 miles to the station at Oroya, which is 70 miles from the smelter and Cerro de Pasco. Six Pelton wheels are connected in pairs to three generators of 3000 kw. each. The effective head of the water is 750 ft. The transmission line has been extended to Morococha, 15 miles from Oroya, to supply the Morococha Mining Co. The power-plant cost about £200,000 and was installed by A. L. Wilcox.

SIBERIA

Sakhalin has long been known to contain oil, and determined efforts are now being made to develop the territory by the Sakhalin Oil Fields, Ltd., a British company. The fields were examined for Prince Radziwill in 1909 by Paul Dvorkovitz, who gave a favorable opinion, and they were later studied by members of the staff of Sir Boverton Redwood.

Personal

A. E. DRUCKER is in Paris.

E. H. LESLIE is at St. Louis.

L. H. WEBB has returned from a European trip.

ROBERT ANDERSON is in Peru for S. Pearson & Son.

P. D. BURT is at Grass Valley on examination work.

PERCY L. FEARN has arrived in New York from Costa Rica.

N. B. KNOX is at Kingston, Jamaica, returning from Colombia.

C. S. HALEY has returned from Colombia and is in New York.

CHARLES JANIN has gone to Russia to make a mine examination.

J. M. LILLIGREN passed through San Francisco returning to Nevada.

R. B. BRINSMADE is studying the economic geology of Jalisco near Guadalajara.

E. S. McCURDY has returned from New York and was in San Francisco last week.

WALTER A. SCHMIDT has returned from Europe and was in San Francisco Wednesday.

E. C. KLINKER was in San Francisco, returning from Los Angeles to the Eagle Bird mine.

THOMAS A. VARDEN, general superintendent for the Corbin Copper Co., at Butte, is at Salt Lake City.

G. M. COLVOCORESSIS, general manager for the Consolidated Arizona Smelting Co., is at Humboldt, Arizona.

W. B. OREM, who has for many years been inspector of mines for the state of Montana, is at Bisbee, Arizona.

CARL J. TRAUTERMAN, of Butte, Montana, will take charge of the milling operations of the Bully Boy company, of Marysvale, Utah, after March 1.

J. P. MONTAGUE has resigned his position as mill superintendent for the Tonopah Extension Mining Co. and will be succeeded by E. M. KIRCHEN, brother of J. G. KIRCHEN, the manager.

E. M. DE LA VERGNE, former vice-president and general manager of the Elkton Consolidated Mining & Milling Co., has been appointed superintendent of the United Gold Mines Co. to succeed EBEN BEEBE.

Schools and Societies

The Columbia branch of the AMERICAN INSTITUTE OF MINING ENGINEERS held its quarterly meeting at Spokane on February 13. This consisted of reading and discussing papers and a smoker given by the Spokane Mining Men's Club.

The UNIVERSITY OF ILLINOIS COLLEGE OF ENGINEERING was recently lectured by Francis S. Peabody on 'The Mining and Utilization of Illinois Coal.' Illustrations included motion pictures of actual underground work, these being the first motion pictures taken in a mine.

The San Francisco branch of the MINING AND METALLURGICAL SOCIETY held a meeting, following a dinner at the Engineers Club, Hotel Sutter, on February 12. W. E. Colby addressed the members on 'The Beginnings of Modern Mining Law in Relation to the Revision of American Mining Law.'

Forty members of the AMERICAN INSTITUTE OF MINING ENGINEERS met at Wilkes-Barre, Pennsylvania, on January 31, to discuss the formation of a local section in the anthracite region. Those present were C. F. Rand, Joseph W. Richards, H. M. Chance, Bradley Stoughton, R. V. Norris, F. W. Chase, C. F. Huber, R. J. Foster, F. A. Hill, and others.

The Metal Markets

LOCAL METAL PRICES

San Francisco, February 19

Antimony	.....	9 — 9½c
Electrolytic copper	.....	15½—15¾c
Pig lead	.....	4 25— 5 30c
Quicksilver (flask)	.....	\$39.00
Tin	.....	42½— 44 c
Spelter	.....	6½— 6¾c
Zinc dust, 100 kg. zinc-lined cases, 7½ to 8c. per pound.		

EASTERN METAL MARKET

(By wire from New York.)

NEW YORK, February 19.—The market for all metals is dull. Copper has a downward tendency, while lead and spelter show no change for the past two weeks. Dealings in copper shares were brisk on the Stock Exchange. The total stocks of all kinds sold today was 429,621. Metal prices in London were: copper closed steady at £65 for spot, off 2s.6d., and £65 10s. for futures, off 2s.6d.; spelter, £21 7s.6d., unchanged; and lead, £19 10s., up 2s.6d. The bull movement in stocks generally has been checked. The issues in January were about £215,000,000.

SILVER

Below are given the average New York quotations in cents per ounce, of fine silver.

Date.		Date.	
Feb. 5.....	57.37	Feb. 12 Holiday	
" 6.....	57.50	" 13.....	57.37
" 7.....	57.62	" 14.....	57.37
" 8 Sunday		" 15 Sunday	
" 9.....	57.75	" 16.....	57.37
" 10.....	57.50	" 17.....	57.37
" 11.....	57.50	" 18.....	57.37

Average week ending.

Jan. 7.....	57.50	Feb. 4.....	57.46
" 14.....	57.75	" 11.....	57.54
" 21.....	57.58	" 18.....	57.37
" 28.....	57.60		

Monthly averages.

	1913.	1914.		1913.	1914.
Jan.	63.01	57.58	July	58.70	.....
Feb.	61.25	.....	Aug.	59.32	.....
Mch.	57.87	.....	Sept.	60.53	.....
Apr.	59.26	.....	Oct.	60.88	.....
May	60.21	.....	Nov.	58.76	.....
June	59.03	.....	Dec.	57.73	.....

In the earlier part of the week ended January 29, according to Pixley & Abell, the market showed steadiness and the rates were easily maintained. On the 27th, prices advanced to 53.5c. for cash and 53.8c. for forward, but they have since fallen away to today's quotations of 53.8 and 53.2c. respectively. The steadiness was almost entirely due to the liquidation of Indian bear accounts, a large amount being covered on the 27th, but there has since been a little Eastern selling, and, with the Indian support withdrawn, prices have sagged to the above quotations, at which the market closes quiet. The United States Mint bought 300,000 oz. on the 24th, and a small amount has been taken for the Continent. Supplies generally continue small, and, unless China opens weak after the holidays, rates should hold at about the present level, until some new factor presents itself.

COPPER

Quotations on copper as published in this column represent average wholesale transactions on the New York market and refer to electrolytic copper. Lake copper commands normally 1-5 to 1-4c. per lb. more. Prices are in cents per pound.

Date.		Date.	
Feb. 5.....	14.60	Feb. 12 Holiday	
" 6.....	14.60	" 13.....	14.63
" 7.....	14.60	" 14.....	14.63
" 8 Sunday		" 15 Sunday	
" 9.....	14.65	" 16.....	14.50
" 10.....	14.70	" 17.....	14.50
" 11.....	14.70	" 18.....	14.50

Average week ending

Jan. 7.....	14.39	Feb. 4.....	14.59
" 14.....	13.97	" 11.....	14.64
" 21.....	14.03	" 18.....	14.55
" 28.....	14.35		

Monthly averages.

	1913.	1914.		1913.	1914.
Jan.	16.54	14.21	July	14.21	.....
Feb.	14.93	.....	Aug.	15.42	.....
Mch.	14.72	.....	Sept.	16.23	.....
Apr.	15.22	.....	Oct.	16.31	.....
May	15.42	.....	Nov.	15.08	.....
June	14.71	.....	Dec.	14.25	.....

£175 5s. for three months. Transactions dealt with 3200 tons in the week.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Date.	
Feb. 5.....	1.00	Feb. 12 Holiday	
" 6.....	1.00	" 13.....	1.00
" 7.....	1.00	" 14.....	1.00
" 8 Sunday		" 15 Sunday	
" 9.....	1.00	" 16.....	1.00
" 10.....	1.00	" 17.....	1.00
" 11.....	1.00	" 18.....	1.00

Average week ending

Jan. 7.....	1.15	Feb. 4.....	1.15
" 14.....	1.10	" 11.....	1.00
" 21.....	1.10	" 18.....	1.00
" 28.....	1.10		

Monthly averages.

	1913.	1914.		1913.	1914.
Jan.	1.28	1.11	July	1.35	.....
Feb.	1.33	.....	Aug.	1.60	.....
Mch.	1.32	.....	Sept.	1.70	.....
Apr.	1.36	.....	Oct.	1.37	.....
May	1.34	.....	Nov.	1.16	.....
June	1.33	.....	Dec.	1.02	.....

TIN

New York prices control in the American market for tin, since the metal is almost entirely imported. San Francisco quotations average about 5c. per lb. higher. Below are given average monthly New York quotations, in cents per pound:

Monthly averages.

	1913.	1914.		1913.	1914.
Jan.	50.45	37.85	July	40.70	.....
Feb.	49.07	.....	Aug.	41.75	.....
Mch.	46.95	.....	Sept.	42.45	.....
Apr.	49.00	.....	Oct.	40.61	.....
May	49.10	.....	Nov.	39.77	.....
June	45.10	.....	Dec.	37.57	.....

Tin witnessed one of the sensational movements which have characterized this metal from time to time, during the week ended January 24, when it advanced £9 per ton in London, according to Henry R. Merton & Co. The price jumped to £179, but on a good deal of realizing, it fell to £174 5s. for cash and

QUICKSILVER

The primary market for quicksilver is San Francisco, California, being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending		Feb. 5.....	
Jan. 22.....	39.00	" 12.....	39.00
" 29.....	39.00	" 19.....	39.00

Monthly averages.

	1913.	1914.		1913.	1914.
Jan.	39.37	39.25	July	41.00	.....
Feb.	41.00	.....	Aug.	40.50	.....
Mch.	40.20	.....	Sept.	39.70	.....
Apr.	41.00	.....	Oct.	39.37	.....
May	40.25	.....	Nov.	39.40	.....
June	41.00	.....	Dec.	40.00	.....

Quicksilver in London was £7 10s. per flask, first hands, on January 24.

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date.		Date.	
Feb. 5.....	5.25	Feb. 12 Holiday	
" 6.....	5.25	" 13.....	5.25
" 7.....	5.25	" 14.....	5.25
" 8 Sunday		" 15 Sunday	
" 9.....	5.25	" 16.....	5.25
" 10.....	5.25	" 17.....	5.25
" 11.....	5.25	" 18.....	5.25

Average week ending

Jan. 7.....	5.02	Feb. 4.....	5.25
" 14.....	5.08	" 11.....	5.25
" 21.....	5.05	" 18.....	5.25
" 28.....	5.20		

Monthly averages.

	1913.	1914.		1913.	1914.
Jan.	6.88	5.14	July	5.11	.....
Feb.	6.13	.....	Aug.	5.51	.....
Mch.	5.94	.....	Sept.	5.55	.....
Apr.	5.52	.....	Oct.	5.22	.....
May	5.23	.....	Nov.	5.09	.....
June	5.00	.....	Dec.	5.07	.....

Spelter prices in London were steady at £21 10s. to £22. The Association of Galvanizers has been finally constituted, and this branch of trade is hopeful.

London prices of antimony were £28 per ton on January 24, according to Henry R. Merton & Co., aluminum, £81 to £85 per ton, and iron 51s. to 51s.7d. per ton.

The Stock Markets

SAN FRANCISCO STOCKS AND BONDS

(San Francisco Stock and Bond Exchange.)

BONDS
February 18.

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Associated Oil 5s.....	\$ 97½	99	Natomas Consol. 6s.....	25	—
Unlisted.			Pac. Port. Cement 6s.....	—	100½
Ass. Oil 6s.....	—	82½	Santa Cruz Cement 6s.....	—	90
General Petroleum 6s.....	41½	45	Union Oil.....	—	88

STOCKS

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Amalgamated Oil.....	—	86½	General Petroleum.....	4½	5½
Associated Oil.....	41½	42½	Noble Electric Steel.....	5	—
E. I. du Pont pfd.....	—	90	Natomas Consol.....	1½	—
Giant.....	84½	—	Pac. Port. Cement.....	—	69
Pac. Cst Borax, pfd.....	70	—	Riverside Cement.....	60	—
Pacific Crude Oil.....	—	35c	Santa Cruz Cement.....	—	55
Sterling O. & D.....	1½	1½	Stand. Port. Cement.....	10	—

NEVADA STOCKS

(By courtesy of San Francisco Stock Exchange.)
February 19.

Atlanta.....	\$.18	Montana-Tonopah.....	\$1.02
Becher.....	.52	Nevada Hills.....	.41
Belmont.....	7.90	North Star.....	.39
Con. Virginia.....	.30	Ophir.....	.75
Florence.....	.56	Pittsburg Silver Peak.....	.35
Goldfield Con.....	1.60	Round Mountain.....	.43
Goldfield Oro.....	.14	Sierra Nevada.....	.11
Halifax.....	1.05	Tonopah Extension.....	1.70
Jim Butler.....	.97	Tonopah Merger.....	.60
Jumbo Extension.....	.24	Tonopah of Nevada.....	7.12
MacNamara.....	.10	Union.....	.22
Mexican.....	1.22	Victor.....	.31
Midway.....	.39	West End.....	1.25
Mizpah Extension.....	.51	Yellow Jacket.....	.60

COPPER SHARES—BOSTON

(By courtesy of J. C. Wilson, Mills Building.)
February 19.

	Bid	Ask		Bid	Ask
Allouez.....	\$ 43	43½	Mohawk.....	\$ 45	46
Ariz. Commercial.....	5½	5½	Nevada Con.....	16	16½
Butte & Superior.....	36½	37	North Butte.....	29½	29½
Calumet & Arizona.....	68½	68½	Old Dominion.....	52½	53
Calumet & Hecla.....	445	450	Osceola.....	82	84
Copper Range.....	39½	39½	Quincy.....	66½	67
Daly West.....	2½	2½	Shannon.....	7	7½
East Butte.....	11½	12½	Superior & Boston.....	2½	2½
Franklin.....	5	5½	Tamarack.....	41	41½
Granby.....	86½	87	U. S. Smelting, com.....	42½	42½
Greene Cananea.....	39	40	Utah Con.....	13	13½
Isle-Royale.....	22½	23	Winona.....	4½	4½
Mass Copper.....	3½	3½	Wolverine.....	47	48

NEW YORK CURB QUOTATIONS

(By courtesy of E. F. Hutton & Co., Kohl Building.)
February 19.

	Bid.	Ask.		Bid.	Ask.
Braden Copper.....	7½	7½	Mason Valley.....	3¾	3¾
Braden 6s.....	115	152	McKinley-Dar.....	1¾	1¾
B. C. Copper.....	2½	2½	Mines Co. Am.....	3½	3½
Con. Cop. Mines.....	2½	2½	Nipissing.....	6¼	6½
Davis-Daly.....	1½	2	Ohio Copper.....	¼	½
Ely Con.....	4	6	San Toy.....	15c.	25c.
First National.....	2¾	3	Stand. Oil of Cal. 320	321	
Giroux.....	1	1½	Tri Bullion.....	¾	¾
Hollinger.....	16	18	Tuolumne.....	¾	1
Iron Blossom.....	1½	1½	United Cop. com.....	¾	¾
Kerr Lake.....	4¾	5	Wetlaufer.....	6c.	8c.
La Rose.....	1½	1½	Yukon Gold.....	2¼	2½

NEW YORK STOCK EXCHANGE

(By courtesy of J. C. Wilson, Mills Building.)
February 19.

	Bid	Ask		Bid	Ask
Amalgamated.....	\$ 75½	75½	Miami.....	\$ 2½	2½
Anaconda.....	36½	36½	Nevada Con.....	16½	16½
A. S. & R. com.....	68	68½	Quicksilver, com.....	2	2½
Calif. Pet., com.....	27½	28½	Ray Con.....	20	20½
Chino.....	42	42½	Tenn. Copper.....	35½	36½
Guggenheim Ex.....	51½	52½	U. S. Steel, pfd.....	101½	102½
Inspiration.....	17½	17½	U. S. Steel, com.....	66	66½
Mexican Pet., com.....	67½	67½	Utah Copper.....	55	56½

LONDON QUOTATIONS

(By cable, through the courtesy of Catlin & Powell Co.,
New York.)
February 19.

	£	s.	d.		£	s.	d.
Alaska Mexican.....	1	5	0	Kern River Oilfields.....	0	7	8
Alaska Treadwell.....	8	0	0	Mexico Mines.....	5	2	6
Alaska United.....	5	2	6	Messina.....	1	10	0
Arizona.....	2	0	0	Oroville.....	0	13	9
California Oilfields.....	6	0	0	Pacific Oilfields.....	0	2	6
Camp Bird.....	0	12	6	Rio Tinto.....	71	10	0
Cobalt Townsite.....	2	11	3	Santa Gertruda.....	0	16	9
El Oro.....	0	15	0	Tanganyika.....	2	6	3
Esperanza.....	0	18	9	Tomboy.....	1	3	9
Granville.....	0	11	3				

AUSTRALASIAN

February 19.

	£	s.	d.		£	s.	d.
British Broken Hill.....	2	3	9	Mount Elliott.....	4	2	6
Broken Hill Prop.....	2	2	6	Mount Lyell.....	1	5	0
Golden Horse-Shoe.....	2	15	0	Mount Morgan.....	3	11	9
Great Boulder Prop.....	0	15	0	Waihi.....	2	12	6
Ivanhoe.....	2	16	9	Waihi Grand Junction.....	1	6	8
Kalgoorlie.....	1	16	9	Zinc Corporation, Ord.....	1	1	3
Mount Boppy.....	0	12	6				

MINT OPERATIONS

The superintendent of the San Francisco Mint, T. W. H. Shanahan, reports as follows for January:

Gold received, fine ounces.....	169,103.71
Silver received, fine ounces.....	100,538.42
Coinage executed, domestic.....	\$2,967,400
Coinage executed, Philippine Islands.....	\$44,000

Coin, bullion, etc., on hand at close of business January 31, 1914, was as follows:

Gold coin.....	\$ 8,149,130.00
Silver coin.....	61,636,921.50
Nickel coin.....	24,030.25
Bronze coin.....	11,088.62
Checking balance Treasurer U. S.....	5,428,776.89
Gold certificate bars.....	108,501,758.93
Gold bullion.....	51,629,461.57
Silver bullion.....	603,002.04

Total.....\$235,984,169.80

DOMINION STEEL CORPORATION

THE past year's output of the Dominion Steel Corporation, Canada, was as follows:

	Tons.
Coal mines.....	5,100,000
Iron ore mines.....	780,000
Limestone quarried.....	582,000
Pig iron produced.....	357,000
Steel ingots produced.....	347,000
Rails.....	175,000
Blooms sold.....	32,000
Wire rods made.....	32,000
Wire and wire products.....	24,000
Steel bars, etc.....	16,000
Sulphate of ammonia.....	5,000
Basic and granulated slag.....	25,000
Tar, gallons.....	5,650,000

The steel plant has received several big orders, and is running full time.

QUICKSILVER production in the United States in 1913 showed a decrease of 5383 flasks compared with 1912, when the output was 25,064 flasks, according to the U. S. Geological Survey. California produced 15,396 flasks, and Arizona, Nevada, and Texas a total of 4285 flasks. The average price at San Francisco in 1913 was \$39.33 per flask, against \$42.05 in 1912. Exports were 1099 and imports 2032 flasks.

PIG IRON PRODUCTION in the United States during January was 1,878,786 tons, which is 97,352 tons less than in December.

Monthly Copper Production

AHMEEK COPPER MINING CO., Keosauqua, Michigan. \$1,000,000 in \$25 shares; 24,736 shares owned by Calumet & Hecla; 3000-ton mill at Hubbard, concentrate smelted by Calumet & Hecla smelter. Total in 1913, 9,100,000 pounds.

ALLOUEZ MINING CO., Allouez, Michigan. \$2,500,000 in \$25 shares; controlled by the Calumet & Hecla, which owns 43,000 shares and \$250,000 in notes of the company; ore is milled by the Lake Milling, Smelting & Refining Co., in which the Allouez owns half. Total in 1913, 4,200,000 pounds.

ANACONDA COPPER MINING CO., Butte, Montana. \$108,312,500 in \$25 shares; controlled through Anaconda Consolidated Copper Co. by Thos. F. Cole, J. D. Ryan, and Standard Oil interests; 10,000-ton concentrator and smelter at Anaconda, 5000-ton concentrator and smelter at Great Falls, Mont., also 70-ton electrolytic refining plant at Great Falls. Production figures include copper from all companies which ship custom ore to Anaconda smelters.

Month.	Pounds.	Month.	Pounds.
June	21,500,000	October	18,400,000
July	21,181,000	November	25,250,000
August	22,500,000	December	25,100,000
September	22,600,000	January 1914	24,400,000

ARIZONA COPPER CO., LTD., Morenci, Arizona. \$379,974 in \$5 shares; controlled by Edinburg Investors; mill at Morenci is being enlarged to 3000-ton capacity and a new 1200-ton smelter near Clifton has just been started.

Month.	Pounds.	Month.	Pounds.
June	3,000,000	October	3,550,000
July	2,600,000	November	2,800,000
August	1,800,000	December	2,920,000
September	1,800,000	January 1914	3,474,000

BRADEN COPPER CO., La Junta, Chile. \$2,332,030 in \$10 shares and \$4,000,000 in 6% convertible bonds; entire stock held by Braden Copper Mines Co.; \$12,000,000 in \$5 shares; \$5,000,000 in convertible bonds; controlled by Guggenheim interests; two mills at La Junta; 3000-ton capacity smelter at Racagua.

Month.	Pounds.	Month.	Pounds.
June	1,808,000	October	2,600,000
July	1,046,000	November	1,592,000
August	1,572,000	December	2,122,000
September	1,322,000	January 1914	2,426,000

BRITISH COLUMBIA COPPER CO., LTD., Greenwood, B. C. \$2,958,545 in \$5 shares; controlled by Newman Erb; 600-ton sampling plant and 2500-ton smelter.

Month.	Pounds.	Month.	Pounds.
June	634,238	September	626,761
July	618,379	October	688,000
August	700,000	November	682,383
		December (est.)	800,000

CALUMET & ARIZONA MINING CO., Warren, Arizona. \$6,285,710 in \$10 shares; has absorbed the Superior & Pittsburg Copper Co. by stock exchange; controlled by Hoatson and other Lake Superior interests; 3000-ton smelter at Douglas. Total in 1913, 51,710,000 pounds.

Month.	Pounds.	Month.	Pounds.
June	3,000,000	October	4,500,000
July	3,800,000	November	4,600,000
August	4,500,000	December	5,230,000

CALUMET & HECLA MINING CO., Calumet, Michigan. \$2,500,000 in \$25 shares; controls the Ahmeek, Allouez, Centennial, Isle Royale, La Salle, Osceola, Tamarack, and Superior copper mining companies, as well as a number that are non-productive; controlled by Agassiz and Shaw interests; 2 mills on Lake Linden, capacity 15,000 tons; smelter Hubbard, Mich.; electrolytic refinery and smelter at Buffalo, N. Y.; figures include output of subsidiaries. Total in 1913, 53,420,000 pounds.

CANANEA CONSOLIDATED COPPER CO. S. A., Cananea, Sonora, Mexico. Capital P20,000 in shares of P100; entire stock owned by Greene Consolidated Copper Co.; \$10,000,000 in \$10 shares; 945,320 shares are held by Greene Cananea Copper Co.; \$50,000,000 in \$100 shares, which is controlled by Thos. F. Cole and J. D. Ryan; 2 mills and smelter at Cananea, 3000-ton capacity. Total in 1913, 37,050,574 pounds. Output does not include copper from custom ores, which amounts to about 600,000 lb. per month, exclusive of Miami.

Month.	Pounds.	Month.	Pounds.
June	2,908,000	October	3,160,000
July	3,328,000	November	3,150,000
August	3,186,000	December	2,976,000
September	3,148,000		

Output of Lake Superior mines estimated.

CENTENNIAL COPPER MINING CO., Calumet, Michigan. \$2,250,000 in \$25 shares; 44,750 shares are held by Calumet & Hecla Mining Co.; ore milled by Lake Milling, Smelting & Refining Co. Total in 1913, 1,400,000 pounds.

CERRO DE PASCO MINING CO., Cerro de Pasco, Peru. \$10,000,000, entire stock held by Cerro de Pasco Copper Co. \$50,000,000 in \$1 shares which is owned by Cerro de Pasco Investment Co., which is controlled by J. B. Haggin, and Morgan estate; 3000-ton smelter at La Fundicion, monthly production figures not given out; output in 1912 was 45,000,000 lb. copper.

CHINO COPPER CO., Santa Rita, New Mexico. \$3,500,000 in \$5 shares; 121,200 shares are held by Guggenheim Exploration Co., controlled by Sherwood Aldrich and C. M. MacNeth; 5000-ton mill at Hurley, N. M.; concentrate smelted at El Paso.

Month.	Pounds.	Month.	Pounds.
July	4,831,200	November	4,492,909
August	6,050,867	December	4,525,792
September	4,435,875	January 1914	6,138,140
October	4,914,944		

CONSOLIDATED COPPER MINES CO., Ely, Nev. \$8,000,000 in \$5 shares; \$3,000,000 in convertible bonds; is a recent merger of the Groux, Butte & Ely, Chairman, and Copper-mines companies, controlled by Thos. F. Cole, Wm. B. Thompson, Charles F. Rand, and Jas. Phillips, Jr.; reduction plant not yet built; production so far derived solely from Groux; ore treated at Nevada Con. smelter.

Month.	Pounds.	Month.	Pounds.
July	607,779	October	160,911
August	541,189	November	136,539
September	204,307	December	197,619

COPPER QUEEN CONSOLIDATED MINING CO., Bisbee, Arizona. \$2,000,000 in \$10 shares; owns 100,000 shares of Greene Cananea; almost all its stock is held by Phelps, Dodge & Co., Inc.; \$44,995,000 in \$100 shares; 4000-ton smelting plant at Douglas, Ariz. Total in 1913, 85,389,630 pounds.

Month.	Pounds.	Month.	Pounds.
June	6,292,480	October	7,653,153
July	7,439,864	November	6,473,792
August	7,590,994	December	8,182,152
September	7,775,560	January 1914	8,099,847

COPPER RANGE CONSOLIDATED MINING CO., Painedale, Michigan. \$39,369,200, in \$100 shares; owns 99,659 shares of Baltic M. Co., 99,699 shares Copper Range M. Co., 99,345 shares of Tri-mountain M. Co., half interest in Champion Copper Co., 16,392 shares of Copper Range R. R. Co., and \$870,000 in Copper Range R. R. bonds; controlled by Wm. A. Paine; production is derived from the Baltic, Champion, and Tri-mountain companies, each of which mills its ore; concentrate is smelted by Michigan Smelting Co., Houghton, which is owned by mining companies. Total in 1913, 24,996,000 pounds.

Month.	Pounds.
January 1914	3,276,000

DETROIT COPPER MINING CO., Morenci, Ariz. \$1,000,000 in \$25 shares; owned by Phelps, Dodge & Co.; 1300-ton mill and 350-ton smelter. Total in 1913, 22,352,299 pounds.

Month.	Pounds.	Month.	Pounds.
June	1,750,601	October	1,861,178
July	1,549,224	November	1,922,352
August	2,187,223	December	2,021,034
September	2,102,818	January 1914	1,590,681

EAST BUTTE COPPER MINING CO., Butte, Mont. \$3,000,000 in \$10 shares; owns 83% of the stock and all bonds of the Pittsmtont Copper Co., which holds 90% of the stock and all bonds of Pittsburgh & Montana Copper Co.; controlled by Wm. A. Paine; 350-ton mill and 1000-ton custom smelter.

Month.	Pounds.	Month.	Pounds.
July	1,060,257	October	1,040,977
August	1,162,006	November	1,002,190
September	1,233,018	December	1,324,560

FRANKLIN MINING CO., Demmon, Mich. \$4,166,650 in \$25 shares; controlled by R. M. Edwards and the U. S. S. R. & M. Co.; 1000-ton mill. Total in 1913, 1,040, 000 pounds.

GRANBY CONSOLIDATED MINING, SMELTING & POWER CO., LTD., Phoenix and Hidden Creek, British Columbia. \$14,849,565 in \$100 shares; controlled by General Chemical Co. interests; 4400-ton smelter at Grand Forks and 2000-ton smelter at Anyox. Total in 1913, 21,960,997 pounds.

Month.	Pounds.	Month.	Pounds.
June	1,789,000	September	1,824,560
July	1,654,000	October	1,779,552
August	1,827,300	November	1,888,767

ISLE ROYALE COPPER CO., Houghton, Mich. \$3,750,000 in \$25 shares; owns a \$50,000 interest in the Lake Superior Smelt-

ing Co., owned by Calumet & Hecla; 2200-ton mill on Portage lake. Total in 1913, 4,680,000 pounds.

MASON VALLEY MINES CO., Yerington, Nev. \$770,000 in \$5 shares; \$1,000,000 in 6% convertible bonds; controlled by W. B. Thompson; 1000-ton smelter at Thompson, Nev., also smelts ore of Nevada-Douglas Copper Co. and custom ore; smelter production. Total in 1913, 14,694,000 pounds.

Month.	Pounds.	Month.	Pounds.
June	1,132,000	October	1,052,000
July	990,000	November	1,174,000
August	966,000	December	1,372,000
September	918,000	January 1914	914,000

MIAMI COPPER CO., Miami, Ariz. \$3,319,690 in \$5 shares; \$1,433,000 in 6% convertible bonds; controlled by General Development Co. (Lewisohn interests); 3000-ton mill at Miami; concentrate smelted at Cananea. Total in 1913, 33,944,795 pounds.

Month.	Pounds.	Month.	Pounds.
June	2,612,650	October	2,862,050
July	2,890,000	November	3,517,800
August	3,097,500	December	3,301,316
September	2,688,600	January 1914	3,258,950

MOCTEZUMA COPPER CO., Nacoazari, Sonora, Mexico. \$2,000,000; entire stock owned by Phelps, Dodge & Co.; 2000-ton mill; concentrate smelted by Copper Queen. Total in 1913, 36,694,013 pounds.

Month.	Pounds.	Month.	Pounds.
June	3,438,793	October	3,178,136
July	2,693,006	November	3,517,800
August	3,542,047	December	3,139,613
September	3,024,121	January 1914	3,021,556

MOHAWK MINING CO., Mohawk, Mich. \$2,500,000 in \$25 shares; controlled by Stanton interests; 3000-ton mill, Traverse bay; concentrate smelted by Michigan Smelting Co. Total in 1913, 5,369,000 pounds.

NEVADA CONSOLIDATED COPPER CO., Ely, Nevada. \$10,000,000 in \$5 shares; has absorbed the Cumberland-Ely Copper Co.; controlled by American Smelters Securities Co. through the Utah Copper Co., which owns half of the Nevada Con. stock; the Nevada company owns the Steptoe Valley Mining & Smelting Co., \$10,000,000; 16,000-ton mill and 1500-ton smelter at McGill, Nevada. Total in 1913, 61,972,829 pounds.

Month.	Pounds.	Month.	Pounds.
June	6,344,863	October	5,898,330
July	5,403,919	November	5,443,047
August	5,989,973	December	5,500,000
September	4,441,671		

NEVADA DOUGLAS COPPER CO., Mason, Nev. \$4,054,800 in \$5 shares; \$276,900 in 6% convertible bonds; also \$158,200 6% refunding bonds; controlled by A. J. Orem; ore smelted at Mason Valley smelter.

Month.	Pounds.	Month.	Pounds.
June	392,288	September	426,070
July	399,451	October	583,330
August	351,760	November	678,120

OHIO COPPER CO., Bingham, Utah. \$12,292,700 in \$10 shares; \$1,326,000 in 6% convertible bonds; 3500-ton mill at Lark, Utah; concentrate smelted at Garfield.

Month.	Pounds.	Month.	Pounds.
June	579,400	September	685,900
July	601,700	October	720,000
August	689,400	November	796,000

OLD DOMINION COPPER MINING & SMELTING CO., Globe, Ariz. \$4,050,000 in \$25 shares; 155,245 shares are owned by the Old Dominion Co., which is owned by Phelps, Dodge & Co.; 300-ton mill, 2400-ton smelter. Production figures include custom ore smelted. Total in 1913, 30,810,000 pounds.

Month.	Pounds.	Month.	Pounds.
June	2,511,000	October	2,037,000
July	2,526,000	November	2,150,000
August	2,524,000	December	2,613,000
September	2,679,000	January 1914	2,797,000

OSCEOLA CONSOLIDATED MINING CO., Osceola, Mich. \$2,103,750 in \$25 shares; owned by Calumet & Hecla; 2 mills, 4000-ton capacity, at Torch Lake. Total in 1913, 11,686,000 pounds.

PHELPS, DODGE & CO., Inc. \$44,995,000 in \$100 shares; controlled by C. H. Dodge, James Douglas, and others; owns the Copper Queen, Moctezuma, Detroit, and Burro Mountain copper companies, Stag Canon Fuel Co.; indirectly controls Old Dominion, United Globe, and Commercial Copper Mining Co.; members of the firm control the El Paso & Southwestern railway, and have large interests in the Rock Island and Great Northern railways. Production figures include all properties under its

Output of Lake Superior mines estimated.

control and copper derived from custom ore, the latter ranging from 750,000 to 1,000,000 lb. per month. Total in 1913, 154,454,144 pounds.

January 1914.....13,411,595
QUINCY MINING CO., Hancock, Mich. \$2,750,000 in \$25 shares; controlled by W. R. Todd; 4500-ton mill at Mason; 340-ton smelter at Ripley.

RAY CONSOLIDATED COPPER CO., Ray, Ariz. \$11,975,740 in \$10 shares; controlled by Sherwood Aldrich and C. M. MacNeill; 8000-ton mill at Hayden, Ariz.; concentrate smelted in A. S. & R. smelter adjoining. Total in 1913, 53,745,934 pounds.

Month.	Pounds.	Month.	Pounds.
June	1,392,612	October	4,871,516
July	4,097,177	November	4,753,000
August	4,401,000	December	5,232,167
September	4,470,551	January 1914	5,705,000

SHANNON COPPER CO., Metcalf, Ariz. \$3,000,000 in \$10 shares; controlled by N. L. Amster; 500-ton mill and 1000-ton smelter at Clifton. Total in 1913, 13,640,000 pounds.

Month.	Pounds.	Month.	Pounds.
June	924,000	October	1,216,000
July	880,000	November	1,110,000
August	1,248,000	December	1,078,000
September	1,232,000		

SHATTUCK ARIZONA COPPER CO., Bisbee, Ariz. \$3,500,000 in \$10 shares; controlled by Duluth Investors, ore smelted at Calumet & Arizona smelter. Total in 1913, 13,219,756 pounds.

Month.	Pounds.	Month.	Pounds.
July	1,019,388	October	993,224
August	1,001,624	November	995,429
September	1,163,237	December	1,050,781

SOUTH UTAH MINES & SMELTERS., Newhouse, Utah. \$1,300,000 in \$5 shares; \$1,300,000 in 6% convertible bonds; controlled by Samuel Newhouse; 1000-ton mill; concentrate smelted at Tooele, Utah.

Month.	Pounds.	Month.	Pounds.
June	142,817	September	249,323
July	195,254	October	239,453
August	230,410	November	232,033

SUPERIOR COPPER CO., Calumet, Mich. \$2,500,000 in \$25 shares; owned by Calumet & Hecla. Total in 1913, 3,078,000 pounds.

TAMARACK MINING CO., Calumet, Mich. \$1,500,000 in \$25 shares; owned by Calumet & Hecla; 2 mills, 3500-ton capacity, at Torch Lake. Total in 1913, 4,142,000 pounds.

TENNESSEE COPPER CO., Copperhill, Tenn. \$5,000,000 in \$25 shares; \$1,500,000 in 6% convertible bonds; controlled by Jas. Phillips, Jr., and Lewisohn interests.

Month.	Pounds.	Month.	Pounds.
June	1,379,220	October	1,392,162
July	1,295,804	November	1,688,000
August	1,143,019	December	1,700,000
September	1,309,985	January 1914	1,474,890

UNITED STATES SMELTING, REFINING & MINING CO. \$44,871,150 in \$50 shares; copper production chiefly derived from its subsidiary, the Mammoth Copper Mining Co., Kennett, California.

Month.	Pounds.	Month.	Pounds.
September	1,750,000	November	1,700,000
October	1,658,436		

UNITED VERDE COPPER CO., Jerome, Ariz. \$3,000,000 in \$10 shares; owned by W. A. Clark; 1000 to 1200-ton smelter at Clarkdale; monthly figures not given out, estimated at about 3,000,000 lb. Total in 1913, 37,750,000 pounds.

UTAH CONSOLIDATED MINES CO., Bingham, Utah. \$1,500,000 in \$5 shares; owns the Highland Boy Gold Mining Co. and 5000 shares of International Smelting & Refining Co. stock; ore smelted at Tooele.

UTAH COPPER CO., Bingham, Utah. \$15,625,990 in \$10 shares; owns half of Nevada Consolidated; controlled by A. S. & R. Co., Sherwood Aldrich, C. M. MacNeill, and W. B. Thompson; 2 mills, 20,000-ton capacity, at Garfield; concentrate smelted at Garfield plant of A. S. & R. Co. Total in 1913, 119,929,809 pounds.

Month.	Pounds.	Month.	Pounds.
July	9,849,043	November	10,787,426
August	10,900,000	December	10,624,790
September	11,992,780	January 1914	10,619,000
October	10,236,575		

WOLVERINE COPPER MINING CO., Kearsarge, Mich. \$1,500,000 in \$25 shares; owns \$80,000 interest in Michigan Smelting Co.; controlled by J. R. Stanton; mill on Traverse bay treated 388,500 tons during last fiscal year. Total in 1913, 4,488,000 pounds.

Company Reports

SAN TOY MINING COMPANY

This Company operates in Chihuahua, Mexico, and the balance sheet for the year ended December 31, 1913, shows the following:

	1913.	Changes.
Gross income	\$317,332	+ \$15,814
Net earnings	132,428	+ 25,971
Surplus	17,428	29,029
Total surplus	513,229	+ 34,928

UTAH COPPER COMPANY

The fourth quarter of 1913 shows that the two mills treated 2,113,980 tons of ore, assaying 1.2165% copper, and yielding 31,982,442 lb. of copper. The total output for the year was 119,939,809 lb. The metal sold realized 14.857c. per pound. Copper on hand and in transit at the end of the period amounted to 39,854,993 lb. Financial results were as follows:

Profit from milling	\$1,479,787
Other income	27,365
Dividends from Bingham & Garfield railway.....	175,000
Dividends from Nevada Consolidated company.....	875,437
Total profit	\$2,557,590
Dividends paid	1,187,760
Net surplus for quarter	1,369,830

SIMMER & JACK PROPRIETARY MINES, LIMITED

This Company owns a considerable property in the Transvaal. The capital is £3,000,000, in 3,000,000 shares of £1 each. The report covers the year ended June 30, 1913. There was a total of 938,103 tons of ore mined. The fully developed profitable ore reserve was estimated at 2,524,000 tons, of an average mine grade of \$5.40, and 406,000 mine tons of partly developed ore worth \$4.70 per ton. Besides this reserve, there is still a considerable tonnage available for stopping from the upper levels and from foot and hanging walls of old stopes, which will be credited to the reserve as the ore is mined. As compared with last year, there was an increase of 48,700 tons milled, the recovery value and working costs being lower by 66c. and 18c. per ton milled, respectively, the net result being a working profit of £466,040, or £60,966 less than for the previous year. The profit from operations for the year was £471,954. Two dividends of 7½% each were declared, amounting to £450,000.

CHIEF CONSOLIDATED MINING COMPANY

This Company operates at Eureka, Juab county, Utah, and the report covers the year 1913. This may be tabulated as follows:

Development, feet	6,383
Ore shipments, tons	51,173
Metal contents:	
Gold, ounces	4,751
Silver, ounces	1,017,107
Lead, pounds	2,584,857
Copper, pounds	114,305
Revenue, after paying transport and smelting costs..	\$376,827
Balance from previous year	303,023
Sundry receipts	18,870
Total	\$698,720
Mining costs	\$264,239
Dividends	175,307
Other expenses	44,112
Balance at end of year	215,062

TONOPAH MIDWAY MINING COMPANY

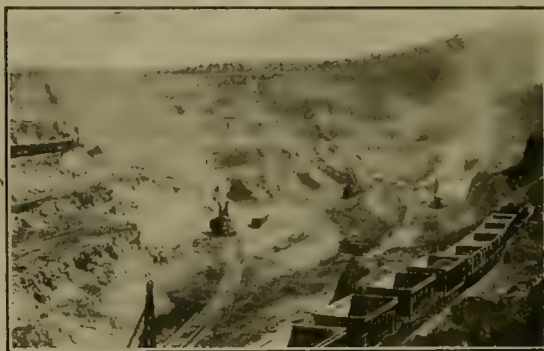
During the year ended December 31, 1913, the Tonopah Midway Mining Co.'s work showed the following results:

Development, feet	3,790
Total to date, feet	11,833
Ore produced in 1913, tons	2,141
Value per ton	\$20.418
Costs per ton	\$6.396
Receipts, including cash, ore, and stock sales.....	102,287
Expenditure covering every account	92,363
Cash on hand at end of 1913	9,924

The superintendent, Nels Nelson, stated that the vein was of no value at 435 ft.; a good deal of work was done at 535 ft., and some ore was extracted; good ore, over 2 to 2½ ft. wide, has been opened at 635 ft.; little work was done at 835 ft. owing to bad ventilation and the distance from the old shaft, there is good ore on this level; No. 2 shaft was sunk to 1200 ft., and stations were cut at 600, 800, 1100, and 1200-ft. levels; cross-cutting is under way at the latter level, and 15 ft. of quartz was cut worth \$3 to \$10 per ton, and this part of the mine is encouraging.

NEVADA CONSOLIDATED COPPER COMPANY

The report for the last quarter of 1913 shows that the output of copper was 16,684,955 lb., and a total of 64,972,829 lb. for the year, against 63,063,261 lb. in 1912. Ore milled during the quarter was 833,989 tons, averaging 1.58% copper. Of this, 93% was from the pits and 7% from underground



OPEN-PIT MINING AT ELY, NEVADA.

workings of the Veteran mine. The cost per pound of copper produced, including all charges but ore exhaustion, was 8.63c. Copper on hand and in transit at the end of the term was 27,916,946 lb. The accounts show the following figures:

Quarterly revenue	\$1,213,948
Dividend No. 17 of 37½c. per share.....	749,796
Ore exhaustion	141,272
Depreciation and income tax	206,561
Net credit	116,318
Dividend (extra) of 50c. per share from surplus account	999,728
Surplus, reduced by extra dividend	7,071,850

THE HYDRAULIC POWER & SMELTING COMPANY

This Company was registered August 4, 1911, to acquire from the Norse Power & Smelting Syndicate, Ltd., and Knut Tillberg: (a) the whole share capital issued of Aktieselskabet Tyssefeldene, a company incorporated under the law of Norway; (b) all the capital issued of the Norsk Elektrisk Metalindustri Aktieselskab, a company incorporated under the law of Norway; (c) all the capital issued of the Trollhättans Elektrotermiska Aktiebolag, a company incorporated under the laws of Sweden. The capital of the Company is £1,000,000,

in 1,000,000 shares of £1 each. It is planned to decrease the capital to £500,000, with the approval of the shareholders, by reducing the nominal value of each share from £1 to 10s. The latest report issued covers the 14 months ended August 31, 1913. The capacity of the zinc refining works at Sundolaken has been increased from 8000 to 10,000 tons per year, and the contract for the sale of the entire production of the works has been made to the end of 1915, at terms enabling satisfactory profits to be made. New zinc-smelting works are being erected and equipped at Trollhättan. When completed, seventeen 1000-hp. and eight 500-hp. furnaces will be installed. However, none of the complex ores for which the works were designed have been available, and the furnaces have been running on the ordinary classes of roasted zinc ores, which do not yet prove to be commercially profitable. Further money for the financing of the zinc smelting was raised by the sale of the Company's water-power interests in Norway to a new company, registered on July 18, 1913, as the Hydraulic Power Company of Scandinavia, Limited.

ASGARD MINING COMPANY, LIMITED

The Company was registered February 16, 1909, to acquire from J. W. Burkitt, the Mount Roundny gold mines and plant, in the communities of Barkowitz, Siboun, Laby, and Zvestoe, Bohemia, formerly the property of the Mount Roundny Gold Mines, Ltd. The report for the period from July 1, 1912, to June 30, 1913, shows that 32,125 tons was milled, yielding 718.40 kg. of amalgam and 6997 oz.; 582 tons of concentrate yielded 1882 oz.; and 15,864 tons of tailing cyanided, gave 243 oz. of fine gold. The total yield was 9122 oz. fine gold. The average working cost was \$4.52 per ton. The ore reserves are estimated at 126,620 tons, the maximum average being \$17.50 at the 250-metre level, and are estimated to contain 52,205 oz. of gold. The receipts for gold and silver, including gold in transit, amounted to £39,307. The credit balance for the year was £9617. Three dividends of 12c. per share have been declared.

PORTLAND GOLD MINING COMPANY

The report of this Company, which operates an important mine and two mills at Cripple Creek and Colorado Springs, Colorado, covers the work done during 1913. The property includes an area of about 130 acres. The mine manager, F. L. Smale, reports that development covered 12,433 ft., of which 8513 ft. was driving and raising on veins or streaks, the remainder being prospecting in barren country. Results of work around No. 1 shaft, especially on the 400-ft. level, were satisfactory, but on No. 2 side, save the 1600-ft. level, development was not promising. At 1600 ft. stoping ground amounting to 1358 lineal feet was opened, 1028 ft. being on No. 1 vein and 330 ft. on an adjacent formation. Stoping widths are from 2 to 23 ft., but the average is 5 ft., with a shipping value of \$35 per ton. Low-grade ore, but probably profitable, was also opened on this level, mostly on No. 1 vein, for a distance of 500 ft. No. 2 shaft was sunk 64 ft., the bottom being in breccia, with small fragments of granite, which may be of local occurrence. No. 1 shaft was sunk 269 ft. in granite, with no indications of fissuring or mineralization. One hundred and ninety feet southeast of No. 1 shaft, at 1500 ft., a vein was cut in the granite area, and associated with it is a phonolite dike on the east, and a basalt dike on the west. At the point of intersection there was a high concentration of gold in the ore, one assay returning 100 oz. per ton. Driving has shown erratic gold content. Further work in depth, it is hoped, will prove profitable ore. The Roosevelt drainage tunnel has resulted in an average reduction of the water-level by 8¾ in. per month. Ore reserves are about the same as at the beginning of the year. It is planned to do 2500 ft. of development on the 1750-ft. level during the current year, when the shaft reaches this point. It will require 8000 to 10,000

ft. of exploration, in addition, to properly open the ground at this depth. Probably 10,000 ft. of work will be done on the upper levels in the known ore zones. Results of the past year may be stated as follows:

Ore treated at Victor mill, tons	178,162
Gold recovered	\$402,923
Ore treated at Colorado Springs mill, tons	53,245
Gold recovered	\$1,380,713
Ore treated to date, tons	1,767,592
Gross value	\$36,268,797
Profit in 1913	604,443
Dividends	300,000
Dividends to date	9,457,080
Surplus at January 1, 1914	1,767,789

GREAT COBAR, LIMITED

This Company operates a large copper property in New South Wales, Australia, which has been a great deal before the mining world lately on account of troubles at the mine, unsatisfactory returns, and dissatisfied shareholders. In the 'Special Correspondence' pages of this journal of January 17, 1914, the whole question was discussed. The general manager, H. C. Bellinger, resigned, and G. C. Klug, of Bewick, Moreing & Co., is now in charge.

Development in the Great Cobar, Cobar Gold, Chesney, and Peak mines covered a total of 8491 ft., and 2164 ft. of diamond-drilling in the parent mine. The main shaft in this mine is down to 1515 ft. The northern orebody was disturbed on No. 10 level, but prospecting has failed to find a profitable shoot. No. 13 level was disappointing. A creep occurred in the southern and central parts of the mine, rendering temporarily unavailable 146,000 tons of ore between No. 5 and 8 levels. The central orebody in the lower levels to No. 14, shows a reduction in size, while ore has not been found in the northern and southern orebodies below No. 11 level. Considerable ore has been developed on No. 3, 4, 5, 6, 7, 8, and 9 levels. Ore reserves are 1,468,749 tons worth 2.49% copper, consisting of basic, silicious, neutral ores, and ore in 'bridges,' also 314,881 tons of ore in upper levels, around the shaft, and broken in stopes. The Cobar gold mine's shaft is down to No. 5 level, and most of the work was done at this depth. Ore reserves are 308,545 tons, assaying 1.7% copper and 0.34 oz. gold per ton. The Chesney shaft is down to 925 ft. No. 8 level development was not promising, and the shaft is being sunk a further 130 ft. Reserves are 612,986 tons, containing 2.58% copper.

The year's results may be summarized as follows:

Smelter work:

Ore smelted, tons	361,566
Copper tons	5,811
Gold, ounces	27,136
Silver, ounces	127,542

Concentration and flotation work:

Ore concentrated, tons	50,383
Tailing treated by flotation, tons	21,810
Jig recovery, per cent	37.33
Flotation recovery, per cent	77.53
Combined recovery of copper in ore, per cent	85.91
Revenue from copper, gold, silver, coal and coke, etc.	£713,206
Expenses at the mines and works	472,280
Australian taxes	7,701
London expenses	10,897
Gross profit	81,926
Balance from last year	34,356
Debiture interest	40,009
Balance for next year	23,210
Metals in transit, stocks of ore and products, stores.	203,989

The directors of the Company had the properties examined by W. Pellow-Harvey, and his complete report is published in the one under review.

Decisions Relating to Mining

COAL LAND—PURCHASE PRICE

Where a coal land applicant filed a proper application to purchase, complied with the regulations of the Department as to publication of notice, etc., and paid the price of the land as determined by conditions then existent as to distance from a completed railroad, he is entitled to purchase at that price notwithstanding the subsequent completion, prior to allowance of entry, of a railroad within fifteen miles of the tract.

Brown Bear Coal Association, 42 Land Decisions, 320. August 13, 1913.

MINING LEASE—ASSIGNEES LIABILITY

Where a mining lessee, under a lease which would expire in 1928, in 1910 leased the property for 20 years, the lessee, under the lease, was, an assignee of the original lessee, and not a sub-lessee, since, where a lessee parts with his whole interest, there is an assignment of the lease and it is immaterial what kind of an instrument or conveyance is used to dispose of the term. In such a case the assignee is liable to the original lessor for the stipulated royalty.

Pennsylvania Mining Co. v. Bailey (Arkansas), 161 Southwestern, 200. November 24, 1913.

CUTTING TIMBER ON MINING CLAIMS

The rights to the timber on the surface of lands embraced within mining locations as conferred by Section 2322 U. S. Revised Statutes, according to the interpretation placed thereon by the Secretary of the Interior, are limited to the cutting of timber necessary for the development of the mine or incidental to operations related thereto. The land must be actually mineral in character and the location must be made in good faith and not for the purpose of controlling water courses or to obtain valuable timber thereon.

Suggestions, 42 Land Decisions, 310.

ACT OF 1866—RIGHTS OF WAY UNDER, PRESERVED

The incorporation into a forest reserve of land over which prior rights of way for pipe-lines, ditches, and canals have existed does not deprive the possessors of such rights of way of the right to use them nor compel them to obtain permits for the continuance thereof from the Department of Agriculture. Section 9 of the Act of 1866 was not repealed by the Act of March 3, 1891, or the Act of March 3, 1891, or the Act of February 15, 1901, and rights of way taken under the provisions of the earlier act are recognized.

United States v. Utah Power & Light Co. (Utah), 208 Federal, 821. March 31, 1913.

OIL LEASE—PARTIAL CANCELLATION

Where an oil and gas lease provided that a well should be completed on the premises within six months, and the lessee proceeded to drill one well into an upper stratum which produced oil in paying quantities, but thereafter neglected and refused for a period of five years to drill any further wells on the leased tract, although it was proved that the surrounding land contained still another stratum of oil sands at a greater depth, the lessor was entitled to at least a part cancellation of the lease for non-performance of its implied covenant of "reasonable diligence," in order that lessor might prevent her land from being entirely drained of oil through operations on adjoining properties.

Jennings v. Southern Carbon Co. (West Virginia), 80 South-eastern, 368. November 25, 1913.

Recent Publications

ANNUAL REPORT of the Secretary of Commerce, 1913. P. 151. Washington, 1913.

REPORT of the Secretary of the Interior. Fiscal year, June 30, 1913. P. 115. Washington, 1913.

RESOURCES of TENNESSEE. January 1914. Published by the State Geological Survey. P. 48. Nashville, Tennessee.

COAL WASHING in ILLINOIS. By F. C. Lincoln. Bulletin No. 69. P. 108. Ill., tables, charts. Engineering Experiment Station, University of Illinois. Urbana, 1913.

VARIATION in RESULTS of SIEVING WITH STANDARD CEMENT SIEVES. By Rudolph J. Wig and J. C. Pearson. Technologic paper No. 29. P. 16. Bureau of Standards. Washington, 1913.

STRATIGRAPHY and PALEONTOLOGY of the ALEXANDRIAN SERIES in ILLINOIS and MISSOURI. By T. E. Savage. Part 1. Extract from Bulletin 23. P. 138. 7 plates. State Geological Survey of Illinois. Urbana, 1913.

PRODUCTION of GAS, COKE, TAR, and AMMONIA at GAS WORKS and in RETORT COKE OVENS, and of GAS and TAR at WATER-GAS WORKS in 1912. By Edward W. Parker. Extract from 'Mineral Resources of the United States, 1912'. P. 32.

GRAPHITE DEPOSITS of PENNSYLVANIA. By Benjamin L. Miller. Report No. 6. P. 147. Ill., maps, index. Topographic and Geological Survey. Harrisburg, 1912. This volume describes the deposits, and mining and milling methods of recovering graphite.

METALLURGICAL COKE. By A. W. Belden. Technical paper 50. P. 48. Ill. The first coke made in the United States was in 1817, and in 1913 the output was about 45,000,000 tons, worth \$115,000,000. This publication describes the manufacture of coke, and recovery of by-products.

THE GEOLOGICAL MAP of NORTH DAKOTA. By Arthur Gray Leonard. Reprint from the *Quarterly Journal*, University of North Dakota, October 1913. P. 13. Ill., map. This is a brief description of the principal geological formations of the state, with explanations of the geological map prepared by the State Geologist.

MINERAL PRODUCTION of VIRGINIA in 1911 and 1912. By Thomas L. Watson. With chapters on 'Zirconiferous Sandstone' near Ashland, Virginia by Thomas L. Watson and Frank L. Hess; and 'Geology of the Salt and Gypsum Deposits of Southwestern Virginia,' by George W. Stose. Bulletin No. 8. P. 76. Ill., index. University of Virginia. Charlottesville, 1913.

TOPOGRAPHIC and GEOLOGICAL SURVEY of PENNSYLVANIA, 1910-12. Issued by the Commissioners of the Survey. P. 182. Ill., maps, plans, index. Harrisburg, 1912. This publication covers the work done in the state during the fiscal years ended June 30, 1911 and 1912. Included are papers prepared by the members of the staff, under the state geologist, Richard R. Hice, dealing with the different areas of the state, and mineral production for the years given.

HEATON'S ANNUAL, 1914. The commercial handbook of Canada and Boards of Trade register. Edited by Ernest Heaton, J. Beverley Robinson, and W. J. Dobson. P. 442. Index. Published by Heaton's Agency, Toronto. Every country boasts of one or more reliable year books, and this one deals with all topics of interest in Canada at the present time. The editors state that this is the Annual's tenth year, and the publication has been a great success every year. One chapter deals with Canadian towns and the local opportunities offering to anybody desiring to start business in them. Twelve pages are devoted to the mining industry. A multitude of other interesting facts is given.

A Gasoline Mine Locomotive

The Geo. D. Whitcomb Co., of Rochelle, Illinois, has recently appointed Parrott & Co. as agent on the Pacific coast. The Company is already represented at Denver by Hendrie & Bolthoff. The Whitcomb company has been in the mining machinery business for 25 years, and for the past nine years has been specializing on a haulage motor for mining operations, making them in sizes ranging from 3 to 20-ton capacity, and either with or without cabs. The Whitcomb motor has been operating principally in the middle and eastern states, but during the past two years, has been placed in a large number of mines in the West. The Alaska Treadwell Co. has three; the Colorado Fuel & Iron Co., four; the Washington Union Coal Co. and the American Fuel Co. of Utah, each has two large motors, as has also the Union Pacific Coal Co. The manufacturers claim many superior points in the general construction of these motors, but invite especial attention to the following points:

1. A fool proof gasoline supply tank. There are four tanks to each motor. They are made of sheet steel with heavy



WHITCOMB GASOLINE LOCOMOTIVE USED BY THE CALUMET & HECLA.
THE STANDARD UNDERGROUND LOCOMOTIVE HAS NO CAB.

brass fittings, tinned inside and outside after being assembled, then thoroughly tested against leakage. The tanks are thoroughly encased and protected by strong covers and are so constructed that no gasoline can be put in or taken out except through a pipe leading to the engine when they are in the motor. Two tanks are used at a time and cannot be replaced without closing valve in tanks and pipe line. The tanks are refilled outside of the mines and carried in and placed on the motor without danger even in the presence of the miners' lamp. The amount of gas escaping from exhaust or otherwise, is reduced to a minimum and where ventilation is up to the law requirements, there is absolutely no cause for anxiety.

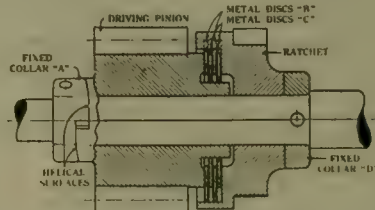
2. The cooling system is a rough and ready one, comprising heavy cast iron tanks of the condenser type, a circulating pump for forcing the water driven from the main shaft and a fan of Sirocco type fitted on the main driving shaft. The fan case is formed to create a split in the air current, half of the air being forced to each side of the motor and through the water into cooling tank.

3. A most interesting feature of the Whitcomb motors is the multiple disc forward and reverse clutch, used in all motors of over 5-ton size. This clutch is made up of highly polished steel discs, alternating with bronze discs, in which latter are inserted over 100 corks one inch in diameter, pressed through a half-inch hole. The corks are finished to 1/32 in. above the surface of the bronze disc. The value of the friction clutch for reverse or forward movement is apparent and this design is a specially efficient one and will stand up to a 50% overload.

The Whitcomb motor is made to operate on distillate oils as well as gasoline. These machines are operating at an elevation as high as 13,000 ft. and upon grades as steep as 15%. The Portland Gold Mining Co. Colorado Springs machine, an 8-ton motor, is hauling an average of 21 tons wet tailing 3000 ft. 4½ to 8% grades on three shifts of 8 hours each and using 7 gal. of oil per shift. This is approximately 9-10 of a cent per ton hour. Many instances show fuel expense as low as 1½c. per ton hour.

Safety Winches and Crabs

The Brown Hoisting Machinery Co., of Cleveland, Ohio, is now equipping its standard crabs and winches with Weston patented safety lowering devices. These prevent the handle flying back and ensure the safety of operators. When the load is being raised, the crab automatically locks itself upon the handles being released. Lowering is accomplished by simply turning the handles backward. The lowering ceases when the cranks are released. The Weston device is described in Pamphlet C, 1914, as follows:



THE WESTON DEVICE.

A sectional view of this safety device is shown in the figure and its operation can be easily seen from this view. It is placed on the main crank shaft and consists of the driving pinion which operates the drum gear, and a pawl and ratchet. The driving pinion and the ratchet are loose on the shaft. They are separated by the metal discs B and C, which are placed alternately. The discs B operate with the ratchet and the discs C operate with the driving pinion, so that when the driving pinion turns in the ratchet, there is a frictional resistance between the discs, the amount depending upon the lateral pressure. The ratchet and the pinion are held between the two fixed collars A and D. The collar A and the driving pinion have helical bearing faces which when turned one on the other, act as a screw on the driving pinion. When the hand crank is turned in the hoisting direction, the screw action between the helical surfaces presses the driving pinion and the ratchet against the discs B and C. The friction between these discs is so great that the driving pinion and the ratchet are locked together and they rotate with the shaft, thereby hoisting the load. The friction between these discs prevents the load from running down. When the load is suspended, it is held by the pawl engaging with the ratchet. To lower the load, it is necessary to turn the cranks backward with only enough force to overcome this friction. But the load can lower only just as fast as the cranks are turned, because any greater speed is prevented by the driving pinion locking with the ratchet. The ratchet can turn in only the one direction on account of the pawl, and that is when the load is being raised. When the cranks are released the driving pinion is immediately locked between the fixed collar A and the ratchet. The metal discs are lubricated and the lowering is accomplished smoothly and not by jerks, which saves in the wear on the machine and also on the hoist line.

F. A. BELT of Mt. Washington, Ohio, has issued a brief circular describing his new duplex calculator, a simple machine for multiplying, dividing, calculating cube and square roots, getting fractions, percentages, and making simple conversions.

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EDITORIAL

LACK of space incident to our printing full particulars of the New York meeting of the Institute has crowded out a number of interesting and important matters that must needs be deferred.

ARGUMENT before the Circuit Court of Appeals at San Francisco, last week, of the case of Minerals Separation against Mr. James Hyde and his associates for infringement of patent rights, brought together a number of men famous in connection with flotation and served to make public much interesting historical and technical data. While it would be improper, pending decision of the case, to discuss its merits, we expect to present shortly a summary of the chief arguments advanced by each party to the controversy.

The Institute and Mining Law Revision

The meeting of the American Institute of Mining Engineers that was held in New York last week was especially notable in two particulars. In the first place it marked the close of a year's work of the Institute under the new constitution and on the new basis. In the second, the position of the Institute as an authoritative adviser of the United States government in matters relating to mining was definitely recognized. Both events are worthy of comment.

A year ago the Institute was working under a system which by custom as much as by terms had come to mean closely centralized authority. Election of officers was a formality, and at the annual business meeting seven members constituted a quorum. To the membership in general the Institute had become merely a publishing house and was known by its *Transactions* rather than its deeds. The *Transactions*, it was conceded, were superb, as they were bound to be under the management of an exceptionally able and devoted editor. But the average member of the Institute thought of it as an outside organization in which he had no personal part: just as the majority of the wealthier Mexicans today look upon the troubles of that unhappy country as a concern of the Government, not of theirs. In the Institute, fortunately, a new spirit stirred and the time came when the membership at large was willing to go to work. As always in such a crisis, leaders appeared and, without making invidious comparisons, it may be fairly stated that among these, the retiring president, Mr. C. F. Rand,

proved the most important. The Institute owes much to many men and to Messrs. C. R. Corning, A. R. Ledoux, James Douglas, Phillip N. Moore, and others who contributed of their time, courage, and patience in the troublesome weeks of 1912, there is a heavy debt; but to Mr. Rand it fell to be the actual leader through the year of reconstruction. With characteristic modesty he has given all the credit to others, but those who have kept in touch with the situation know that it was the quiet unselfish man in the president's office who did most of the work. The achievements of the year have been summed up in the statement that he converted a mob into a disciplined army. Certainly the organization of the members into a series of technical committees is proving an effective means of increasing their activities. We need accept neither the optimistic beliefs of those who see in this a permanent cure for all evils, nor the doleful predictions of those who refer to the rapid decay of new brooms, to credit the move with much usefulness and many possibilities. When the committees become moribund, if they do, another and possibly a better method of provoking discussion and registering public opinion may be put in operation. The Mining and Metallurgical Society has one such method and it has accomplished results of note. The committees in themselves are unimportant, but the fact that a considerable portion of the membership of the Institute has been awakened and set to work, is profoundly significant.

Among the new technical committees, that on mining law, under the able chairmanship of Mr. Horace V. Winchell, easily attracted chief attention at the New York meeting. We listed last week the papers on this subject that were to be read, and we print this week notes on the actual sessions. The keynote of the meeting was the necessity for revision of the mining law. Mr. Winchell presented the case for the plaintiff in a carefully prepared statement of reasons why the law needed thorough reconstruction. Briefly these are: (1) that the law was not planned to apply to many kinds of mineral deposits or to conditions as they are today; (2) that it discourages prospecting; (3) that the apex or extralateral right provokes needless litigation; (4) that it contains no provision for court review of land office decisions; (5) that the coal land and oil land laws are inadequate and antiquated; (6) that no suitable provision is made for lands containing radium-bearing minerals, potash salts, phosphates, and other minor products; (7) that no notice of mining claims is required by the United States; (8) that there is no statute of limitations as to attack on patent for placers on the basis of irregularity or fraud; (9) that an unlimited number of quartz claims may be located by one individual. There is not room here to detail Mr. Winchell's excellent arguments in support of these criticisms, but we print on other pages the paper by Mr. C. W. Goodale, in which is presented the details of one case illustrating excellently the actual results of our law of extralateral rights.

A definite plan of procedure looking toward the

needed modification of the mining law has been worked out by Mr. Edmund Kirby as chairman of the committee on mining law revision of the American Mining Congress, and was presented at the Institute meeting. Congress has been asked to create a commission to hold hearings in the mining states and to prepare and present, not later than next January, a definite bill for a new act. In the address delivered by Mr. Thomas J. Walsh, senator from Montana and chairman of the Senate Committee on Mines and Mining, which we print, the present status of this and other legislation is discussed. It is evident that rapid and sure progress is being made. We regret the apparent purpose to constitute the proposed commission wholly of lawyers. They should be represented, and it goes without saying that no statute should be loosely or carelessly drawn. It should not only be written in well chosen words, but it must be constructed with full knowledge of existing laws, customs, and court decisions. It is neither wise to go on indefinitely patching the old law nor to sweep it aside entirely. Our laws are like our institutions. They grow out of our needs and our life, and are not to be lightly changed. All this may be conceded and yet it may be fairly demanded that the mining men be represented on the commission. They are the ones chiefly concerned and they should at least be given the opportunity to formulate and present their ideas in finished form. It is as pertinent to suggest that the lawyers appear before the commission as that the mining men do so. It is hardly likely that any bill drafted by this commission will be accepted without change, and on both the Senate and House Committees are excellent lawyers well informed as to mining. They will have the final word as to the form into which the proposed law shall be cast. If to the chairmen of the two committees three others nominated by the President should be added, with the understanding that all should be familiar with mining, and one or more should be a trained lawyer, an excellent body would be created.

There is one other, though minor point, in Mr. Walsh's address to which we take exception. Though among those who have favored the adoption of the leasing system, we have been careful time and again to point out that this is a matter of policy concerning which there is abundant room for difference of honest opinion, and while we deplore as sincerely as does Mr. Walsh, the intemperance that has at times characterized the discussion, we have not noticed, while dodging perhaps our not unfair share of brickbats, that it was wholly one sided. The essential thing is that the way now seems opening to agreement on a plan of action. The new law is unlikely to be exactly what any one of us wants, but we can well concede minor points in approval of the intelligent and sympathetic manner in which Mr. Walsh and his associates in the Senate, and Mr. Foster and his fellow members in the House Committee on Mines and Mining, are approaching the problems of the miners. The era of talk seems at last to have given way to one of constructive action.

New York Meeting, American Institute of Mining Engineers

EDITORIAL CORRESPONDENCE

The annual meeting of the American Institute of Mining Engineers was held at the Institute headquarters, in New York, February 16 to 20. The general arrangements for the meeting were made by the executive committee of the New York section, of which L. D. Huntoon is chairman. The opening session was held at 8:30 o'clock on the evening of February 16, and, in spite of the stormy weather, a large attendance was present, a happy augury for the success of the following sessions. A. L. Ledoux was the chairman for the evening and introduced the retiring president, C. F. Rand, with the following remarks:

"In 1910 I met for the first time Charles F. Rand, who had been elected a director of this Institute. He immediately made a strong impression upon me. Quiet in demeanor, with a low voice, he spoke but little, but every time exactly to the point. His suggestions were recognized as pertinent, and his propositions were clear-sighted and met with almost unanimous approval. He had a genius for figures and showed unusual ability for organization. It was but natural that he should be made a member of the finance committee, and thereafter our budgets became more practical. We had had a strong council and board of directors, and most conscientious presidents, but we were all bound by traditions of conservatism which required a shock from the outside to loosen. And the shock came! Later, in 1912, in the stormy days through which our ship was passing, Mr. Rand became, naturally, by unanimous approval, sole nominee for president of the Institute. Not only was he recognized as a proper commander, but he had the rare ability of making us all work with more enthusiasm in our several offices. Early in the year of his presidency, 1913, he commenced to promote local enthusiasm, and the result was a marked revival in the activities of all local sections and the formation of new ones where previously interest in the Institute had waned, in some cases reaching a point where there was danger that new organizations might take some from our membership, whose interest in special branches had led them to believe that these interests could be best promoted outside of the Institute; there was great danger that there would be formed a Pacific Coast association of engineers whose members would secede from us; that the iron and steel men would drift away, as well as those interested in coal, petroleum, etc. This danger was offset not only by the promotion of local sections, but by the formation of many technical committees. It was thought by many, and said by some, with a shake of the head, that the enthusiasm inspired by our president would wane; that the committees would cease their activities sooner or later, and that conditions would drift back to what they were previously. Everybody is

happy to observe how mistaken was this view. The inspiration of the initiative shows no signs of diminution, as is evidenced by the number of papers which these committees have been able to secure for our present meeting. So many, indeed, are they, and so varied, that for the first time, if my recollection serves me, we are to meet simultaneously in different rooms where members may foregather with others especially interested in special lines.

"It is not necessary to speak of the success of the Butte meeting, which was perhaps the most valuable, technically and socially, of any that has been held in recent years, and it may be said that the enthusiasm not to fall below the standard of Butte is forecasted in the arrangements which are being made for our meeting next summer at Salt Lake City. In saying this, I would not detract in the least from the infinite pains taken by the local committee at Butte, nor from the local efforts which are already inaugurated to maintain that standard at our Salt Lake meeting, but would merely emphasize the fact that enthusiasm is not always spontaneous, but results from the example and initiative of some one individual, and the individual in our case is Charles F. Rand.

"Mr. Rand is modest and would be the first, though perhaps the only one, to disagree with me in this estimate, and would say that the success is due to the coöperation which he has had from everyone. I would not detract from the appreciation due to the board of directors, nor to the secretary, but call you to witness if it be not true that the captain of a great ship, who has brought the vessel through great peril safely, should deservedly receive the acclaim, although he may modestly point to the loyal backing and efficient service of all of his subordinates from the stokehold to the bridge. Mr. Rand was not satisfied to leave the presidency with everything working well to insure our future, but desired to increase our membership materially. As the result of his personal efforts, again ably seconded by loyal lieutenants, there has been the greatest increase in membership in any year of our history, no less than 786 applications having been received since February 1913. Not the least of Mr. Rand's services has been in persuading a very busy man to consent to become his successor in the presidency. I am not charged with the duty, and this is not the moment, to say anything about Mr. Thayer; however, I trust that I have reminded you sufficiently of our obligations to Mr. Rand, who will now address you, so that you will feel that what is in the thought of everyone here has had at least some expression, however inadequate."

With characteristic modesty, Mr. Rand, in responding, made only a few brief remarks to the effect that nothing serious was to be done at the opening session,

and that the statements of the chairman should be taken in that spirit. The chairman then announced that certain communications had to be brought to the attention of the members present, and a colored slide was thrown on the screen, showing C. F. Rand being wafted to regions of bliss, attended by angels, while on the horizon the rising sun showed the genial countenance of Mr. B. B. Thayer. Next followed a letter from P. F. Corrigan, consulting miner, of Butte, commending Mr. Rand in his effective work for the Institute, but warning him to beware of getting "too manny collidge professors" into it, and especially commending his wisdom in securing B. B. Thayer, a practical miner and "a fine feller," for his successor. This was followed by an exhibition of colored slides made from photographs made by the field staff of the Underwood Company showing a great variety of unusual and difficult subjects to photograph, such as mountain peaks, volcanic explosions, battles in recent wars, and so on, in which great interest was displayed by all.

The regular meeting began with the business session at 10 o'clock on the morning of February 17. The usual reports of the officers and standing committees were read and approved, and A. S. Dwight and E. G. Spilsbury, acting as tellers, announced the results of the letter-ballots for officers.

The number of ballots received was 941, and the following gentlemen, having received the respective number of ballots set opposite their names, were declared elected: President, B. B. Thayer, 934; vice-presidents, H. C. Hoover, 925, W. L. Saunders, 903; directors, C. W. Merrill, 925; A. L. Ledoux, 924; R. W. Brock, 917; H. L. Smyth, 916; D. C. Jackling, 876. The president then announced that Dr. James Douglas, who undertook last year to raise the funds to cancel the land debt of the Institute, had turned over to the treasurer \$28,000 in cash, and pledges of members aggregating \$6000 more, which would cancel the unpaid balance of \$34,000 remaining on the land debt, thus relieving the Institute of the burden of nearly \$3000 per year for interest charges. The gift was accepted with thanks for the effective service Dr. Douglas had rendered in raising the sum. Mr. Ledoux gave notice of his intention to propose an amendment to the constitution providing that members should not be dropped for non-payment of dues until they are two years in arrears. E. W. Parker and J. W. Richards were appointed a committee to draft a tentative form of amendment, which was presented later in the morning and discussed at some length. This amendment cannot be acted upon until the next annual meeting, but at the suggestion of A. C. Lane, a vote was taken upon it in order to indicate to the board of directors what the sentiment of the membership is. The vote disclosed a large majority in favor of a more lenient provision than that in the new constitution adopted last year.

The business session was then adjourned at the call of the president, and the reading of technical papers was begun. In the absence of H. A. Guess, his ad-

mirable paper was presented in abstract by B. A. Robinson and was well received. But, as is usually the case, the absence of the author put a damper upon the discussion. The same was true of the following paper upon metallurgical practice at the Nipissing mine, by James Johnston, though R. E. Hore and others called attention to some of the more important features of the paper. Adjournment was then taken for lunch, which was served in the adjoining room, and the members spent a pleasant hour in foregathering, the cordiality of the gathering being stimulated by a committee of members of the Institute appointed for the purpose.

At the afternoon session on Tuesday, William Kelly presided. The first paper, by H. H. Clark of the Bureau of Mines, was on safeguarding the use of electricity in mines. This was followed by another paper on the same subject by C. M. Means, of the Pennsylvania State Bureau of Mines, which was read in abstract by the chairman, in the absence of the author. The two papers were then discussed together by G. S. Rice, B. F. Tillson, and others, the discussing coming to centre about the use of portable electric lamps and their constructions. This was followed by a discussion of the use of electric motors and shovels for excavating purposes, by H. W. Rogers. This was discussed by E. G. Spilsbury and also by F. H. Armstrong, who described a recently constructed shovel in which water is pumped into an accumulator by an electric pump, the mechanism of the shovel being actuated by the water. This has not yet been put into operation. This paper was followed by one on electric mine locomotives and coal-cutting machines, by A. W. Belden. Another paper on electric haulage underground, by Charles Legrand, was passed over, in the absence of the author. The use of electric energy for hoisting, milling, and electric concentration at the Mineville iron mines was discussed by Solomon Le Fevre. This was followed by an account of the use of electricity at the Penn and Republic mines of Michigan, by William Kelly and F. H. Armstrong. The session was concluded by an account of the records made in drilling work during the construction of the Kensico dam, of the Catskill aqueduct system, by W. L. Saunders.

The evening session was held at the American Museum of Natural History, and was opened by a lecture on hydraulic mining, by Howard W. DuBois, illustrated by numerous colored lantern slides and a moving picture of hydraulic operations. Following this, E. O. Hovey gave an illustrated description of the Copper Queen mine, and then an opportunity was afforded for those present to inspect the model of the Copper Queen mine, as well as the model of one of the stopes, which has been presented to the Museum by Dr. Douglas. These have not yet been placed on view to the public, so that the evening was therefore a private exhibition for the benefit of the members of the A. I. M. E.

For an account of the later sessions, see page 391.

Mining Legislation at Washington

By THOMAS J. WALSH

*The Committee on Mines and Mining of either House of Congress has not heretofore been regarded as much more than one of the numerous paper committees, created and preserved chiefly to afford to the representative designated as its chairman, a needed clerk. It bids fair at present, however, more because of the important legislation affecting the mining industry that crowds upon the attention of Congress than by reason of the personnel of its membership, to be transformed from a more or less moribund organization to an active legislative force. The haste in which this résumé is necessarily prepared impels me to confine my remarks to measures that have been referred or which it is expected will be referred to the Senate Committee.

The Revision Commission Bill

This has had under consideration a bill introduced by Senator Smoot, for the creation of a commission, charged with the duty of revising and modifying the laws in relation to the appropriation and occupation of mineral lands of all kinds, a subject which, as I am advised, has had repeated consideration by this body. As the bill came to the committee the commission was to consist of three members, one of whom should be a lawyer of experience in the practice of mining law, one a mining operator, and one an officer of the Geological Survey. Being referred to the Department of the Interior for an expression of its views, it was proposed that the membership be increased to five, giving the Bureau of Mines a representative and an additional representative to the operator. It was, however, urged before the committee that as the work devolving on the commission is the preparation of a draft of a code of laws, that in the past have given rise to interminable litigation and that are likely to be a fruitful source of perplexity to the courts for years to come, it ought to be entrusted exclusively to lawyers of eminence and character, conversant with the troubles that have been encountered in the past, and most competent from this experience and learning to devise a system under which unnecessary controversies may be avoided in the future. While the suggestion might appear to have originated in a desire upon the part of members to take care of their brothers of the law, a little reflection will exhibit much merit in it. It was advanced that the commission being authorized to hold public hearings throughout the mining regions affected, and elsewhere, at will, it would unquestionably invite an expression of views from operators, engineers, and prospectors, from representatives of the Geological

Survey and the Bureau of Mines. The bill contemplates that a report shall be made before January 1, 1915, and provides that each member of the commission shall be paid a salary of \$500 per month for the time actually devoted to the work.

It is now over forty years since our system of laws in relation to the disposition of mining lands was devised. Generally speaking, it has met the conditions in a most satisfactory way, excepting always, the part dealing with the disposition of lands containing coal. That part never would have been operative at all had not the practice now condemned as criminal been pursued. As the appropriation of coal lands has all but ceased in consequence of the failure of the law to recognize that an entry of 320 acres will not justify the expenditure necessary to the mining of coal on a commercial basis, a revision in respect to lands valuable for coal is imperative. Aside from that feature, however; the conviction is quite general that the extralateral rights give rise to complications so numerous and serious, it is such a prolific breeder of litigation, not infrequently characterized by imposition and perjury, that it ought to be abandoned. The idea in which it had its origin was a just purpose to stimulate the prospector by assuring him the vein discovered through his sagacity and his self-denial, and was most commendable. But in practice it often served to deprive the enterprising miner of the legitimate fruit of his toil and expenditures. Every lawyer of experience is familiar with instances in which orebodies of great value have been uncovered by expensive development made by the owner of the claims in which they are found, and who has been obliged to yield them up upon the claim of an apex in adjacent territories, the owners of which had no suspicion of their existence.

It will be found profitable to compare the working of the system to which we have become attached, with those that have been developed during the past two score years in the English colonies, the Latin-American republics, and other nations that have been required to legislate concerning the public mineral lands. An enlightened public sentiment concerning our mineral land policies can be formed only in the light that is afforded by knowledge of the kindred systems of the progressive peoples of the earth. A compilation of such laws, accompanied by a brief explanation of their character and the measure of success which has attended their working, is all but essential to comprehend the actual value of our own.

The Alaska Coal Land Bill

Some of the questions with which the commission will be called upon to deal, should one be appointed, brook no delay. They must be met at once and solved

*Address delivered before the American Institute of Mining Engineers at New York by the chairman of the Senate Committee on Mines and Mining.

in some way looking to revision later in the light of facts brought out or views advanced by those deputed to study the subjects as a whole. Of this character is the question of how to open the Alaska coal deposits.

The bill providing for the construction by the Government of railroads in that territory from the seaboard to the inland waterways, has passed the Senate and will speedily, it is believed, be approved by the House. The President's sanction of the general purpose of this act has been given in advance in his message to Congress. It must be accompanied by an act which will permit and invite the workings of the coalfields. It is idle to imagine that the Executive Department will advance one step toward the construction of railroads in Alaska unless assured in advance that coal mines will be opened to afford fuel during construction and traffic when the road is built. The Senate Committee has under consideration a bill which is the result of repeated conferences participated in by the Secretary of the Interior and his staff and the chairman of the House and the Senate Committees respectively on Public Lands, Territories, and Mines. It is a frank adoption of the leasing system, to which none of those having any conspicuous part in the preparation of the bill confess any attachment. The Congressional members are all convinced, however, that the concession is essential to the necessities of the case. They entertain the view that to enact a law providing in any terms for the disposition in fee of coal lands in Alaska would be in effect to doom the country to another decade of inaction. I am myself of the opinion that any Secretary of the Interior who should permit Alaska coal lands to be patented under any kind of a law passing the fee would be driven from public life, and it would be good fortune if he did not pull down the temple of the administration of which he formed a part as he passed out of it. It is to be regretted that a great public question such as this is cannot be debated dispassionately and without impugning the motives of those who adhere to what may be said to be the Western view, except when and insofar as the conditions point to selfishness in those upholding it. The promoters of the leasing plan never admit the possibility of an honest difference of opinion concerning the wisdom of the departure they propose. All who oppose them are involved invariably in the common denunciation which is leveled at the plunderers of the public domain and the defenders and apologists for such. There has been no deliberate judgment by the American people in this supremely important question. They have been turned by invective from the consideration of it. The leasing system was tried in connection with the lead lands of the Mississippi Valley and abandoned after proving a dismal failure. Probably the essential difference in the conditions under which it was tried and those now prevailing deprive the experience we had under it of anything like controlling force, but if so the public has not been advised as to why the same troubles are not in store for us. Calumniation has been so long the portion of those who have sought to gain a fair hearing

for the system of alienation of fees that few remain who have not despaired of securing considerate attention to the merits of that plan. Anyway the friends of Alaska are without hope of convincing the public mind, at least not speedily, that as to coal deposits, popularly believed, and doubtless with justice, to be exceptionally rich, the leasing system is not a most doubtful experiment. The people of Alaska pray for any kind of a law which will permit them to mine coal. They have ceased to debate the merits of rival systems.

It must be confessed that the plan of reserving title in the government is growing in favor. The Western representatives are much more tolerant of this idea than they once were. The legislation of such states as Colorado and Montana concerning their own coal lands, forbidding their sale, but authorizing the operation of them under leases, is appealed to with embarrassing effect. It is true that the policy of the state is primarily to make as much money as it can out of its school lands while the policy of the federal Government is, or ought to be, to make its lands serviceable in the development of the sections in which they are situated. But the state is not altogether unmindful of its larger interests in the sale of its granted lands, and the policy of local development is as well subserved under a leasing system, if all the returns are devoted to improvements within the state, instead of going to meet the general demands upon the federal treasury. The Northern Pacific Railway Co. has the most vital concern in the rapid development of the territory adjacent and tributary to its lines. But it has also adopted the leasing system as to its coal lands and declines to sell such at any price.

Those responsible for the Alaska coal land bill referred to, find sufficient justification in the foregoing to tender a measure recognizing the leasing system. Under it the Secretary of the Interior is authorized to withdraw eight sections in the Bering River coalfields and twelve sections in the Matanuska field for the use of the navy or to be used in connection with the government construction work or for disposition by Congress in case of oppressive conditions arising from monopoly, it being contemplated that the Government might in the future deem it the best solution of difficulties which might arise similar to those encountered in connection with the anthracite coal situation in the east, itself to supply the market from its own fields. Leases are authorized for indeterminate periods with provisions for readjustment of prices every 20 years, no lease to be for more than 2560 acres to any person or corporation. Drastic provisions are inserted in the law to prevent evasion of the provision limiting the area in which any individual may be interested. Forfeiture and imprisonment are the result of conviction. It is believed the risks are so great that few will care to take the chances involved in an effort at monopoly. The royalty is fixed by the lease but cannot be less than two cents per ton, and it all goes toward the redemption of the bonds issued for the construction of railroads in the territory and for purposes of similar character when

the obligation created by them is discharged. The lessee is entitled to sue the Government on any cause of action arising out of his lease in the Courts of Alaska, so that any arbitrary or destructive policy on the part of the Department may be restrained and questions arising upon the construction of the lease determined as they would be between private parties under like circumstances. To compel the operation of any ground leased, a rental in addition to this royalty is exacted at the rate of 25c. per acre the first year, 50c. per acre annually for the next four years, and \$1 per acre for each year thereafter. For local use the Secretary is authorized to issue permits without any charge for the working of tracts not to exceed ten acres, the purpose being to permit the homesteader and miner to secure coal for his own use at an adjacent bed.

The Radium Bill

A third bill before the Committee which has given rise to much discussion appertains to lands containing a radium-bearing ore. These are mainly pitchblende and carnotite. The former is often, perhaps usually, found in metal-bearing veins and in association with the precious metals as well as with zinc and lead, the latter, so far as known, appears only in veins or pockets in sedimentary rocks. The carnotite ores are the chief source of supply. They abound in an area reaching from Colorado into Utah, 150 miles long and varying in width from 5 to 25 miles. Discoveries have been reported in Arizona, Montana, Idaho, and South Dakota, but no authentic information is available of any workable fields save those of Utah and Colorado. The wonderful advance made in the use of this remarkable agency in the eradication and cure of cancer and other malignant growths has directed the attention of the world to the sources of its supply. The exceptional riches of our western fields have made the output of them eagerly sought after by the laboratories and reduction works of Europe. Two great plants in the state of Pennsylvania are now treating the ores and claim to be supplying the trade each with a gram a month salable at about \$120,000. Thus far their production has gone very largely to foreign markets, as has practically all the ore not treated by them. They own the claims from which their supply is drawn, one of the companies having acquired about 140 claims. Another association has 80 odd, a third 40 or more. Though the crude ore which is the source of by far the greater part of the products of the works in Europe comes from this country, our surgeons are forced to go there to procure their supply. Unmistakable evidence is at hand of something like a race to purchase or locate every deposit of any prominence, and surgeons of eminence who are intensely interested in the success that has been achieved in the use in therapeutics of this singular substance, and the still more marvelous possibilities that experiments are constantly revealing, became genuinely alarmed on visiting the region from which the ore comes lest the whole of it should speed-

ily fall into the hands of a monopoly which might maintain the price of its product so high as to make it available for the treatment of those only who could afford to pay anything that might be demanded.

These conditions prompted the introduction of a bill which obligates the locators of all claims containing radium-bearing ores to sell their products to the United States at the market price to be fixed by the Secretary of the Interior. Development work or mining during a period or for periods aggregating four months is required, and even after patent, if the property is not worked with diligence, the Secretary is authorized to enter upon the property and mine it, paying to the owner the market value of the ore, less the cost of extraction. Rights to claims located prior to the passage of the act are, of course, not affected, but the Government is given the preference right to buy the output of all claims hereafter located. The Bureau of Mines is perfecting a process which it is claimed will enable it to reduce the ores at a cost not to exceed that now attending similar work by private companies. Two questions are of first importance in the consideration of this measure; first, whether it is justifiable to impound all ores produced in our territory to supply the needs of our people; and, second, whether the peril of monopoly is sufficiently imminent to justify the Government in itself undertaking the work of extraction.

Non-Metallic Minerals

Various other bills related in character to those referred to will be considered in conference, such as have been mentioned, and then introduced. First in importance is an oil and gas bill. The basic feature of this bill is one which permits the discoverer to purchase a limited portion of a tract for the exploration of which an exclusive license is issued to him, the remainder then being leased. It is proposed to give the adventurer the exclusive right for two years to prospect over four sections, if they are distant 100 miles from a producing well, and over one section if it is less. Should he discover oil or gas, he is entitled to locate, in the one case 640 acres, in the other 160 acres of the land included in his permit, acquiring title under the procedure described in the case of placer mines.

The same principle is to be made applicable to the disposition of valuable deposits of chlorides, sulphates, borates, or nitrates of potassium or sodium. Phosphate deposits it is proposed shall be leased in tracts not to exceed 320 acres by competitive bidding. The royalties from all leases of lands outside of Alaska, except so much as is deemed necessary to defray the cost of administering the laws (for this principle applies to all leasing measures) go into the reclamation fund. A general coal land bill has been prepared by the Department on the same lines. The Committee of both Houses, the Department, and the Congress will be thankful for any consideration you may give these various measures and for any helpful suggestions.

The Apex Law in the Drumlummon Controversy

By CHARLES W. GOODALE

The litigation between the St. Louis Mining & Milling Co. and the Montana Mining Co., Ltd., over portions of the Drumlummon lode covered a period of more than 20 years, and resulted in a judgment for damages in favor of the St. Louis company of such an amount that the Montana company declined to pay the judgment and therefore lost the entire property.

The Drumlummon lode claim, in the Marysville district, Montana, was located in 1876 by Thomas Cruse.

advisable to acquire adjoining claims on both sides of the Drumlummon, in order to avoid possible litigation over apex rights. They bought the Marble Heart, but would not purchase the Hopeful at the terms proposed for the reason that exploration in the Cruse level had shown the vein to be barren in that region. The owners of the Hopeful were sinking a shaft on that claim in 1889, and the Montana company enjoined them, contending that, owing to the triangular form of the location, it had no extralateral rights. When the cause was heard by Judge Knowles in the United States District Court in Helena, in June 1890, he supported the contention of the plaintiff, and no appeal was taken, because it was found that the portion of the Drumlummon vein in controversy was not of sufficient value to justify further litigation.

The St. Louis claim was located September 28, 1878, as an extension of the Drumlummon. There is abundant evidence from the location notice, and from other facts, that its side-lines were straight, as shown by dotted lines in Fig. 2, but the discovery vein of the St. Louis proved disappointing when opened, and in the meantime the 9-Hour location having been made by William Robinson, July 26, 1880, on a promising discovery of ore, the St. Louis owners, in surveying their claim for patent in July 1881, ran their lines so as to take in the 9-Hour discovery. When Robinson objected, they made angles in their side-lines, leaving out the shaft, but by such a narrow margin (about 10 ft.) that when they applied for patent he put in an adverse claim. On March 7, 1884, he was induced to withdraw his suit, the St. Louis owners agreeing, on the issuance of their patent, to convey him a portion of the ground, known

thereafter as the compromise strip. As this would have the effect of moving the St. Louis line 40 ft. farther away from his discovery, he felt secure in his mineral rights to the 9-Hour vein. The locator had only developed the property to a limited extent, when he sold it to the Montana company.

Going back now to the beginning of the litigation with the St. Louis M. & M. Co., a suit was started on October 14, 1890, by that company against the Montana company for \$2,000,000. An incline shaft had been sunk on the St. Louis claim to a depth of about 370 ft. (Fig. 2) in an effort to find the Montana com-

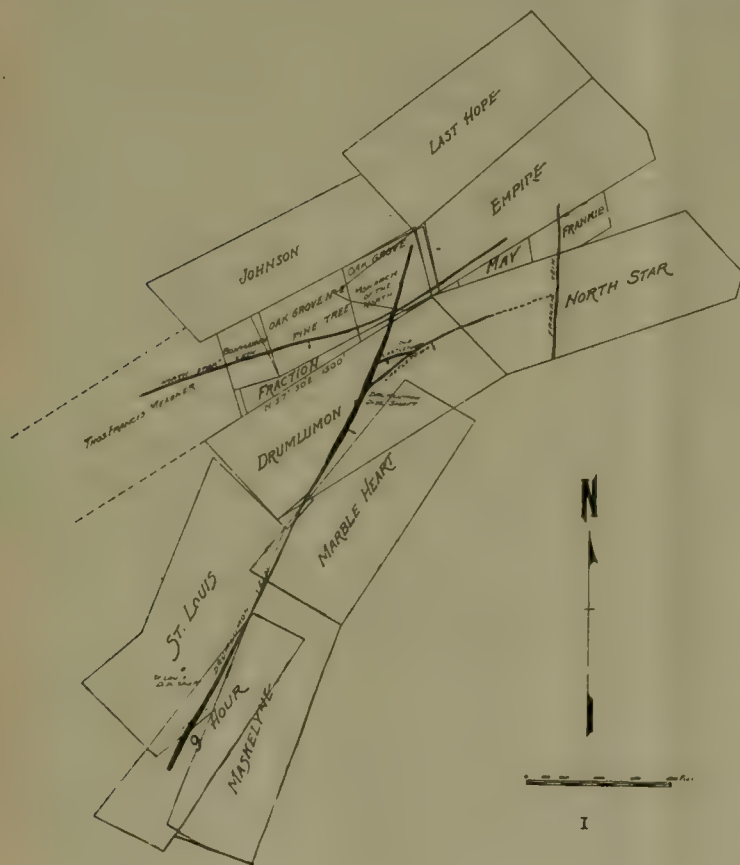


FIG. 1.

When he staked out his claim, he assumed that the discovery on the Drumlummon vein, and another showing of mineral about 200 ft. distant, were on the same vein, and the centre line of the claim was given a course of N. 57½° E. (Fig. 1.) Development of the Drumlummon vein soon showed that its strike was about N. 15° E., and that the other outcrop was on the North Star lode, so it was inevitable that the Drumlummon vein would cross one or both side-lines of the location, and the Montana company found it

*Abstract of paper read before the Butte section and the annual meeting of the American Institute of Mining Engineers.

pany's workings, as it was known that the Cruise level had been driven several hundred feet south of the Drumlummon end-line and into the Marble Heart claim. This shaft was started as close as possible to the side-line of the St. Louis, and was given an inclination parallel to the known dip of the Drumlummon vein. The geologists of the plaintiff asserted that the shaft was sunk on the foot-wall of the Drumlummon vein, and set up the theory that the Drumlummon vein entered their claim at its north end-line with a width of about 70 ft., varying from that to about 30 ft. in its course southerly, and claimed the Jubilee and Jubilee No. 2 ore-shoots in virtue of apex rights to which they were entitled by the alleged fact that they had the foot-wall in the St. Louis claim, the hanging wall being in a junior location, the Marble Heart. The case came up for trial April 17, 1893, in the United States District Court at Helena, and at the conclusion, five weeks later, the jury gave a verdict in favor of the defendant, thus supporting its geologists in their statement that the Drumlummon in its apex through the region in question was a narrow vein, not to exceed 3 ft. in width, existing between two well defined walls, and with a distinctive barren filling. The nature of this vein-matter as shown by analysis of the country slate or hornstone, both within the wide vein as claimed by the plaintiff's geologists and outside of it, showed little difference in the composition, but the plaintiff insisted that what the defendant called the whole vein was only the hanging wall gouge, and that the rock between this and the plaintiff's alleged foot-wall, from 30 to 70 ft. distant, was "broken, brecciated, recemented vein matter." The defendant pointed to many places where the stratification planes of the slate were strongly in evidence, and asserted that wherever they were indistinct this condition could be explained by the proximity to the contact with the diorite.

After the purchase of the 9-Hour claim the Montana company began active exploration of the ground, both at the surface in the discovery shaft and in deep levels. By the summer of 1893 developments had shown that the vein would cross the east side-line of the St. Louis claim as patented, and on June 19, 1893, the St. Louis company commenced an action to restrain the Montana company from working any part of the vein the apex of which was in the St. Louis claim as patented, and for damages, placed at the sum of \$10,000, for ore extracted from within the boundaries of the compro-

mise ground. A temporary order was issued, restraining the Montana company from sinking its Apex shaft upon the compromise ground near the boundary line between this ground and the 9-Hour claim. The case was removed to the federal court, and on September 16, 1893, a new complaint was filed in which the damages were placed at the sum of \$200,000 for the ore then extracted. For a distance of 100 ft. or more at

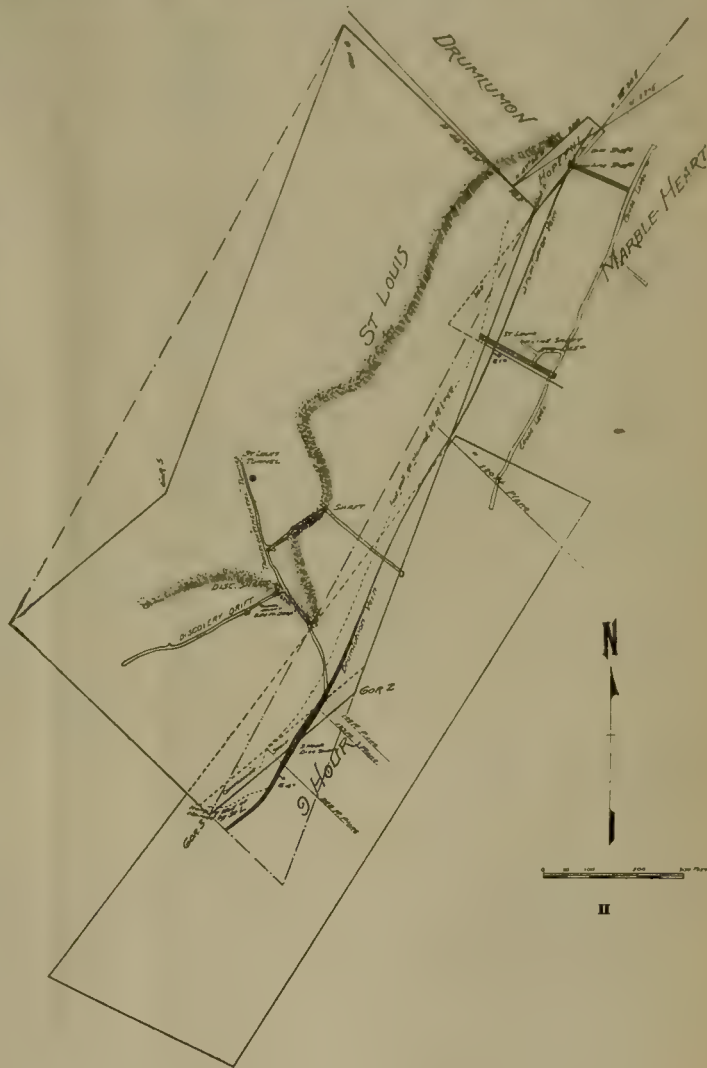


FIG. 2.

the surface, and to a depth of about 50 ft., the ore was richer than had been found in any other workings of the Drumlummon vein, and the fight for its possession became very bitter. The Montana company claimed the right to the ground in controversy by virtue of the agreement to convey the compromise ground. It could not maintain its right without the full legal title to the ground, and thereupon it commenced an action to compel the St. Louis company to deed to it the compromise ground in accordance with the agree-

ment which had been entered into with Robinson and his associates. Pending the proceedings in this 'specific performance suit,' the proceedings in the court were suspended. The suit dragged its length along until the year 1898, when the Supreme Court of the United States affirmed the decision of the State, District, and Supreme courts requiring the St. Louis company to convey the compromise ground in accordance with its agreement, which was done, and a deed was executed July 1, 1898. The patent of the St. Louis claim was issued in July 1887, and William Robinson, or his successor in interest, the Montana company, should have received a deed promptly, but it was only given after eleven years of annoying and expensive litigation.

Amended Complaint Filed

In November 1898 the St. Louis company filed its first amended complaint in the United States Circuit Court, claiming the right to the ores beneath the compromise ground by virtue of its ownership of the apex of the vein within the limits of the St. Louis claim wholly outside of the compromise ground, from a point on the east side-line of the St. Louis claim between corners No. 1 and 2, 520 ft. distant from corner No. 1 of the St. Louis claim to a point on the west side-line of the compromise strip distant 108 ft. from the intersection of the west side-line of the compromise ground with the east side-line of the St. Louis claim, running from corners No. 1 and 2, where the hanging wall of the vein began to cross from the St. Louis ground into the compromise ground and for an additional portion of the said vein for a distance of 25 ft. to the point where the foot-wall of the vein passed out of the east side-line of the St. Louis lode claim into the compromise ground. These points of departure of the hanging wall and foot-wall from the St. Louis ground into the compromise ground became known as the 108 and the 133-ft. planes.

The case was not reached for trial until 1899. Shortly before the commencement of the trial the plaintiff amended its complaint, making the total damages claimed \$600,000. The trial was heard before Judge Knowles in the United States Circuit Court in the month of August 1899, and resulted in a verdict for the plaintiff in the sum of \$23,209 for ore extracted north of the 108-ft. plane, or from a vein which had its apex entirely within the St. Louis claim outside of the compromise ground. The district judge held that in order to entitle the plaintiff to recover, it must have within its own surface lines the entire apex of the vein from which the ore was extracted. Both parties sued out writs of error, the St. Louis company upon the ground that it was entitled to the ore within the vein to the extent that it had any of the apex within its surface lines, and the Montana company on the ground that the deed conveyed to it all of the mineral beneath the compromise ground, and that as the verdict embraced damages only for ores extracted from beneath the compromise ground, it was entitled to a

judgment. The Circuit Court of Appeals reversed the case on the St. Louis company's writ of error, holding that the company, as the owner of the senior location, was entitled to recover to the extent that it had any of the apex within the surface of its ground, and affirmed the judgment to the extent of \$23,209, overruling the Montana company's contention that the deed conveyed the ore beneath the compromise ground, where such ore was found in a vein apexing partly or wholly outside of the deeded ground. This action of the Court of Appeals was reversed by the Supreme Court of the United States on writs of error sued out by the Montana company, and that court held that the reversal of the judgment of the Circuit Court as to one portion of the case reversed the entire case, and remanded the case to the Circuit Court for a new trial, without deciding any of the points in controversy.

The case was again tried in the Circuit Court in Helena, before Judge Hunt, district judge, sitting as a circuit judge, in May and June, 1905. Judge Hunt, following the ruling of the Circuit Court of Appeals, held that the plaintiff was entitled to recover for the ores extracted between the 520-ft. and the 133-ft. planes, and a verdict was rendered in the sum of \$195,000. Writs of error were again sued out, and the case was reviewed by the Circuit Court of Appeals. It then went to the Supreme Court of the United States, where, on January 14, 1907, (204 U. S. 204), the Supreme Court rendered its opinion that the deed to the compromise ground conveyed all of the mineral beneath the compromise ground, and, as the decision of that point might end the litigation, none of the other questions were directly passed upon. But in his opinion, Justice Brewer raised, for the first time, the suggestion that the deed to the compromise ground carved out a section from the vein.

The Injunction Dissolved

When the mandate was filed in the Circuit Court, the Montana company moved to dissolve the injunction, which had been granted at the time of filing the original complaint, restraining the Montana company from extracting ores from beneath the compromise ground, basing its motion for dissolution upon the decision of the Supreme Court of the United States that the deed to the compromise ground conveyed to the Montana company all of the ores beneath its surface. On March 30, 1907, Judge Hunt, district judge, sitting as a circuit judge, granted the defendant's motion and dissolved the injunction. The St. Louis company then applied to the Supreme Court of the United States for a modification or an explanation of its opinion relative to the construction of the deed, but the Supreme Court denied the application without any further opinion. The St. Louis company then, on August 28, 1907, made an application for leave to amend its complaint so as to claim damages for ores extracted from the vein on its dip after it had passed through the compromise ground, placing its damages at \$500,000 for ores ex-

tracted from that portion of the vein on or about June 30, 1893, and for \$500,000 for ores extracted from that portion of the vein between June 30, 1893, and the date of tendering this amended complaint. It also alleged that the foot-wall of the vein was at all points either in the compromise strip or the St. Louis claim, and passed out at some indefinite point across the south end-line of the St. Louis claim as patented; the contention of counsel for the St. Louis company being that under the Supreme Court decision, the St. Louis company owned all the ore in the vein after it had departed from the compromise ground on its dip, so long as any part of the apex of the vein lay within either the compromise strip or the St. Louis claim.

This proposed amended complaint not only extended the surface area in which was embraced the apex of the vein from which the ore was alleged to have been extracted, but carried the place of trespass into the depth of the mine and into stopes which had been taken out many years before the filing of this amended complaint, which ore, it was contended by the St. Louis company, was of the same rich value as that taken from the compromise ground near the surface. The proposed amended complaint also set forth the fact that the Montana company had worked out the remaining vein belonging to it, had ceased its operations in Montana, and was in an insolvent condition, having no property within the jurisdiction of the court, except the practically dismantled mining plant. The plaintiff asked for an injunction on the equity side of the court restraining the Montana company from mining upon the compromise ground, notwithstanding the decision of the Supreme Court of the United States that the ore beneath that ground belonged to the Montana company, basing its right to an injunction upon the allegation of insolvency and inability of the Montana company to respond in damages in the event that the St. Louis company recovered judgment; and that the St. Louis company must necessarily recover judgment in some amount, because the portion of the vein from which the ores had been extracted was, by the decision of the Supreme Court, awarded to the St. Louis company.

This construction of the decision of the Supreme Court by the attorneys of the St. Louis company was assailed by the attorneys for the Montana company upon the ground that the declaration of Justice Brewer in the opinion of the Supreme Court that the effect of the compromise deed was to carve out a section of the vein, leaving the remaining portion unconveyed, referred only to the portion of the vein on its dip where

all or a part of its apex lay within the St. Louis claim, and had no reference to the vein after its apex had wholly passed into the compromise strip, and that the Supreme Court by its refusal to modify or amend its mandate had practically so determined. Objection was also made to the filing of this amended complaint upon the ground that by extending the point of departure of the foot-wall from the 133-ft. plane to a point across the south end-line of the St. Louis claim

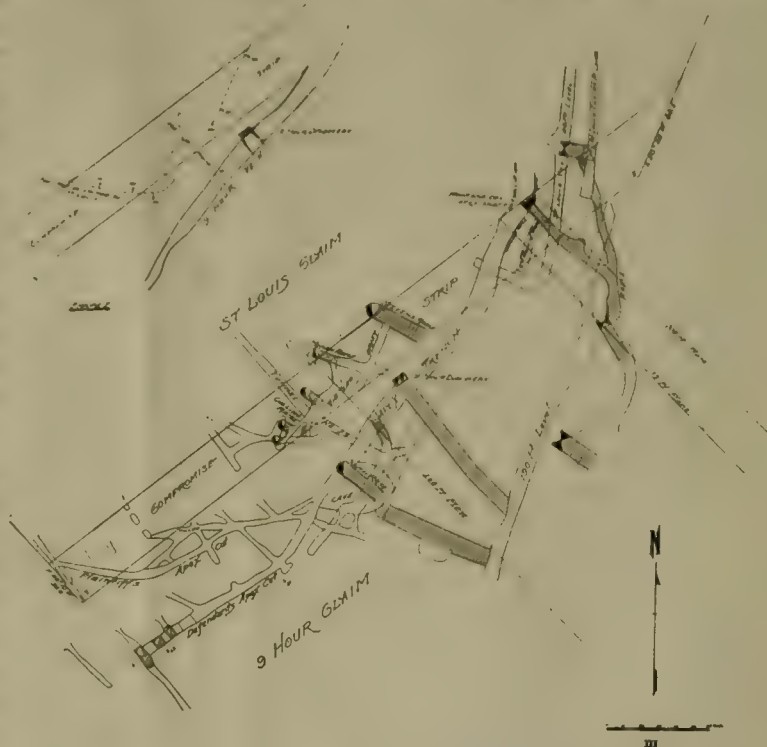


FIG. 3.

there was brought into the litigation a trespass upon an area of ground not embraced in the original ground, and that as to that portion of the damages claimed, the statute of limitations had barred recovery. These contentions were finally overruled by the Circuit Court, and on December 2, 1907, leave was given to file the third amended complaint, the defendant then answered, and on January 10, 1908, Judge Hunt issued an injunction restraining the Montana company from extracting the ores from beneath the compromise strip pending the litigation. This injunction was unique in the history of mining litigation in Montana, in that it restrained the Montana company from extracting ores from the portion of the ground awarded to it, in order that these ores might be preserved to answer any judgment which might be recovered against the Montana company for trespass upon the portion of the vein which, it was claimed, the Supreme Court had awarded to the St. Louis company. An appeal to review this action of Judge Hunt was taken to the Circuit Court of Appeals for the Ninth Circuit, and on

March 2, 1909, the action of the Circuit Court was affirmed.

The case then came up for trial again before Judge Hunt in 1909, commencing June 14 and ending August 11. Before and during the trial extensive explorations were made upon the surface ground, and the case was bitterly contested by the experts of the two parties as to the position of the foot-wall. At the close of the testimony on behalf of the Montana company, the St. Louis company amended its third amended and supplemental complaint and replication by withdrawing the allegation of the compromise ground as a part of the St. Louis claim, and substituting in lieu thereof the allegation contained in the former complaints that the compromise ground was and always had been a part of the 9-Hour claim. The complaint was further amended by alleging that the apex of the vein in controversy passed entirely into the compromise ground

recovery upon new allegations of fact, upon which they confessedly could not have recovered under the complaint as it stood up to the time when the Montana company was required to present its evidence. Under the pleadings as they stood up to this time, a portion of the apex of all the vein in controversy lay within the compromise strip, and the compromise strip "was and always had been a part of the St. Louis claim," which part had been conveyed to the predecessors of the Montana company by a conveyance prior to that by which the remainder of the St. Louis claim had been conveyed by the same grantors to the St. Louis company. Under the law the effect of the first deed—that conveying the compromise strip—was to convey all of the vein on its dip so long as any part of the apex lay within the compromise strip. By this last amendment, the St. Louis company was permitted to take the position that the compromise strip "was and

always had been a part of the 9-Hour claim," thus presenting a question of rights on the dip of a vein, the apex of which was divided between the junior 9-Hour claim and the prior St. Louis location, thereby presenting entirely different questions both of law and fact. The controversy by this last amendment then narrowed down to the question as to whether the foot-wall passed into the compromise ground at the 133-ft. plane or at a point farther south, designated as the 268-ft. plane. The jury found that the foot-wall entered the compromise ground at the 133-ft. plane (as contended by the witnesses of the Montana company, who maintained that the apex of the vein was only about 10 ft. wide, as against the assertions of the St. Louis witnesses that its width was 55 ft.), and awarded the St. Louis company damages for the amount of ore extracted from the vein after it had departed from the compromise ground, aggregating 1912 tons, valued at \$237,470.40. The court had instructed the jury that if they found in favor of the plaintiff, they should include in their verdict interest at 8% per annum on the value of the ore ex-

tracted in 1893. As nearly sixteen years had then elapsed, the interest amounted to considerably more than the value of the ore. From the above amount was deducted the value of 218 tons of ore taken by the St. Louis company from beneath the compromise strip, amounting to \$34,341.38, including interest, making the verdict \$203,129.02. Upon a writ of error the judgment was reviewed by the Circuit Court of Appeals, where it was affirmed (183 Fed. 51), a petition for a writ of certiorari was denied by the Supreme Court of the United States on March 6, 1911. The Montana Mining



FIG. 4.

at the point designated as the 268.6-ft. plane. This amendment, which was strenuously objected to by counsel for defendant, and was made after the granting of a sweeping injunction upon the construction of the Supreme Court decision, urged by the St. Louis company's counsel, and after defendant had been compelled to prepare its defense of the cause to meet such legal theory, and after all of the evidence in chief of the St. Louis company had been introduced upon this theory—permitted the St. Louis company to completely somersault in its legal position, and seek a

Co. decided to offer no further resistance, and in due course the property was sold by the sheriff to the plaintiff.

In the foregoing chronology of the litigation and analysis of court proceedings, Messrs. E. C. Day, C. F. Kelley, and L. O. Evans have kindly given me great assistance. Reviewing, again, the court proceedings, shows that the litigation in its various phases required in the aggregate about five months in the four trials on questions of fact, and that it reached the State Supreme Court once, the Circuit Court of Appeals five times, and the Supreme Court of the United States four times. Furthermore, much time was occupied by the courts in many preliminary hearings.

Comments on the Verdict

The jury by its verdict showed that they did not accept the wide vein theory of the plaintiff, for if they had they would have awarded him damages for the proceeds of 31,592 tons of ore, instead of for 1912, which was about the amount admitted by the defendant as having been extracted by it under its own surface, but from that part of the vein having its apex partly within the St. Louis claim west of the compromise strip. The award of \$237,470.40 must have placed an original value of about \$55 per ton on the ore. Fig. 4 shows the extent of the excavation made by the Montana company north of the 133-ft. plane and east of the compromise ground, and nearly all of the work was done in and beyond the extreme northern limits of the pay ore. Many samples were taken before the trial from the ore remaining in these workings and the assays were submitted in court, giving what was thought ample proof that the material extracted did not return the company a profit of \$15 per ton. Samples had also been taken as the work progressed, but the samplers and assayers of that time were either dead or out of reach, and the Company could not prove its records by personal testimony. Furthermore, believing fully in the validity of its title to the compromise ground and to all the mineral therein contained, and that no adverse rights could be successfully claimed beyond this strip and within the 9-Hour location, as patented, the defendant had not taken the precaution to run the ore in question through the mills by itself, thereby placing on record its billion yield. Moreover, there was an advantage in working it with ore from other parts of the mine.

The advocates and defenders of our mining law insist that in no way except by giving the discoverer of a vein the right to follow it on its dip under adjoining ground can he realize the full benefits to which he is entitled, but in the case under review, the plaintiff was not suing for any rights directly pertaining to his discovery vein. His demands were based entirely upon an incidental vein, the existence of which was unknown to him when he made the St. Louis location, and this vein only skimmed along his side line, but the actual discoverer of the lode in question, or his succe-

sors in interest, finally lost the entire property as a result of these demands. With no development along the vein, the strike in the 9-Hour discovery led the locator to believe that in compromising with the St. Louis he would have the apex of the lode within his claim from end to end, and from all considerations of equity and justice, the worst that should have happened in consequence of his lack of knowledge of the course of the vein, should have been the loss of the ore included within the vertical boundaries of the St. Louis claim, excluding the compromise ground. But what happened? By the application of the apex law, he was deprived of all ore in the vein he had discovered up to the 133-ft. plane, and was adjudged to be liable in damages to the St. Louis company for more than \$200,000, covering 1912 tons of ore which he extracted from under his own surface. Furthermore, if the jury had accepted the wide vein theory of the St. Louis witnesses, and had given them extralateral ownership to all the ore up to the 268-ft. plane, the 9-Hour locator would have had no rights in his discovery shaft, and would have been a trespasser, and liable in damages, when he took a little sack of ore from there to the assayer, so that he could support the affidavit in his location notice, that he had made a valid discovery.

Can anyone describe an instance where such injustice has resulted in the operation of the mining laws of other countries? With extralateral rights abolished, underground rights would be settled quickly on mathematical planes, and years of litigation, with attending costs, would be avoided.

South Dakota has a forest law which Government Forest Service officials hold up as a model for Western states to copy, claiming that its enactment and enforcement would not only conserve timber, but would, through preventing fire, have an important effect on water supplies. The Service calls attention to the fact that the timbered mountains are the areas upon which the people of the West are absolutely dependent for their water supplies. The law is, in part, as follows: "Any person who shall cut any timber upon any common school or other lands within this state, shall pile up and dispose of all brush and debris in such manner and under such regulations as may be prescribed by the board of school and public lands, and shall commit no waste or unnecessary damage to the standing trees and young growth."

There was no railway construction in Alaska during 1913. Of the 466 miles of track previously built, only 260 miles was operated in 1913. This is largely due to the high cost of fuel and to the tax of \$100 per mile on all operating lines. These conditions have tended to discourage the railways, especially those which are only partly completed. In 1913 the White Pass & Yukon, the Copper River & Northwestern, and the Tanana Valley railroads were the only lines to be continuously operated, according to Alfred H. Brooks, of the U. S. Geological Survey.

What is the Matter With Prospecting?

A REJOINDER

Fayette A. Jones:—It is with much interest that I have noted various opinions relative to the decline in prospecting. Of the various views presented none, from my viewpoint, has even approached the fundamental cause of the prevailing blight. The true reason is not hard to find and the answer is simple: demonetization of silver did it. The incentive for making new discoveries was ruthlessly swept aside by demonetization and the prospector's chances of success declined fifty per cent.

E. W. Reuther:—From reading your vital question, 'What is the Matter with Prospecting?' I am very glad to learn that there is a spirit of concern about. I only wish it may ripen again the fruits of enterprise. There are a few loyal remnants left of the legions that used to work under the customs and rights of the old mining districts, and they are still anxious for a chance to earn their grub stakes or to do assessment work on the claims of others under fair conditions—an eight-hour day, and wages at \$3.50 per shift. Conditions have changed since the old days. Big corporations now take up land which was staked for mineral claims and use it for other purposes; and they have the assessment work on mining claims done by foreign laborers working ten hours a day for a wage of \$2.50, thereby depriving the prospector of the support that he needs to enable him to find new mining districts. Every fair-minded prospector is independent and self-reliant. All he needs is a reasonable reward for his labor and a fair chance. It would be only fair to ask for indirect government support by means of laws providing that all assessment work be performed only by citizens of the United States or persons who have signified their intention of becoming citizens. As our Government is a co-partner in all mining claims, I can see no just reason why alien laborers should be the chief benefactors under the requirement of the annual expenditure of \$100 per claim. There should be an 'assessment inspector' to see that the annual labor on every claim is performed, and a record should be kept of all claims inspected by him. In case the assessment work is not done the owner should be compelled to forfeit his property, or to pay a fine of \$100.

John C. Molder:—The prospector was driven out by recent legislation in the mining states, for every new law has been against him. For instance, Arizona passed a law that a prospector could not re-locate his claim. A few years ago a law was passed in Arizona authorizing the State University to do assaying for prospectors, with a charge of 50c. for a gold-silver assay. The next legislature increased the charge to \$1, because it was said that the lower charge ruined the business of the regular assayers. To encourage

prospecting, each mining state should have a free assay office to which a prospector could send samples of ore that he might wish to have tested or assayed. A prospector never has much money, and if he finds a strange mineral which might be valuable he can seldom afford to have it tested. If a property is being worked for certain metals (such as gold, silver, or copper) and a prospector discovers a deposit of a different kind of metal or mineral, he should be allowed to develop it and acquire ownership. Every county should have a collection of ores and minerals so that the prospector may compare his 'finds' with the known ores exhibited. The taxes from one good mine will pay all of the expenditures made on behalf of the prospector. After a prospector has worked for years and has spent his money trying to keep up the assessment work on a claim, the courts should allow no one to take it away from him. The state or federal government ought to have engineers and geologists to examine all prospects and small mines, and their reports should be on file so that a prospective buyer may be able to secure reliable information. This would help the prospector to find a market for his properties. As a rule the prospector gets very little from his discoveries. Protect the prospector from claim-jumpers and swindlers. Open wide the gates of opportunity and he will find his way through.

H. S. Hite:—The land that is open for prospecting, in this state especially, has been pretty well gone over, but there is still a great deal of ground for the lonely prospector. The land, however, is controlled by companies or corporations that will not allow prospecting because they hold agricultural titles. Then comes the individual agriculturist who does not want any 'coyote holes' dug in his ground. Again, there are some of these agriculturists that are willing to have a prospector go on the ground providing he only wants about one-tenth of what he finds.

I know of much of this so-called agricultural land upon which you can raise a good prospect, and that is about all you can raise, as it will hardly support the wild native vegetation. Some of this land has been held by mineral locations, and afterward the same people that swore it was mineral land swore that it was non-mineral. If there were some way to get at this ground, so that the man with the pick and pan could see what was in it, some of the old-time prospectors would come to life again, and it is more than likely we would have some more good mines and more money spent for prospecting. No prospector cares for a lawsuit, and not many mining men that have capital to spend on prospects care to go to law over land that is claimed as agricultural.

Frank P. Davis:—I believe you could get at this subject better by means of a response from the prospector himself. I have followed that line for 35 years, and I think I ought to say something from my side of the fence. For the past five years, money has been closer and harder to get for developing prospects than ever before. Outside of a few low-grade copper mines, nine out of ten of the new properties that have been opened and put in the mine class in the past ten years have been developed by the prospector and lessee, not by the capitalist. You will find a great number of the old-time prospectors at the present time in some out of the way place or in some idle mining camp, holding down a few mining claims which they are developing as fast as their limited means will allow, while waiting for a buyer. It seems that capital wants a mine for a prospect price. Nowadays if a prospector is lucky enough to go out and get someone with capital to look at his prospects, this is generally his story.

If the prospector looks good to the capitalists they will ask the price of the group of claims, and will be told five or ten thousand dollars, or whatever figure the price may be, with a year's bond and lease, but the owner wants five or six hundred dollars down. Now the showings on this prospect may look good enough to warrant some work and perhaps the expenditure of from ten to fifty thousand dollars in development. But the capitalists will pay nothing down. They do not stop to think that the prospector has done many a hard day's work showing up what is in sight. He probably owes money for his supplies and equipment, but he can get nothing down for what he has put in. There are many good prospects lying idle because of this averseness to paying a few hundred dollars in cash. It seems that many of the mining engineers who are sent out to look at a prospect are not competent to do so. They come with the understanding that they are going to examine a prospect, price probably \$5000. If they don't find a mine, they turn it down. What is the reason? They don't stop to think that if the showings were as good or better two or three hundred feet deeper the property would be worth twenty times as much as the price asked. They work on the theory that only one prospect out of a hundred makes a mine. In earlier days any fair looking prospect, that had the 'ear marks' of a mine, would be taken up quickly, but it now seems that the only thing which will interest capital is a big boom and lots of talk.

The Government can be of great help to the prospector, and be the cause of many discoveries. The prospector in the field has a very hard time to get his samples assayed. Let the Government start good assay offices in the different western states, where a bona fide prospector could get an assay or an analytical test on his samples without paying cash. Then the \$100 annual assessment work on a mining claim ought to be done away with. Have an annual tax, say \$10, for each claim. This would be much better in more ways than one for all concerned, except the few who make

a living by doing assessment work (and a kick from the miner's union). A part of the tax could be used for the maintenance of the assay offices. Prospecting, in one sense, is much easier today than it was years ago, as the thousands of feet of development done in late years are really a great help, whether ore has been discovered or not.

W. S. G. Todd:—On behalf of the prospector, I wish to say that too much credit cannot be given the man who has the nerve and inclination to throw a fry pan, coffee pot, a little plain grub, and a roll of blankets upon a 'jack' and hike for the unexplored mineral regions. He must find mineral that will pay, or his grub and time, which are his stock in trade, are lost. He stakes everything he has. If it was not the prospector who made the first move toward bringing into existence the mines that in 1913 produced about \$88,000,000 in gold in the United States, I should like to know who did. Suppose a prospector makes a promising find. He has no capital, but as long as his grub lasts he is hard at work, and he opens up his ore on the surface as best he can. Then what happens? He is compelled to go to work for wages or look for some one with money to help develop or buy his prospect. The prospector struggles along doing such development as is within his means, hoping someone will come along who is willing to take a chance with him. Finally someone does come. He looks over the property, and perhaps the district, and concludes that both look promising. He takes a round of samples, the best high-grade he can find, and starts down the trail. He doesn't go far, however, until he relieves himself of the test samples, but not of the high-grade. That is his pay-streak, for he may be out several months, during which time he takes up quite a collection. He does not return. He is an imposter, but he creates a bad impression with the prospector.

The prospector's next experience is with the 'shoe-string' promoter. Men of this class are pretty well represented. They float around through the mining country taking options and bonds on everything that looks at all promising. They want to secure options for from three months to a year or more. They are close to millions and will take your proposition up at once, but of course 'you know we can't hurry the big fellows.' Now, as a matter of fact, about as near as these fellows ever get to money is in passing a bank. Should one of them happen to reach real money, he usually doubles the price of the property, with the result that the whole matter will be dropped immediately after an examination. The poor mine gets the blame, and the capitalist becomes more cautious. This method causes the report to be circulated that a prospect or small mine cannot be bought at a fair valuation. We are surrounded today by conditions caused largely by too much middleman, and mining has come in for its share of the bad resulting from it.

Finally, the prospector may take a trip to the city and may call upon Mr. Goodfellow. After giving a de-

scriptum of his property, the prospector is informed that Mr. Goodfellow has no clients at present who would care to develop a prospect, but he has a friend who is in touch with capital. The prospector then describes his property to this man, who informs him that he controls considerable money available for mining, but at present he has none for developing prospects, the demand being for developed properties. However, he shows of some local people who might be interested. Before leaving, the prospector is given to understand that in case any business is done, both he and Mr. Goodfellow will have to be taken care of to the extent of about 100, each. In the course of time the prospector is brought face to face with the man who really has capital. He listens attentively, says that he is somewhat interested, but does not think it is just what he wants. In fact, if you had just what he did want you could work out your own salvation with a hand mortar. So finally, with shoes and patience worn out, the prospector returns to camp.

I am strongly in favor of government aid to the prospector for the same reason that he cannot get it from any other source and get a square deal, and I believe he is entitled to at least a small portion of the benefit to be derived from the property he has discovered. I note the opinion has been expressed that under no condition is aid to the prospector a function of the Government. Now, in my opinion, it not only is a function but a duty of the Government to aid in every way possible the development of the resources of this country, and the people who are engaged in it.

H. Pembroke:—I am much surprised at the statement of 11 out of 15 writers that there is plenty of money for the development of prospects. This is the reverse of the experience of the prospector, most assuredly, and it is mainly for this reason that prospecting seems to be on the wane. If there is plenty of capital, I should like to ask Mr. Teyer what is the proper channel through which the prospector can reach it. The past few years have seen the growth of huge corporations that have indirectly controlled prospecting, mining and smelting operations. It is stated that one corporation selected one or two properties out of over 700 that were presented for its consideration. It is not stated why this wholesale rejection, but it would not be safe to say that the 698 lacked merit. Is it not just possible that a great deal of the trouble is right here—control of the capital, production, and the market through certain metal-selling agencies? If that is the case, as a banker, Mr. Hayden is quite right in saying "I do not believe there should be any better market for undeveloped lands created."

Who is the wise man of the East or West who is to tell the value of an undeveloped mining property? Mr. Teyer goes back to a certain miner who drove 1900 ft. to a certain mine before "striking it." He then went to a certain banker, offering part of his stake at 24 per share. It was declined until a certain Hebrew bought some of it. Then the banker who

was not a Hebrew, by the way, took hold of it. This stock was about \$7 for a year or so, when it began to climb until it reached \$55 per share. The property has produced millions, it still produces. There is a certain mine in Eureka, Utah, upon which \$150,000 was spent before a pound of ore was found. Then this same banker was offered a large number of its shares at 40 cents. He sent an engineer to examine the property. He advised rejection. This stock rose to \$2 almost immediately, and this mine has also produced millions. There are a number of such instances in every field. The point is: who is competent to say whether a prospect will make a mine or not? And who is thus qualified to speak of the rejections, who rejected them and why? Again, where is the wise man?

Referring to the engineers' statement that there is plenty of capital for prospectors—where is it? Can they get it? Can they tell the prospector or miner how to get it? They cannot. I mean, as a class they cannot, because the average engineer is a very good blooded animal. He realizes his limitations—he cannot see farther than the point of his prospecting work, any more than the prospector can. I say nothing about his technical ability to prognosticate upon the signs that are about him. And the average engineer will not make a positive statement that the capital will come back to its investor. He cannot. I have had unusual opportunities to study the engineer, and my sympathies are surely with him. If there is an abused profession it is his; abused because of things absolutely beyond his control. Fair and complete discussion of this question will do good. I compliment you on your effort. Keep the good work going. Let us learn just where the trouble is. We must all remember that "the mining industry is the avenue through which flows the imperishable wealth of the world, that from no other source can gold and silver and the baser metals be secured."

S. A. Knapp:—I have read with considerable interest the remarks of the several gentlemen published in your symposium relative to prospects, prospectors, and prospecting. Having had a considerable experience with the subjects mentioned in California, and in Nevada from 1876 to 1905, during which period I have staked a large number of prospectors, and been interested in numerous prospects, I would say as the result of my observations: 1. That it takes prospects to make mines, as all mines must necessarily go through the prospecting stage. 2. That it takes prospectors to hunt up and find the prospects as a rule, although accidental discoveries have been numerous. 3. That prospecting, particularly in the desert regions, needs hard persistent work, deprivation, close and careful examination of small details, a good general knowledge of mining work and of the characteristics of various ores, and in any region the successful prospector must be a close observer. 4. That a government aid is unnecessary, and would be, I think unwise, all that the

prospector asks of the Government is covered by Section 2319 of the Mining Law of 1876, to wit:

"Section 2319. All valuable mineral deposits in lands belonging to the United States, both surveyed and unsurveyed, are hereby declared to be free and open to exploration and purchase, and the lands in which they are found to occupation and purchase, by citizens of the United States and those who have declared their intention to become such, under regulations prescribed by law, and according to the local customs or rules of miners in the several mining districts, so far as the same are applicable and not inconsistent with the laws of the United States," and the free use of water and fuel on the Government domain, and to be unhampered in his work, or in obtaining title to his property, by red tape and unjust rules.

The true prospector, living in the mining regions, generally has some arrangement with local people, ranging from the merchant to saloon man, barber, farmer, and others, by which he is enabled to obtain supplies for his trips, and with whom he shares his finds whatever they may be—good or bad. Usually many prospects are tried out in a small way before a good one is found, and it takes sand and nerve to keep at it until a good one is found. Very many fortunes can be traced to the successful result of small investments made in this way. It is probable that most of the lodes and deposits in California and Nevada, distinguished by bold and prominent outcrops, have been examined to a greater or less extent. The mineral sections of California have been much more closely prospected than those of Nevada; there are, however, thousands of square miles in the state of Nevada, in which the mineral resources are practically unknown; the country has been simply run over. The improvements in metallurgy and the building of railroads make available ores that a few years ago were practically valueless, and passed by as worthless by the prospectors of that time; zinc and copper ores in Nevada, even on the line of railroads were unmarketable until within the past few years.

In the 80's, the only market we had for copper ores was a limited demand at Dayton, for oxidized ores for the manufacture of bluestone for reduction of Comstock ores. John Ludwig ran a small water-jacket, at the old Ludwig mine, and made some copper. The Blue Light mine smelted about 16,000 tons of 17% carbonate ore at Sodaville, and wore the copper out, shipping it around until they sold it, for the reason that it had considerable arsenic in it. In the desert regions, the scarcity of water and difficulty of obtaining supplies has retarded the prospecting and subsequent development of large areas. When a supply point is established, prospectors work out from that point into the surrounding country, and discoveries are made; prospectors, ranging out from Tonopah, discovered Goldfield, Manhattan, Round Mountain, Clifford, Silver Bow, Cactus Peak, and other promising mineral districts. From Columbus and Candelaria, in former years, prospectors ranged out, discovering the deposits

of Lada valley, Palmetto, Tule canon, Log Springs, Old Gold mountain, Lone mountain, Monte Cristo district, Marietta, and Klondyke, not quite reaching Tonopah and Goldfield. From Hawthorne, the prospectors worked out, discovering the Hawthorne district, Santa Fe district, now Luning, Mt. Cory district, Confidence district, Garfield district, Kinkead district, Silver Star district, Hutton valley, Whiskey Flat, Lucky Boy, Cat creek, and many others.

Many discoveries have been accidental, and many important properties have been passed by unnoticed. Tonopah was discovered by Jim Butler by accident. The ravine, where the main street is, was used regularly by sheep and cattle men in driving their stock back and forth; they passed within a few feet of large and rich outcrops. The spring supplying water at Goldfield was for years claimed by John Chiatovich, of Silver Peak, and used as a supply for his horse ranch, which covered the present site of Goldfield. In the early 60's an exploration party (of which the late J. H. Kinkead was a member) went down through that section, and camped at this spring for a week, ranging out from there, but found nothing to suit them, and went on; they were looking for prominent quartz outcrops, and the silicious porphyry outcrops of that district didn't look good to them.

In the Silver Peak district, the first discovery was of the Vanderbilt group (silver-lead), in the southern part of the district, made by teamsters hauling salt from the Silver Peak salt marsh to the silver mills at Reese river (Austin). Their cattle were turned out to graze, and strayed up to the hill where these large lodes of good lead-silver ore outcropped, and attracted the attention of the teamsters. Later Reinzi Hughes, a tinsmith from Columbia, Tuolumne county, went to Esmeralda district (now Aurora). Not finding anything to suit him there, and hearing of the find of the teamsters, he went down there. He went prospecting in a cañon about four miles north and discovered the large gold veins upon which the property of the Pittsburg-Silver Peak is situated, and which are keeping 100 stamps dropping regularly. The Garfield district, which produced about \$3,000,000, was found by a wood chopper. The Indian Queen mine, near Benton, Mono county, a large producer, was found by an Indian, who showed it to William Witherell. The first discovery in Bull Frog district was made by an Indian, who showed it to Bob Montgomery. The Rawhide district is on the old Wadsworth road to Columbus (the main freight road to southern Nevada for many years). The lodes were in plain sight, but no attention was paid to them, until a prospector who had learned that it wasn't always necessary to find a quartz outcrop to get ore came along. The new camp of Rochester is in an old mining district, but these large lodes were overlooked and neglected for many years.

Many deposits have been found, worked for a time, and abandoned for one reason or the other, and many of these, when properly developed, will be revived. Among the number are such districts as Grantsville,

Downieville, Ione, Lodi, Benton, Troy, Tybo, Liberty, Aurora (now being developed), Belmont (again to be worked), Candelaria, Silver Star, Garfield, Hawthorne, and hundreds of others. As these are revived and re-established, the prospectors will get to work again; and with better conditions and a better knowledge of ores many more discoveries of importance will be made. The prospector relies, as a rule, on the general average working out. He realizes that he must expect to examine many lodes before finding a good one, and therefore takes disappointments philosophically. Our most successful mining men—Hearst, Lane, Hayward, Haggin; and before them, John Gashwiler, Henry Allen, Isaac Bateman, Steve Roberts, and others—operated on the same general plan, except in a larger way: a promising prospect always appealed to them, and when they reached the position where they could

afford the loss of a few thousand dollars many prospects were examined or developed. If they got one mine out of a dozen trials, and some of these expensive, they came out on the right side of the ledger. Companies organized to operate on this basis, with sufficient capital to handle the properties acquired, are practically certain of success when carefully and economically managed.

Give the prospector a fair show. Help him when you can, if you find him square, if it is only with an encouraging word. When he finds a good prospect, don't try to beat him out of it, but give him a fair chance so that if it proves good he will derive some benefit from his labor and exertions, and he will continue to look for and find new and now unknown mineral properties that will keep up and add to the mineral production, and he won't ask or need any government aid.

A Water-Actuated Sampler

By E. LE ROY

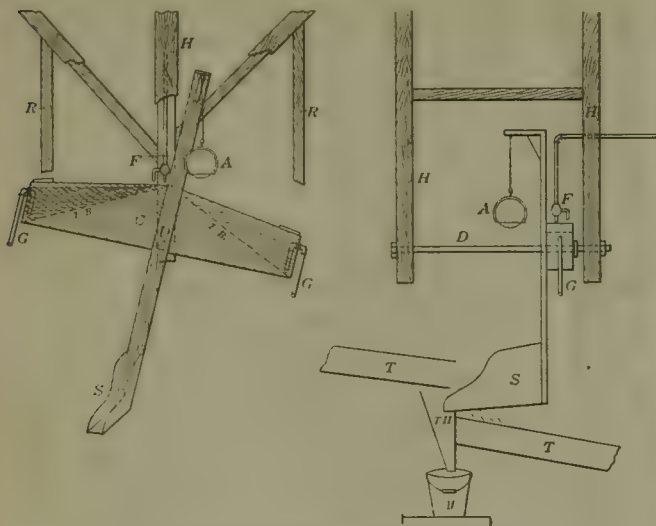
The accompanying rough sketch shows the essential features of a water-actuated automatic sampler, which can be easily constructed and installed in any mill. This sampler is superior to most samplers of the tilting-

reaches the level, it overcomes the gravity of the down side of the box plus the gravity of the swinging ball or weight *A*, and the box tilts until arrested by the buffer *R*. At the same time the scoop *S* cuts the flow of material in the launder *T*, depositing it in the sample pail *V*, or conveying it to any desired place. As soon as the box tilts, the siphon *G* quickly empties the lower end of its load; and as soon as the weight of water is sufficient, the operation is resumed in the other direction, again causing the sampling scoop *S* to cut the flow in *T*.

The pendulum is the only new feature, and, in my opinion, the important one. Without its use the sampler will start off very slowly and gradually increase in velocity until at the end of the oscillation it is traveling at a fair rate of speed. With the ball or weight always off centre and lending its weight each time to that of the load in the box *C*, it acts, as it were, as a governor and prevents the irregular motion usually seen in samplers without the weights. At the same time it effectually eliminates the possibility of the scoop coming to rest in the stream to be sampled, an occurrence which frequently happens with a sampler of the tilting-box type not provided with the swinging weight. A discarded Aldrich pump valve-ball makes a very good weight, but a piece of lead, a section of rail, or any scrap will answer. Of course, the weight will have to be adjusted as well as the length of supporting wire, to correspond with the weight of the sampler.

Eighty-four machine-drills were worked in the Champion Reef gold mine, India, during the past fiscal year. The cost of compressed air per drill, including system losses but exclusive of air used for blowing out after blasting and for ventilation, was \$533, and maintenance and renewals \$79 per year.

Iron ore output of over 10 districts of Spain was 10,100,000 tons in 1913.



WATER-ACTUATED AUTOMATIC SAMPLER.

box type because it is quick in its action and will not stop in the oscillation and flood the sample, owing to accumulated tailing or pulp adhering to the sides of scoop.

The sampler can be suspended by the supports *H* (see sketch) and balanced on the rod *D* which runs through the tilting-box *C* below the false bottom *FB*. The sampler is actuated by a small flow of water, regulated by the petcock *F*, which is connected by a small pipe to the mill-supply pipe or if preferred to a low-pressure main. When the water in the tilting-box



TENSION AND SUPPORTING TOWERS ON LONG SPAN CROSSING VALLEY.

An Aerial Tramway to Chinese Coal Mines

By C. A. TUPPER

With the practical completion of the Panama canal, and partly because of the changed conditions which this will bring about, the attention of mining men and of large industrial interests has been directed forcibly, of late, to the possibilities offered by the coalfields of China. That these are of tremendous extent has been known to geologists for many years past. From superficial but fairly comprehensive examination of outcroppings in provinces near the coast, some English and German authorities have arrived at the conclusion that the known deposits, both of anthracite and bituminous, exceed in value those of all other countries combined. While this may be, and probably is, an exaggeration, the fact remains that the beds cover, in the aggregate, a vast area. That the time is fast approaching when Chinese steam coal will become of immense economic importance to the shipping and manufacturing industries of the world at large is also apparent.

Until recently, this coal in limited quantities was recovered entirely in open-pit workings or from short, untimbered adits which were driven not to exceed 400 ft. into the hillsides. Such operations were, and in places still are, carried on without the use of machinery and entirely by coolie labor with crude implements and baskets. A good 'mine' produced about

36 tons per day and employed up to 60 men. Within the past few years, however, a number of modernly equipped properties have been opened up by German, English, and Chinese companies, as well as for the account of the Government, and facilities for an annual production somewhat in excess of 3,000,000 tons are now being utilized nearly to capacity. Prominent among the concerns operating are the Schantung Bergbau Gesellschaft, the Chinese Engineering & Mining Co., and the Hanyang syndicate or Hanyeh-Ping Iron & Coal Co., as representatives of the three nationalities principally concerned in developing the coalfields of the country.

It has remained, however, for an association of Chinese merchants, identified with the so-called 'salt monopoly' of Petchili, to undertake the most noteworthy and spectacular enterprise of this kind, that is, the building of a 15-mile aerial tramway, supported on steel towers, to provide for transporting coal from the native mines in the mountains west of Toli to the railroad station at that place for trans-shipment to Peking. The headquarters of this association, which for convenience will be called the Toli Syndicate, are at Tientsin.

While the members of the syndicate do not own or



FROM THE FOOTHILLS TO TOLI.

operate any mines, they have controlled from the first the marketing of a good grade of anthracite brought from the district mentioned, which was packed in on camels and donkeys for the entire distance. With the building of the first railroad south from Peking, however, a number of small mines were opened along the route, and the competition of this fuel shut off the supply from the Toli workings. Then came the construction of a branch line connecting Toli to the trunk road from Peking to Wuchang; and the project of bringing in coal from that district was revived. Packing the coal to Toli on the backs of animals would still make the price at Peking prohibitive, as compared with competing fuel; so the first idea was to extend the railroad line on into the mountains.

Preliminary estimates showed, however, that the expense would far exceed any returns to be expected from traffic, and the topography of the country made construction exceedingly difficult; hence it was suggested by the engineers called into consultation that an aerial tramway be built. This, after due consideration, was determined upon by the syndicate; and the entire planning and construction of the line was entrusted to Adolph Bleichert & Co., of Leipzig, Germany, a firm which specializes in this kind of work.

The tramway, as now completed and put in operation, was built in the form of an elongated Y, so as to tap the three principal centres of production. Starting from Toli, it traverses cultivated fields and terraces until the foothills are entered, about six miles out. There the first outcroppings of coal are crossed and a junction known as Tien-shan has been built. At this point the line divides, one branch finding its terminus five miles up in the mountains at Chin-Chiankon and the other four miles on the opposite side of the district at Hung-Mechan. The fields are, however, nearly contiguous; so that loading stations are placed at intervals between Tien-shan and the two outward termini. From the various mines, which number upward of 600, the coal is brought by pack animals or on coolies' backs to these stations, there weighed and recorded and then dumped into bins. These bins have hopper bottoms, from which the coal is drawn off directly to the buckets of the tramway, shunted in on an overhanging rail track for the purpose. When a bucket is loaded, the carriage from which it is suspended is simply shoved out onto the track cable, automatically couples to the traction cable, and is whirled away in the direction of Toli. At Toli the station contains large masonry bins for the coal, and cars are switched in underneath a loading spout. The line is designed to carry 50 tons per hour, or 1000 to 1200 tons for day and night operation.

For the entire traffic of the system 440 carriers, each unit consisting of a carriage and bucket, are at present in service. The loading stations being mainly at considerable elevations, the operation is largely by gravity; while the steep grades and long spans made it possible to obtain the capacity mentioned with a bucket speed of 8.2 ft. per second, except on the upper stretch of the Hung-Mechan line, where it was made approximately 5 ft. per second. The power generated by the loaded buckets coming down is ordinarily sufficient to carry the empties up; but any energy needed to prevent a stoppage of traffic, and also for breaking where necessary, is provided by six power-plants. There is one of 80 hp. at the Toli station for the first six-mile stretch, also 15, 13, and 6-hp. plants on the line to Chin-Chiankon and 25 and 15-hp. plants for the Hung-Mechan route. Each of these consists of a locomobile, the top of the boiler forming the baseplate of the engine, a very compact, easily transported unit for isolated service.

Thorough and easy control is maintained over the traffic. A tele-

phone line is strung along beneath the cables, and before the tramway is put in operation each morning, which takes place from above, all stations report to the dispatcher that the track is clear. As soon as this is understood, the traction cable is started up at reduced speed and a load sent from each of the upper termini. Then the loaded buckets follow one another from the different stations, with gradually increasing frequency and acceleration, until the line is loaded to its capacity and the velocity of travel has become normal.

With the tramway fully loaded, the operation proceeds almost automatically, except for the distribution of the traffic from the various stations, which is a matter of practice on the part of the attendants in starting the buckets between other down-coming loads. No care has to be given the buckets passing through loading stations, except at Tianshan, nor is any operator required at angle or tension stations. For all of these, where the carriages enter and depart, there are rail cross-overs, with terminal shoes or saddles so designed that the transit to and from the track cables is without any bumping or jarring. These shoes are also provided with hinged steel hoods, which save the cable joints from undue wear.

When the loads arrive at Toli the coal is automatically weighed, recorded, and dumped to the railroad bins. The 'empties' then pass around a loop, unless switched off by the attendant, automatically couple to the up-traction cable, and start on the return journey, to be taken off at stations along the route as needed. There are also special receptacles which can be sent up with supplies.

The carriage used with each bucket consists of two steel side plates, between which are mounted two wheels fitted with phosphor bronze pins and so designed that, as the upper surfaces become worn, they can be turned around underside up. The hanger pins are made of machinery steel. By an ingenious lever arrangement the weight of the load acts as the gripping force, which varies with the inclination of the cable. This construction possesses the advantage of being independent of any nice adjustment of the jaws, so that the grip automatically accommodates itself to irregularities in the wear of the traction rope. The mechanism operating the jaws is entirely enclosed within the main casting, and it is impervious to the elements, which makes it possible to operate the tramway under the severe weather conditions sometimes obtaining in the mountains west of Toli, including the occurrence of heavy sandstorms.

The types of supporting towers can be seen from the illustrations. These are of structural steel, light or heavy as the conditions along each stretch require, but of ample strength in every case to sustain the heaviest possible loading of the line and with large factors of safety. They were riveted together on the ground, then raised and secured to masonry or concrete foundations. The spacing of the towers was, of course, governed by the capacity of the line and the gradient at the various points. Where long spans were necessary, the usual precautions were taken.

The carrying or 'track' cables were carefully selected for strength and wear, being, for the heavier gradients, of the 'lock-coil' type. The traction cable is of equally good quality for the service required. In a line of this strength it was, naturally, necessary to apply tension to the track cables at suitable intervals, and special tension towers were erected for this purpose in addition to similar arrangements at the stations. The tension weights, suspended in slides, consist of steel cages filled with cut stone; and by adding or taking out these slabs the tension of the line can be varied to suit operating requirements.

The lubrication of the track cables is automatically effected by a traveling oiler. The special compound used is carried in a cylindrical



TYPES OF TOWERS.

tank, to which is attached a small rotary pump driven from the carriage wheels by a belt and gears, forcing the lubricant up through a small pipe to the cable at a point just under the middle of the carriage, so as to exert a spraying effect. There is also a special device for slushing the traction cable. This consists of a U-shaped receptacle containing the mixture used, which is suspended near one of the terminal guide sheaves. The rope passes over a small roller, which slushes it in the same manner as a ring oiler of a bearing, and brushes set just beyond in the receptacle wipe off the drip.

The construction of the line was carried out under

The engineer in charge was, however, a diplomat. Aided by letters from members of the syndicate, he established friendly relations with both the Manchu and Chinese nobles, placated the local magistrates, and through the influence of these classes succeeded in convincing the elders of the villages that no violence would be done to their customs or religion. On the other hand, he pointed out the benefits that would accrue to the district from the money paid for the coal, for labor and supplies, and he spent money liberally in demonstration of his claims. The priests and monks he won over to such an extent that the latter boarded the Europeans throughout the course of the



INTERIOR OF LOADING STATION.

much difficulty. Besides the obstacles interposed by the topography of the country, with lack of roads and bridges and the absence of any facilities for transporting materials beyond Toli, a plague broke out among the laborers and the erectors encountered violent opposition from the inhabitants of the districts traversed.

The chief objection of the natives arose from the threatened desecration of their ancestors' graves and also from the fact that men working on the tramway would be able to look down into the inclosed gardens where the women and girls were secluded. Furthermore, the priests and monks along the route discovered that the tramway would pass over or along their temples and monasteries, so that their opposition was added to the hue and cry against the 'foreign devils.'

work, giving them lodging in the hillside monasteries.

Besides the supervising engineer, there were six erecting men sent out from Leipsic. Work not done by them was performed by Chinese artisans recruited on the ground.

Progress was greatly aided by the fact that every piece of steel or other material sent out from Germany was in just the right shape to be put together. As each section of the tramway was completed between stations or any point where a terminal could be temporarily rigged up, it was utilized for transporting men and materials, much as a railway is pushed forward, and this also helped to solve many difficulties. The line is now in successful operation; and one of the results of its construction will be the development of the Toli coalfields along modern lines.

From the Capitalist's Viewpoint

By ADOLPH LEWISOHN

"In an address which I recently made to the graduates of the Columbia School of Mines, I gave my views regarding the mining industry of this country. I said that I considered mining enterprises, with the assistance and advice of the right mining engineers and experts, safer from a business standpoint than farming and industrial enterprises, and, therefore, I think it most important to give the young men the very best opportunity for a thorough education in the science of mining and metallurgy. The ore from which the results are obtained is already in the ground, and it is only a question of the time and the method of extracting same and producing the metal therefrom. Crops, on the other hand, have to be grown, and depend greatly upon the elements and many other conditions which are beyond our control.

In the business of mining, success depends largely upon the ability of the engineer or expert to determine correctly the grade and approximate quantity of ore that is in a given space in the mine, and the metallurgical treatment which will give the most satisfactory results. A farmer may have all the necessary knowledge and ability and yet may not be able to obtain good results under certain adverse conditions as above mentioned. The success of industrial enterprises depends greatly on the ability to procure the raw material from those who produce it and to manufacture it into the finished article at a price which will leave a profit. The raw material in a mine is supplied by nature. It does not have to grow as crops do, but is there ready to be taken out at any time, and the results depend greatly on the reliability

of the mining engineer or expert and his ability to correctly determine the quantity that can be extracted and at what cost. The market price of the metal may vary, but well trained, experienced men can form a fair judgment as to this. As a general rule, a mining enterprise that is able to produce the metal at not higher than the average cost of production should be able to compete with the other producers and be considered as good enough to enter the field of competition.

The capitalist must be able to form a judgment as to whether he can furnish the necessary capital, either himself or jointly with others, who will make the investment under his leadership. He, with the advice of the engineer or expert, must determine whether the enterprise is good enough and will likely turn out to be successful and profitable, and whether he is able and willing to furnish the necessary capital to bring the enterprise into successful operation. Much, therefore, depends upon the action of both the capitalist and the engineer. No business is more dependent upon accuracy than the mining business, and, while the mining expert must have some imagination, he must be able to tell exactly what is based upon actual knowledge and what represents merely imagination. He must tell plainly what he actually sees, and must have the knowledge to enable him to advise how to treat the ore and to figure the cost of treatment, so that the capitalist can judge whether it can be made a commercial success. Honesty and frankness are also absolutely essential. If the mining expert does not know, it is better for him to say so. With accurate information before him, the capitalist can do his part and by experience will be able to judge whether the enterprise can be carried out successfully. Under these conditions I consider that mining is a good and safe business.

*From *The New York Times Annalist*.

Smelting in Colorado

The Globe, Pueblo, Arkansas Valley, and Durango

Source of ores.	Dry tons.	Gold, oz.	Silver, oz.	Lead, lb.	Copper, lb.	Value.
British Columbia	6,079	320	203,569	553,412	43,347	\$ 159,060
*Colorado	599,584	290,248	7,749,527	71,537,256	6,852,992	14,799,152
Canada	5,960	252	2,945,375	13,320	64,810	1,776,093
California	991	54	43,455	633,379	.....	54,768
Idaho	66,202	54	2,230,718	62,414,047	150,377	4,084,767
Montana	6	.....	.....	1,065	.....	47
New Mexico	110	360	209	146	1,513	7,802
Nevada	32	19	1,626	27,272	.....	2,198
South Dakota	2,169	2,498	4,476	2,324	193	54,439
Utah	1,949	31	16,589	1,064,831	5,857	57,979
Total	683,082	293,836	13,194,944	136,247,052	7,119,089	\$20,996,305

*Including ores shipped to other plants of the Company outside of Colorado.

plants in Colorado of the American Smelting & Refining Co., treated ores with the following results in 1913:

Precipitating gold from cyanide solutions on zinc wafers was found to be a success by John S. MacArthur at Caveira, Portugal, but not on the Rand or at Waihi. Mr. MacArthur now thinks that precipitation is aided by the presence of mercury and lead in solution, the

former metal sometimes equaling the amount of silver in quantity, and the lead is generally only a fraction of the silver present. The precipitate tested by him contained 35% of mercury, which is recovered by distillation.

Discussion

Readers of the *MINING AND SCIENTIFIC PRESS* are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment. Selection of any contribution is determined by its probable interest to the readers of this journal.

California Miners and the Exposition

The article published in the *Mining and Scientific Press*, January 31, has caused so much interest that we take pleasure in printing a few of the numerous letters received by Mr. van Barneveld regarding the proposed state mining exhibit.—EDITOR.

Sir—I have read the article in the *Mining and Scientific Press*, outlining the plan for the mining industry of California, with much interest. It seems to me that if this plan can be adequately carried out it will insure a most interesting and instructive exhibit which would be of material advantage to the state and to the mining industry. I will be very glad to do what I can to make this plan a success, and will be glad to have you advise me further as to the practical means that may be decided on to put this plan in operation.

G. W. METCALFE.

Sir—Your conception of the purpose and object of the exposition meets with my full approval, and I also agree with your idea that the mining industry, and particularly the industry of this state, should make an exhibit which will command widespread attention. There can be no doubt that a comprehensive, well arranged, and coördinated state exhibit will represent the importance of mining in California far better than a series of detached and unrelated county exhibits. I see no other way of properly emphasizing the importance and size of the oil and mineral resources of California, except by means of such a state exhibit. The construction, as you suggest, of a model mountain illustrating methods of mining and methods of oil production will make a very interesting and imposing centre exhibit in the mining building, and I think it is proper that the name of California should be associated with such an exhibit, because of California's position as a gold and oil-producing state.

S. W. MUDD.

Sir—Everywhere we hear that money is scarce, but as every little thing helps by joining the efforts and good will of all the miners and mining men and mining engineers interested in placer mining, I believe the proposed plan will answer the purpose and fix a date in the placer mining industry. This plan does not prevent each individual, each county, having an individual exhibit if desired, but individual exhibit or county exhibit will not impress the public, which when visiting the exposition has no time for details and needs the essence. In the mining industry California has a unique situation, and there is no other place on

earth where so many and varied mining methods can be applied, and the grouping of them in few separate units which can be seen at once is certainly going to bring success.

PIERRE BOUERY.

Sir—I read with much interest your article, 'California Miners and the Exposition,' in the *Mining and Scientific Press* of January 31. I fully agree with you, "the proper place for California's mining and oil exhibit is unquestionably the Palace of Mines and Metallurgy," not in separate county exhibits where there probably would be many duplications. Moreover, by reason of lack of funds, or limited variety in mineral product or both, it would be impracticable for counties to make a comprehensive well worked out and interesting mineral exhibit. I commend your plan, and shall be pleased to assist you in any reasonable manner.

HAROLD T. POWER.

Sir—Your idea of centralizing the mining exhibit, as outlined in the *Mining and Scientific Press*, January 31, appeals to me as being a very excellent one. It is unfortunate that no funds have been provided for a state exhibit, but it would seem, therefore, that the individual counties would be more justified in assisting in the financing of such an exhibit out of exposition funds which they are raising by taxation. I believe, if the matter were sufficiently strongly brought to the attention of the counties, that something could be done in the direction indicated.

JOHN B. KEATING.

A Blacksmith's Problem

The Editor:

Sir—The blacksmith here at the mine is having considerable trouble in making his steel stand the rock, which is a diorite containing much feldspar and rather hard quartz. He is also having trouble with his picks. Could you tell me what temper he should give them, and what he should put in the water?

W. S. DOOLEY.

Adin, California, January 24.

Doubting whether any general rule could be laid down to cover such a case, we referred this inquiry to T. H. Proske, whose long experience enables him to speak with authority. Mr. Proske has sent us the following.—EDITOR.

The Editor:

Sir—Your letter of January 30 came to hand several days ago, but I was so busy that I did not have time to answer it promptly, and trust that you will pardon my neglect in this matter. Referring to the letter of Mr. Dooley's, I will say that his situation reminds me of the story of a young lady who was telling a friend of hers how to make a young man propose. Her advice was "to brighten up the parlor, have a nice fire in the grate, dress herself up real neat and tidy, have the light turned low, and when the young

man arrives escort him to the sofa, sit down beside him and if he didn't 'pop' pretty soon, it was time to change the man on the sofa." My opinion is that it is time for Mr. Dooley to change the man on the sofa. If he is a man that knows his business, he will demand good clean coal, good clean soft water, and a good grade of steel, then he will solve the problem of making his steel stand up to the work it has to do. If he is not capable of doing this he is a costly luxury to Mr. Dooley.

I remember an experience I had at one time at the Granite mine at Cripple Creek. I had several brands of steel, and it took some time to get them separated and to learn the proper heat for tempering each. During this time I experienced some trouble in getting the various kinds of steel to stand up, but once I had it all separated and marked, I had no trouble. One day a new lot of steel without any brand on it came in. The shipper advised that it was a certain brand and grade. As the steel was made up but not tempered, it was up to me to temper it for the first time. Acting on the advice I had as to the brand and grade, I proceeded to temper the steel, and every piece came back to the shop broken. The superintendent was furious, but I told him to keep his temper, that I had been lied to about the brand and grade, and assured him that I would make this steel stand up if it were possible. If not, I advised that it would be best to return it. Exercising some care the second time and tempering at a lower heat, I made a success at once. None of the steels broke and only one or two were soft.

No fixed system can be worked out to temper the various brands and grades of steel. What is best for one grade or brand will not do at all for another: a heat of a certain degree will harden the bit just right for one steel, make it too hard for another, and not hard enough for another. It is safest to stick to one grade and brand, then put it up to the blacksmith to temper it right. It is not best to change steel every time the blacksmith is changed, but insist on the blacksmith changing himself to the steel. If he is not flexible enough for this he is not a good man.

T. H. PROSKE.

Denver, Colorado, February 10.

Ore

The Editor:

Sir—The differentiation between the terms 'ore' and 'waste,' in the mining sense, deals with so many variable factors that it is a very nice balance applying to each mine under its particular conditions, but admitting of little or no generalization; in fact, it is thoroughly recognized in the old established districts that the waste of today is the ore of tomorrow. The definition that could be made so elastic as to cover a rock or mineral aggregate that was ore under one set of conditions and waste under another, would be too cumbersome to be useful. Then, too, it is extremely improbable that the miner can be educated to any

such refinement of language as is contemplated by some of the individuals who are contributing to this discussion.

Extending the matter of correct diction and terminology to radium-bearing rock, it becomes still further complicated, and it suggests another phase of the same question. This in relation to the random use of the words 'radium' and 'radium ores' to designate rock which carries the newly discovered rare element in quantity which is infinitesimal. When one stops to consider that a gold ore comes correctly under the term even though it may have an assay value not to exceed \$2 per ton; and further, that this quantity would represent approximately one-tenth of one ounce per ton of rock, or one-two hundred and ninety thousandth part by weight in the proportion of gold to rock and its mineral components, the use of the word 'gold' begins to be out of all proportion to the quantity factor. The same applies to silver. But when this is applied to the radium content in ore which is radium-bearing, the proportion in Ra/U_r equals, for the carnotite ore, 2.34×10^{-7} , and for the pitchblende ore 3.21×10^{-7} . With uranium itself occurring in very small proportion, the lower grades of both ores is by weight between a three and four hundred millionth part of the weight of the rock mass.

It is unfortunate that the word radium has been so freely used in the designation of low-grade uranium ores slightly radio-active, and unless some reform is brought about, the words radium ore will cease to have any meaning and will become the sport of the dishonest promoter. Already it is evident that many broken-down promoters are getting into the field with the avowed intention of profiting by the interest which has been aroused by the threat of Congressional withdrawal of radium-bearing lands in public domain, and to a lesser extent in publicity that has been given to healing properties in therapeutic uses as applied to the dreaded disease cancer. Some of us are watching with much interest the outcome of the dealings of the miner with the United States Government, where the miner takes up land in what is known as the radium-bearing areas in Colorado, and are wondering whether the Government agent knows what he has to deal with when he deals with the miner. The difficulties of checking on lots of ore, in transactions between buyer and seller, in dealing in carnotite ores from the southwestern part of Colorado, are only beginning to be known, and they are serious. What they will be when it comes to dealing with the individual miner on what the Mining Bureau calls a "reasonable basis," can only be surmised.

To people interested in the production of ores low in uranium and infinitesimally lower in the radium content it is already apparent that the effect of the activities in the field is to create artificially high value for lands, with a corresponding tendency to higher prices for the salts of radium; and on the other hand the federal authorities are getting ready to investigate

anything that savors of fraudulent misrepresentation of the facts when it comes to circularizing mine reports or putting out the inevitable prospectus. Developments through the next year will be interesting.

FORBES RICKARD.

Denver, Colorado, February 12.

Agitation at the Nevada Hills

The Editor:

Sir—I have read with interest Alfred James' annual review of the cyanide process and have gained valuable information from it. Mr. James has, however, made some deductions from published costs which are incorrect, due, I presume, to the fact that he is not familiar with the conditions under which the costs are made. For example, Mr. James compares the Nevada Hills agitation cost of \$0.85 with the three cent cost of the Hollinger and leaves the impression that the interrupted wash or change of solution during agitation, practised at the Nevada Hills, is responsible for the difference. This conclusion is not warranted by the facts, and I hope to show: first, that the change of solution is of very slight cost; second, that the Nevada Hills agitation costs are not unduly high.

As to the change of solution: this is accomplished in a Dorr thickener and is a mechanical operation precisely similar to that of counter-current decantation or continuous decantation, as it is called in the Nevada Hills cost sheet, except that one tank is used instead of three. Since the cost of decantation is given as three cents, it seems reasonable to assume that the cost of the change of solution is about one cent and could not possibly be responsible for the wide difference in question.

There are two reasons why the agitation cost at the Nevada Hills is high as compared with the Hollinger cost. The principal one is that all chemicals used in dissolving at the Nevada Hills are charged to agitation, so that the itemized cost for the month quoted reads as follows:

Labor	\$0.105
Cyanide	0.436
Lime	0.116
Lead acetate	0.065
General superintendence	0.038
Power	0.062
Total	\$0.822

From this it is plain that \$0.617 in chemicals alone may be deducted from the Nevada Hills agitation cost. Furthermore, the period of agitation is about forty-eight hours at the Nevada Hills, while I believe it is but five or six at the Hollinger. If this is the case, agitation costs about the same per hour at each of these mills. While the subject of the interrupted agitation is under discussion, it may be of interest to note that its effect, though difficult to determine exactly, was good, as evidenced by the fact that solutions from the first agitators after the decanting tank show a more

rapid rise in the solution values than in those before it. Also during a period when the decanter was not in use, the tailing was consistently higher than that obtained during its use.

L. B. EAMES.

Goldfield, Nevada, January 28.

Sulphide Enrichment

The Editor:

Sir—In a recent article in *Economic Geology*, Vol. VIII, p. 621, A. C. Spencer treats the chemistry of chalcocitization comprehensively. Discussing the statement of D. C. Bard, relating to the behavior of metallic sulphate solutions on calcite gangue, he cites one of his experiments in which cupric and ferrous sulphates were brought in contact with calcite, and states that calcite does not precipitate copper from such a solution. C. F. Tolman, in a recent number of the *Mining and Scientific Press*, apparently supports Mr. Spencer. Further, he doubts Mr. Bard's conclusions, for, according to his knowledge, there are many secondary enriched sulphide orebodies in limestone. Incidental to some other experiments on sulphide enrichment, I placed some ground calcite in a test tube and added some cupric and ferrous sulphate solutions of about tenth normal strength. At the end of fifteen hours iron and copper were precipitated. In the filtrate some ferrous iron was found, but no copper. I have come, therefore, to confirm Mr. Bard's conclusions. Upon the examination of the chalcopyrite and pyrite crystals placed in the same solution, distinct color changes were noted. The coating on the chalcopyrite resembled bornite and that on the pyrite, chalcopyrite. The coating was dissolved in hot hydrochloric acid, and tested for iron and copper. It showed the presence of some iron, but no traces of copper. I still hope to get some copper coating, which may take place much later than that of iron.

GEO. NISHIHARA.

University of Minnesota, February 12.

The Canadian Klondyke Mining Co. has two 16-in. ft. dredges near Dawson, and the following are sizes of various parts of the machinery on one:

Hull:	
Length, feet	136
Beam, feet (including 6-ft. overhang).....	62½
Depth of hull, feet	12 to 14½
Digging ladder, length, feet	98
Weight, tons	108
Lower tumbler, tons	13
Upper tumbler, tons	24
Number of buckets	68
Weight of buckets, pounds each.....	4,700
Capacity, cubic feet	16
Screen, feet	9¾ by 50
Stacker with 48-in. belt, length, feet.....	115
Centrifugal pumps used, inches	14 and 16
Total motor power	1,100
Weight of dredge complete, tons	1,100
Cost of dredge	\$475,000

Concentrates

Most of these are in reply to questions received by mail. Our readers are invited to ask questions and give information dealing with the practice of mining, milling and smelting.

Of 2,113,080 tons of ore mined by the Utah Copper Co. during the last quarter of 1913, 91% was recovered by steam-shovels and 9% from underground work.

A dry-crushing ball-mill will discharge 20.07% on 40 mesh, as compared with 9.3% with rolls, under certain conditions and with a 22-mesh screen, according to E. H. Johnson.

Cost of development at the Nevada Hills mine, Fairview, Nevada, in 1913 was as follows: driving and cross-cutting, \$6.09; raising, \$4.94; sinking winzes, \$10.77; shaft-sinking, \$62.04; and core-drilling, \$2.58 per foot.

Transmission lines should not be stretched too tight. In December 1913 the Oriental Consolidated company, operating mines and mills in Korea, had considerable trouble through the breakage of its power wires. These were stretched too tight and broke in cold weather, necessitating slackening them in 52 places.

The transportation of black powder in metallic kegs in cars hauled by a trolley locomotive has caused more than one serious accident, the powder being ignited by a spark made from the passage of an electric current. It is bad practice to take powder and men into the mine together, or to use a trolley motor to haul a car containing powder.

Comparative tests have shown that the maximum efficiency of a centrifugal pump is attained with a lift of from 15 to 20 ft. With plunger pumps a similar efficiency is not reached until the lift is from 35 to 40 ft. After the maximum efficiency has been reached, the subsequent efficiency in the case of the centrifugal decreases with every increase of lift, whereas the efficiency of the plunger type of pump increases uniformly with the lift.

No classifying apparatus, which depends primarily on gravitational settlement for satisfactory operation, can be expected to work efficiently when the feed supply is not absolutely steady and uniform. Pulsations are often due to the operation of the pump conveying the pulp; and in the case where wet crushing is followed by sliming, it is always advisable to avoid pulp elevation as much as possible until after fine grinding is completed. Pulsations are then avoided in the classifiers, the pulp passing direct to them from the batteries. If this method is adopted there is an additional advantage accruing from the fact that wear and tear on elevating machinery is generally much less after the ore has been reground than before.

Cementing diamond-drill holes is frequently necessary. Ordinary portland cement requires from four to five days to set, and to avoid this loss of time or the expense and delay of moving the drill to another hole, rapid setting cement is sometimes used, which will permit the resumption of drilling 24 hours after the hole has been cemented. This cement, however, is so weak that it will not hold up ground which caves badly. A suitable mixture for cementing holes, which has been tried and found to possess both the advantages of strength and rapidity of setting, may be obtained by adding soda to the cement in the proportion of 1 lb. soda, 3 sacks cement, and 50 gal. water. This will set in 24 to 36 hours and will be as strong as any neat cement.

Quick hoisting is characteristic of the small lead and zinc mines of the Mississippi Valley. It is customary to hoist in buckets, or 'cans,' as they are locally termed, working without cross-heads, and occasionally even without exchange of signals between the 'histerman' at the top and the 'hooker' at the bottom. The hoist is set in the head-frame close to the trap-door through which the bucket comes. The engineer controls his engine with one hand, and with the other opens and closes the trap, hooks and unhooks the tail rope, dumps the bucket, and guides it back to the shaft. Working in this fashion, 1035 cans, weighing 1000 lb., have been hoisted from a depth of 275 ft. in an 8-hour shift, using a small first-motion steam-engine. With an electric hoist at the Diplomat mine, in the Joplin district, 1031 buckets were hoisted in a 9-hour shift from a depth of 200 ft. At this mine 5848 buckets were hoisted in 6 shifts.

Concreting stamp dies in a mortar-box has been done with satisfactory results by Chester L. Proebstel, of Yreka, California, during the past 18 months. The die is first placed on the ordinary cushion of sand and then a concrete of 40% portland cement and 60% clean quartz sand is used, filling the space around the dies up to the under side of the chuck-block. The concrete is put in medium wet, well tamped, and allowed to set for several days. This will probably seem to be a loss of time, but is about equaled by the increased capacity and time saved in cleaning-up during the life of the die. As the die wears away, the concrete also wears, and at about the same rate. No difficulty is experienced in removing the worn out dies, as the concrete is practically gone at the same time. The wear of the concrete when properly put in is fairly uniform, and cones toward the centre of the die, thus tending to throw all pulp on to the die with each return splash. There are several advantages to be gained in this arrangement: (1) better inside amalgamation is insured, as all loose amalgam and quicksilver is kept up near the inside plates; (2) during a clean-up the amount of battery sand is small; (3) dies are not removed at monthly or semi-monthly clean-ups; and (4) there is no danger of dies bouncing or moving.

Special Correspondence

GUADALAJARA, JALISCO

SCARCITY OF SILVER COIN IN MEXICO.—BANKING AND HARDSHIPS OF MINING COMPANIES.—EXPORTS OF ORE AND CONCENTRATE.—CINCO MINAS AND EL FAVOR.

The Mexican government is now coining large quantities of *listones* (50-centavo pieces) in an effort to relieve the difficult situation that has resulted from the hoarding of silver and the consequent shortage of coin for business operations. A call was made on the Sociedad Afnadora de Metales, the French refining concern of Mexico City, for 4 tons of silver per day for a period of 50 days, but as the silver bullion shipped to Mexico City amounts to only 2½ tons per

product of the Real del Monte Co. of Pachuca, a subsidiary of the United States Smelting, Refining & Mining Co., and at present the largest producer of silver in Mexico.

A number of mining companies have funds tied up in the Bank of London & Mexico, which is paying no more than \$200 weekly on each checking account at its main bank and branches, and have been forced to provide additional funds for new accounts in other banks. It is reported that some of the larger companies received information that the bank planned to restrict payments shortly before it closed temporarily, and it is said that the El Oro Mining & Railway Co. drew out \$250,000 in one check. It is understood that the negotiations with London bankers for a loan of £800,000 for the Bank of London & Mexico have fallen through. Officials of the finance department have held conferences with representatives of mining companies, in connection with plans for reforming the present mining law so as to facilitate the exportation of ores and mill products ordinarily handled by



GUERRERO MILL OF THE REAL DEL MONTE Y PACHUCA COMPANY.

This plant has a capacity of 300 tons per day and cost \$800,000. It consists of 40 stamps crushing through 4-mesh screens, 8 Evans-Waddell Chilean mills, Wilfley and Johnston tables, Dorr classifiers, Abbé tube-mills, Callow cones, agitation apparatus for slime, a decantation and Butters filter plant, and precipitation on zinc shaving. The Loreto mill, operated by this Company, has a capacity of 300 tons per day. It consists of jaw-crushers, 14 Chilean mills crushing through 40-mesh screen, also 40 stamps, Wilfley and Johnston tables, Dorr classifiers, Abbé and Krupp tube-mills, agitation of slime with cyanide, decantation and Butters filter plant. Costs at the mills are from \$8 to \$10 per ton. Power is supplied at \$96 per horse-power year.

day, the Sociedad Afnadora has been unable to fill completely the government's order. The silver is being purchased at a rate of \$50 per kilogram. The government has agreed to deliver to the companies supplying the silver \$85,000 in 50-centavo pieces weekly, this amount being more than sufficient for payroll requirements. For some time mining companies in many states have been forced to pay premiums for silver coin needed for their payrolls, and in some instances much difficulty has been experienced in securing adequate supplies. The companies shipping to Mexico City at first arranged to deliver a certain amount of silver and receive the equivalent in silver coin, less expenses of assaying and coining, but later the government decided to purchase the bullion through the Sociedad Afnadora, and that concern will pay for it in foreign drafts. Of the 2½ tons of silver daily marketed through the Sociedad Afnadora, 1 ton is the

the smelters of the country. The plans are due to the fact that the majority of the smelters have been forced to close. Export shipments of ore now are being made through Vera Cruz by concerns operating in Oaxaca and the state of Mexico, and the Amparo Mining Co., a Jalisco concern, is shipping its concentrate through Manzanillo to the Selby smelter in California.

The big reduction plant of the Cinco Minas Co., of New York, at the Cinco Minas, in the Hostotipaquillo district of Jalisco, has been placed in commission, and the 30 stamps are dropping steadily. It is expected that the mill soon will be handling 300 short tons of ore per day. A large tonnage of ore is already blocked out in the mine, and extensive development is being resumed. The Cinco Minas mill was built under the direction of Godfrey D. Doveton, who died recently in Guadalajara as the result of injuries received

at Cusco Minas when his right arm was caught in a belt-conveyor and terribly torn. The addition to the El Favor mill in the Hostotipaquillo district, consisting of 15 stamps, 2 600-mills concentrators, and cyanide annex, is in operation treating principally ore from the Moloboa mine, which, like El Favor, is a Makeover property. In the original El Favor 20-stamp mill an increased tonnage of El Favor ores now is being handled, and the Company is doing some custom work. The acceptance of custom ores is promoting development in the Hostotipaquillo district. Construction work on the reduction plant at the Casados mine in that district is nearing completion, and it is expected to have the plant in readiness for operation by next May. From 75 to 100 tons will be handled daily. In a small experimental plant now in operation at the Casados, an extraction of 85% is being obtained. Shipments of high-grade ore from Casados continue at the rate of two carloads per month.

LONDON

ARGUMENT IN FLOTATION PROCESSES, AND COMPOSITION OF THE COURT.—ENGLISH INTERESTS IN ONTARIO, AND NEW COMPANIES.

As I mentioned in December, the flotation appeal to the Judicial Committee of the Privy Council was ordered to be reheard before a fuller court. The whole of the week ended January 31 was occupied by this rehearing, and judgment has been reserved. It will be remembered that the appeal was lodged by Elmore against the judgment of the New South Wales court, which held that the Minerals Separation process, as used by the Sulphide Corporation at Broken Hill, was not an infringement of the Elmore acid patent of 1901. The court that heard the appeal in December was composed of Lords Dunedin, Moulton, and Shaw, and as I pointed out at the time, the last two had sat on the English case. Whatever the reason, the Lord Chancellor ordered a re-argument before five judges, and the court consisted of the Lord Chancellor and Lords Parker, Sumner, Parmoor, and Dunedin. It will be noted that Lords Shaw and Moulton retired from the case. Of these five judges, the Lord Chancellor, otherwise Lord Haldane, is a lawyer of unusually wide interests, from education to the army. His quick trip to America and back is sufficiently recent for readers to remember it. Parker and Sumner are judges that have much to do with patent law, and, curiously enough, before they were elevated to the bench, had been engaged as counsel in flotation litigation, though not in connection with the validity of patents. Parmoor used to be Sir Alfred Cripps. All these judges are men of high attainments, who have won their way by their abilities, not pitchforked into their positions for political services rendered to their parties. Altogether it is a notable court, though naturally no individual member knows anything about ore dressing. But as Sir Joseph Porter used to say in the opera: "It is one of the glories of this great and happy country that the judges never know anything about the matter in hand." In this way they differ from the editors of technical papers. Nevertheless, this court has a shrewd idea that Elmore was the first to mention the function of acid in assisting the selective action of oil for metallic surfaces. It would not surprise me if they reversed the Australian judgment.

At the present time, Canadian ore deposits are receiving a large share of attention among London speculators. The two Cobalt companies controlled in London by Rose & Van Cutsem, and in Canada by Parker and Watson, namely, the Cobalt Townsite and Casey Cobalt, are doing so well that English investors are for the first time feeling that they are getting something from Cobalt. Interest in Porcupine has mostly disappeared. There is a boom at present in connection with Kirkland Lake properties. A great quantity of advertisements are being circulated by the Kirkland Lake

Proprietary, which is run by H. G. Latilla, hitherto connected chiefly with Rhodesia, where he worked in conjunction with Sir Abe Bailey. One of the weekly papers made an onslaught on Mr. Latilla and his new promotion, alleging that all the companies in his office were bogus ones. This was a serious accusation, but Mr. Latilla has passed it by with a pleasant account of the large amount of business his companies have done. The Kirkland Lake Proprietary will form a subsidiary company to acquire the Tough-Oakes property, directly Clement Foster arrives in this country with the necessary deeds. The Company has also bought or has options on the whole of the capital of the Sylvanite, and has a similar option on 64% of the Teck-Hughes. In addition, it has options on 51% of the Burnside claims and 78% on the Gull Lake. The report by H. H. Johnson on the Kirkland Lake district is not immune from criticism from the technological point of view. In many quarters this promotion is not popular. Nevertheless, I ought to say that a financial group of excellent standing, L. Ehrlich & Co., taking their advice from an eminent geologist who has visited the district, has become enthusiastic.

Another company is the Kirkland Lake Exploration, formed by the Anglo-Spanish Trust. The latter Company is a private enterprise, and its constitution and objects are unknown, except to those who have time to search the records at Somerset House and elsewhere. The promoters appear to be a firm of stockbrokers, Wheeler, Cornwallis West & Co., of Pinner's Hall. The prospectus as advertised asks for £50,000 cash wherewith to explore and hunt for mines. Particular interest attaches to this promotion because F. H. Hatch, the eminent geologist, is on the board of directors and was advertised as having a call on shares. Naturally, mining engineers objected to Mr. Hatch becoming associated with Stock Exchange gambles in this way, and a few days after the issue of the prospectus he publicly renounced his call, and was appointed to the position of consulting engineer to the Company. He has left for Kirkland Lake, and no doubt his geological knowledge will be of immense value, not necessarily to the Company, but to the world at large.

VICTORIA, BRITISH COLUMBIA

PORTLAND CANAL DISTRICT, WORK OF THE TUNNEL COMPANY, AND PROSPECTS OF OTHER PROPERTIES.—LILLOOET DISTRICT.—CORONATION AND WHY NOT COMPANIES.

The latest reports from the Portland Canal district state that the long cross-cut adit, which the Portland Canal Tunnels Co., Ltd., has been driving for the past year, to prove whether the orebodies on the Glacier creek and Portland Canal groups of claims maintain their continuity to any great depths, has been driven 2830 ft., and has passed through two crushed zones, in each of which a little ore was found. Driving on both of these zones has been carried on for a while, resulting, it is now said, in exposing a body of better grade ore, but only about 6 in. thick. This is in the Glacier Creek group and at a vertical depth below the old workings on that property about 2000 ft. At the present time this is the only work being done in the Portland Canal district. The other companies, of which there were 12 or 15 working in 1910, have suspended operations, apparently waiting for the results of the Tunnel company. W. J. Elmendorf, formerly of Spokane, is the manager for the company, and it is on his advice that this long adit has been driven. In 1910 there was such a boom in this district that mining stocks of some of the companies were selling readily on the local exchanges at above par; but the results from operations during that and the succeeding years have been so disappointing that naturally the stocks have slumped. It is predicted that if further driving continues to develop orebodies of commercial grade, the camp will revive and probably another boom occur.

During the present winter, work has been carried on by the Coronation Mining Co., on Cadwallader creek, and the Why Not Syndicate, on Bridge river, in the Lillooet district. The former Company has been sinking on the Little Joe claim, below the No. 4 level, and at last reports had reached a depth of about 60 ft., having followed profitable ore all the way. This winze was started near the western end of the shoot in the Little Joe vein, the length of which pay-shoot on the No. 4 and upper levels has ranged from about 350 ft. to nearly 700 ft., the greatest length being found on the No. 1 and 2 levels. A pump is now being installed, and the Company proposes to continue sinking as deep as can be handled with windlass, then drive east along the vein. I am informed that, should the development work prove as satisfactory as it promises to, from the results obtained from assays of the ore taken from the winze, machinery will be installed to do deeper development on a systematic plan. Last year the ore milled from the vein between No. 3 and 4 levels averaged about \$33 per ton in free gold, and the concentrate saved by blankets averaged 4% and contained \$150 per ton. The Why Not Syndicate has been driving on the main orebody, the drift being now in 180 ft. Cross-cutting from the end of this drift has been started, in the expectation of cutting another orebody, which shows outcrops paralleling the vein



SURFACE VIEW OF LITTLE JOE CLAIM.

on which the drift has been run. If the gold content in the main vein averages not less than \$8 per ton, operations can be carried on profitably on this property, as the facilities for mining, transporting the ore to the millsite, and milling with water power are extremely favorable for working at a minimum cost. The other properties on Cadwallader creek and Bridge river, although idle during the present winter, will be actively worked during the summer. In fact, it is expected that operations will be resumed on the Pioneer and Lorne groups of claims, early in the spring. In this district the snow is usually all off early in April.

The Copper River coalfields are situated on the Copper river, west of the Bulkley valley, about 30 miles from the new town of Smithers on the Grand Trunk Pacific railroad. Recently the firm of Aldous & Murray, Limited, of Vancouver, secured an option on the coalfields, and shipped a diamond-drill, with other machinery and supplies, to the property. It is reported that a wagon-road has just been constructed to connect this property with Smithers, about 30 miles distant. This machinery will be transported over it at an early date, and drilling operations begun to test at depth the various seams of coal that underlie these fields, which are reported to cover 16,000 acres. There are said to be six seams of coal on the property, and the main one is said to average 12,500

tons per acre. The owners of this coalfield are the National Finance Co., of Vancouver, and it is from that Company that Aldous & Murray have secured an option, but in whose interests is not yet known, although because of the close connection between that firm and the Grand Trunk Pacific railroad, it is considered likely that they are acting for the railroad company. This, however, is only a conjecture caused from the fact that Aldous & Murray have been right-of-way agents for the railway, and they now have the exclusive sale of the Grand Trunk Pacific townsite of Smithers.

NEW YORK

FINANCING BRITISH COLUMBIA COPPER, BRADEN COPPER, INTERNATIONAL SMELTING & REFINING, AND INTERNATIONAL AGRICULTURAL CHEMICAL COMPANIES.—AMERICAN INSTITUTE OF MINING ENGINEERS MEET.

The improved state of the money market is already beginning to exhibit itself in new financing of mining companies already under way, or merely proposed. I have already referred to the proposals for Inspiration and British Columbia. The full details of the British Columbia plan have now been given out and involve the creation of a new company, the Canadian Copper Corporation, Ltd., with an authorized capital of \$5,000,000 in \$5 shares, and with \$1,000,000 in 10 year 6% convertible bonds. Hayden, Stone & Co. have underwritten \$600,000 of the bond issue, and such is the magic of a name that when this fact was announced British Columbia shares made a sharp advance. The debentures will carry with them *pro rata* stock in the Company, and Hayden, Stone also have an option on the remaining \$400,000 in debentures and 200,000 shares. This entire scheme depends on the exchange of over 51% of the stock of the British Columbia Copper Co. before March 15.

The rumors that have been current for many months that Braden would have to do some new financing are taking more definite form. Braden has an authorized bond issue totaling \$8,000,000, divided into \$4,000,000 6% first collateral trusts, all outstanding, \$2,000,000 7% second collateral trusts, \$1,000,000 outstanding, and \$2,000,000 7% three year convertible debentures, all outstanding. Authorized stock issue totals \$14,000,000 of which \$6,000,000 is outstanding, \$7,000,000 is held in the treasury against the conversion of bonds, and \$1,000,000 held in reserve against the \$1,000,000 remainder of the second lien 7's, authorized but unissued. The earnings of the Company are now substantially in excess of its present bond charges. No definite statement as to what form the new financing will take has yet been made. Another company which is expected to do some new financing is the International Smelting & Refining Co., which has undertaken to build the smelter at Miami to treat the Inspiration and Miami concentration. Although not exactly a mining company, the International Agricultural Chemical Co. has a good deal of interest from a mining standpoint, since its raw materials are largely the product of mining or smelting. The Company has been carrying a floating debt of \$4,825,000 representing its growth and expansion in the past two years. This will be taken care of by a new issue of 5% debentures. The first mortgage 5% issue of 1928 under which two separate pieces of financing have already been accomplished has now been closed and no prior obligations can be put ahead of the new \$7,000,000 bonds. With this financing, American Agricultural will have \$17,000,000 bonds, \$27,000,000 preferred, and \$18,330,000 common; or \$45,000,000 of stock paying dividends as an equity behind its bonds.

Details of the earlier sessions of the American Institute meeting held in this city last week are given on another page. The sessions of Wednesday and Thursday, however, were no less interesting.

The number of papers to be presented was so great that it

was necessary to hold simultaneous sessions in adjoining rooms. In one room the papers on mining law were the topic for discussion. H. V. Winchell was to have presided over this session, but was unable to arrive in time because of a late train, and J. A. Holmes presided. The first paper was 'The Disposition of Natural Resources,' by G. O. Smith, presented in abstract by the author. Dr. Raymond announced that he had submitted discussion of this for publication, but brought out a few important facts. The next paper was 'Should the Apex Law be Now Repealed,' by C. H. Shamel, which was read in abstract in the absence of the author. This was vigorously criticised by Dr. Raymond, who pointed out that the law of 1872 was not the outgrowth of "monumental custom," but was rather the product of a few years of local experience, and ridiculed the method of determining the amount of litigation caused by the apex law used by Mr. Shamel, since a suit which directly arose from an apex question might be attacked and defended on twenty different technical points, though the apex question was the sole originating cause, illustrating his argument by actual cases. But he chiefly objected to the proposal to have questions of fact decided by the U. S. Geological Survey, and not subject to review by the courts. Thomas J. Walsh, U. S. Senator from Montana and chairman of the Senate Committee on Mines and Mining, argued in a similar vein; citing cases from his experience in Montana. This led naturally up to the next paper, 'The Apex Law in the Drumblummon Controversy,' by C. W. Goodale, appearing on another page, which was read in abstract in the absence of the author. The account of the famous controversy was supplemented by Dr. Raymond, who was connected with the case in the beginning, and by Senator Walsh, who was one of the attorneys in its concluding stages twenty years later. M. K. Rodgers told of some of the difficulties of the apex law according to his wide experience and stated that he would advise a client to invest in property in Canada or Mexico, rather than in the United States, since revolutions in Mexico only damaged a property, whereas in the United States it might be lost altogether. He also told of the admirable foresight of a Swede whose claims in Alaska fairly bristled with stakes. When asked why his claim appeared to have been 'jumped' so often, he replied, "I yump him myself every six weeks."

Next a paper on 'Classification of the Public Lands' was presented in oral abstract by George Otis Smith. An article by F. F. Sharpless on the 'Segregation and Classification of the Natural Resources of the Public Domain' was passed over, in the absence of the author. A paper on 'The Initiation of Title to Mineral Land,' by Albert Burch was read by G. O. Smith, and another on 'Good Ideas in the Mining Laws of British Columbia and Mexico,' by F. L. Sizer was read by T. T. Read. At the afternoon session, H. V. Winchell presided and read his paper, 'Why the Mining Laws Should be Revised.' This was followed by 'Mining Law Revision: How to Obtain it,' by E. B. Kirby. Senator Walsh then gave the review of the present status of mining legislation at Washington which is elsewhere reproduced. The ensuing general discussion brought out the views of the many important mining men present and made especially clear the necessity that the new code of mining laws should be drafted by experienced mining men who are also familiar with the law. In the adjoining room a session on iron and steel was held. The sessions for the day were concluded by an illustrated lecture on the mining of bituminous coal, by Samuel A. Taylor.

In the evening the annual dinner was held at the Waldorf-Astoria, the same place as last year. The attendance was unexpectedly large and after over 200 members, their wives, and guests had been crowded into the dining room, a number of late comers had to be turned away. At the close of an excellent dinner the retiring president, C. F. Rand, with characteristic modesty, made a speech attributing the good

results of the year to everyone else except himself. At its conclusion W. L. Saunders, the toastmaster, asked anybody present who had not been mentioned to hold up his hand, which evoked much applause but no hands. The new president, B. B. Thayer, was then introduced and in a brief, businesslike speech pointed out that Mr. Rand had given largely of time and effort to the upbuilding of the Institute, and that his ability to evoke enthusiasm in others was only a part of what he had done. Mr. Thayer was followed by Thomas J. Walsh, senator from Montana, who praised the mining engineer for his contribution to civilization. Thomas B. Stearns then spoke of the glories of Colorado, and was followed by W. A. Clark, ex-senator from Montana, who spoke of early days in mining education in this country and paid a tribute to Dr. Raymond, who spoke next and was somewhat pessimistic as to whether the new broom of enthusiasm in the Institute would continue to sweep clean. The concluding speaker was D. M. Riordan who spoke in his usual vein.

On Thursday simultaneous sessions were again held. In the geological session the depth to which underground waters extend was first discussed. The topic was opened by a paper by A. C. Lane and was afterward discussed by J. F. Kemp, F. L. Ransome, L. C. Graton, E. C. Bastin, T. T. Read, and J. D. Irving. The next topic was the question as to what extent chalcocite is primary and to what extent a secondary mineral. The topic was presented by L. C. Graton and was discussed by J. D. Irving, T. T. Read, W. Lindgren, and F. L. Ransome. The third topic taken up was the discussion of the garnet zones produced by igneous intrusions. This was discussed by Waldemar Lindgren and, in a written paper, by C. K. Leith. Meanwhile in the adjoining room the oil and gas session was dealing with an even more interesting list of papers. The afternoon session was almost devoted to E. Coste, who first presented in abstract the paper by A. Adiassewicz on the Russian Oil Fields, and then defended vigorously his own theory of the formation of petroleum deposits. S. S. Wyer discussed the proposal to make natural gas lines common carriers and M. W. Ball discussed the placer law as applied to oil. R. M. Catlin and F. M. Anderson discussed the occurrence of oil shales at Elko, Nevada, where the oil cannot be extracted by solvents, only by distillation. The session was concluded by a most interesting paper by I. N. Knapp on oil and gas sands, illustrated by excellent lantern slides. There was to have been a session in the afternoon to discuss papers on precious or base metals. The first paper, by C. R. Hayward, was presented in abstract by H. O. Hofman, and Robert Linton presented his interesting paper on cyaniding silver ores in Mexico, but none of the authors of the eight other papers on the program were in attendance, and the session adjourned. This was the sole defect of what was otherwise one of the best meetings the Institute has held, and it is to be regretted that authors who have contributed important papers should not be on hand to present them and to answer questions.

Last week was an extraordinarily dull one, as far as mining news is concerned. Possibly all the mining men were attending the meeting of the American Institute of Mining Engineers, and had no news to give out, or it may have been the weather, which piled one snowfall on another, blocking the streets and hampering everybody in the conduct of business. Interest centres on what will happen in Mexico, now that one of the bandits who poses as a patriot leader has been so unwise as to shoot an Englishman. As a result, the attitude of 'watchful waiting' has received a severe jar and everyone is speculating on what the outcome will be. The ferocity and insolence of the atrocious act has aroused general resentment, but scarcely to the point of a general demand for intervention. The copper market has fallen flat and little business has been done. Even the export sales failed and the week closed with everybody awaiting developments.

General Mining News

ALASKA

BETHEL

An option and bond on the Royal group of 14 quartz claims, and the Golden Gate valley placer property of 1000 acres, has been given to New York people by H. W. Reeth.

FAIRBANKS

The Newsboy mill crushed 400 tons in January, recovering \$11.25 per ton, with a profit of \$500. The whole length of Cleary creek is active, with shaft-sinking, taking out dumps, and getting ready for next season. At 1 Below, Hilty & Co. are finishing the bedrock drain, 1900 ft. long, after a year's work. It is 3 to 5 ft. wide inside timbers, and 35 ft. deep. Adjoining claims will benefit by the drain. Ivy & Co. are digging a drain to connect with Hilty's. DuBerry and Fuller have helped with the Hilty drain and are ready to hoist gravel. Work on 3 Below is to be resumed by Cunningham, Morrison, and Rasmussen. A dump of fair size has been taken out from the old Boone by Woods and Piper. Shafts are being sunk on 6 Below by Johnson and Pearson. Lalu, Black, and Mitchell are taking out good 'pay' from 7 Below. A large dump is on 8 Below, owned by Nars, Hansen, and Jorgenson. Work is to be started on 9, 10, and 11 Below in May.

JUNEAU

The Alaska Mexican, Alaska Treadwell, and Alaska United companies have declared dividends of 20c., \$1, and 30c. per share, respectively, payable at San Francisco on February 28.

NELCHINA

On bedrock, 14 ft. deep, G. A. White has found gravel worth \$1.50 per square foot, at 16 Above Flat creek. Four feet of gravel will yield from 1 to 40 cents per pan. A new deposit has been discovered 18 miles from Flat creek, and the prospectors have 18 in. of gravel giving from 15c. to \$1 per pan. Fairbanks men have bonded claims for \$90,000 on Crooked creek. A Keystone drill will be used next summer. There are about 300 men and 4 women in the camp at 16 Above, Flat creek. The winter has been fine, the coldest day being 42° below zero, little wind, and 30 in. of snow.

ARIZONA

GREENLEE COUNTY

The directors of the Arizona Copper Co., Ltd., report that after carrying to reserve \$34,415, in terms of the agreement with the debenture holders, and \$45,585 for capital expenditure, the surplus for the year ended September 30, 1913, in-



CAVED SQUARE-SET SLOPE, ARIZONA COPPER CO.'S MINE.

cluding \$39,261 brought forward, is \$246,911. Deducting preferential dividends amounting to \$24,531, the sum of \$222,380

is left, out of which the directors recommend a dividend for the year of 66c. per share, free of tax; of this amount of dividend 36c. per share was paid in July last. The dividend absorbs \$208,986, and the balance of \$13,394 will be carried forward. The Company has ordered a 150-kw., 250-volt, synchronous converter, three 60-kva. transformers, and switchboard panels from the General Electric Company.

CALIFORNIA

AMADOR COUNTY

The South Eureka Mining Co. has paid another dividend, making \$41,998 for the current year.

BUTTE COUNTY

A fine diamond was found recently by a prospector in placer ground at Cherokee. He sold it to an Oroville jeweler for \$100. Over 250 stones have been found in this district to date. The old Magalia or Pershbaker drift gravel mine in the Magalia district, will probably be opened by driving a long drift to drain the old workings.

CALAVERAS COUNTY

The Hamby mine, near Mokelumne Hill, which has been worked in a desultory fashion for 10 years, is being unwat-tered. Prospects are good, and there is a good hoist and mill on the property. L. Everett is superintendent.

NEVADA COUNTY

Rich gold ore is being extracted from the Premier mine, north of Grass Valley. Jesse R. Butler is superintendent.

On February 22, a cross-cut in the Golden Center mine, Grass Valley, cut 30 in. of rich gold-bearing ore, which was highly mineralized. It was found 300 ft. from the shaft, and gives 400 ft. of backs. Leyner drills are used in development work.

PLACER COUNTY

Nevada people have acquired the Little Banner mine, on the American river, one mile from Auburn, for \$25,000. A 300-ft. adit has been driven to cut the vein, and a fair tonnage has been proved. The Rawhide mine, on the north fork of the American river, six miles from Towle, is being worked again by J. L. Bryson, under lease from the Helester Gold Mining Company.

PLUMAS COUNTY

Good ore has been opened in the San Jose mine, near Seneca.

SHASTA COUNTY

The Mt. Bally Mining Co. is to erect a small mill on its West End mine near Stella. Kennett people are mostly interested, and Briceland Blair is manager. The Gladstone company, near French Gulch, has paid another dividend of \$9000, making \$18,000 for this year.

SISKIYOU COUNTY

The mine and mill of the Gold Run, at Gilta, are being worked full time with 15 men. R. W. Bender is superintendent.

SAN DIEGO COUNTY

The Montezuma mine consists of 18 claims covering 360 acres in the San Ysidro range, 11 miles from Warner's Springs, and over \$100,000 has been spent in development. Regular work started in January 1911, and 3255 ft. has been opened in the Morning Star and Eureka claims, and 599 ft. in three other claims. Eight ore-shoots have been opened in the two claims mentioned, giving a high average in gold, silver, lead, and copper. The main shaft is being sunk to 250 ft., where it is intended to drive 1000 ft. No. 2 drift is in 941 ft. The shoots are up to 160 ft. apart at this level. In September 1913 the shaft-house and equipment was destroyed by fire, a loss of \$5355. This has been renewed by a larger plant. A 5-stamp mill and concentrator has been in operation, but a cyanide plant is necessary. David McGregor is superintendent.

TRINITY COUNTY

On February 18, Frank Schlomberg sold 11 placer claims on the north fork of Coffee creek, 16 miles from Trinity Center, to W. H. McEwen, who recently bought the Mad Ox mine near Whiskeytown. The late owner has worked one giant for a considerable time. The gravel is said to amount to 500,000 cu. yd., worth up to 50c. in gold.

TULUMN COUNTY

(Special Correspondence.)—The Jamestown Exploration Co., which is operating the Carlin mine, near Jamestown, has elected a new board of directors composed of C. L. Sisk, L. T. Freitas, A. R. Kirkland, W. S. Kelly, and J. H. Utt, and will establish its principal office at Stockton. It is understood that the Company will in the future make a weekly report to the stockholders. The Plummer brothers, of Columbia, have been recovering a good deal of gold from a new prospect on the Caverone ranch, four miles east of Columbia. Outcrops of the vein contained coarse gold, and the lucky finders realized several hundred dollars during the first few days. Prospects for further gold returns are said to be decidedly good. The Sugarman mine, on Bald mountain, north of Sonora, has been producing a large quantity of gold during the past few weeks, but how much has been extracted cannot be learned, though it is said to amount to several thousand dollars. The mine is worked by Charles Smith and Robert Watson. The Wilson & Means 'pocket' mine, on Jackass hill, near Tuletown, is again yielding gold for Charles and James Gillis and H. Bowerman, who have been working the property for a number of years. Since the find was made a few days ago, over \$10,000 has been recovered, and it is believed that when a thorough clean-up has been made, that sum will have been considerably increased. Probably not until the latter part of March will complete milling operations be resumed at the Shawmut. Meanwhile repair work and improvements which have been in progress for some time will be finished.

Sonora, February 21.

YUBA COUNTY

Good gravel has been opened in the Orient drift-gravel mine in the Camptonville district. John B. Lassiat is superintendent for the lessee, W. H. Hood.

COLORADO

EAGLE COUNTY

There is nothing new regarding the alleged discovery of rich carnotite ore in the Dakota mine, near Eagle. Silver ore is being transported from the Lady Belle mine to the cars at Eagle on sleds. The road to the North Dakota and Best Chance is in bad condition. Mines on the Salt Creek side of the mountain are opening excellently.

FREMONT COUNTY

A wagon-load of ore, assaying 34% lead, 4½% copper, 32 oz. silver, 0.11 oz. gold, with uranium and vanadium content, has been sent to the Pueblo smelter from the Oak Creek district, 15 to 20 miles west of Canon City. The ore was brought in by E. C. Metz. Considerable excitement prevails in Canon City.

GUNNISON COUNTY

The Glacier Mining Co., which has recently been organized and which is operating the Star and Independent mines on Italian mountain, has taken a bond and lease for \$25,000 on the mining claims on Italian mountain which was owned by the late Howard Marshall. The mill is working at the Iron Cap, near Spencer, and mine men are working under A. McFarlane.

LAKE COUNTY (LEADVILLE)

Storms have interfered with regular work in the district. The present outlook for increased activity is good. The Leadville district mill is working steadily and producing 60

tons of zinc concentrate per day. Residue from the old Adams mill containing 18 to 20% zinc, is being concentrated to 40 and 45% zinc. Retimbering the Moyer shaft of the Iron Silver Mining Co. is nearly finished. Five furnaces are working at the Arkansas Valley plant.

OURAY COUNTY

The report of the manager of the Mountain Top mine, G. H. Reinhardt, states that the main north drift is 967 ft. long. The first ore-shoot was 326 ft. long, and 6 to 18 in. wide, and the paystreak averaged gold 0.153 oz., and silver, 14.47 oz. per ton. The lead content will average 5%. At 560 ft. north of this shoot, another was cut, which was profitable for 210 ft. The paystreak was from 12 to 36 in. wide, averaging 13.37% lead, 0.047 oz. gold, and 34.45 oz. silver. About 890 ft. north, the foot-wall side of the drift opened the Big Spar vein, resulting in a heavy flow of water. The vein showed no mineralization. Work on No. 6 level and in the main raise is promising. The Company's Morning Star mill-site is at Cañon and Blythe creeks, and safe from snow-slides. A better site is west of the Atlas mill, and near the upper terminal of the proposed Ouray-Sneffels tramway. Surveys have been made for tramways from the Mountain Top-Sunrise adit to these sites. The respective lengths and falls are 4956 ft. and 1940 ft., and 5400 ft. and 1070 ft. The flotation process in the Atlas mill works satisfactorily, and as the Mountain Top ore is similar, the process may suit. Tests on ore from the Humboldt mine gave over 90% of the lead and silver by flotation.

PITKIN COUNTY

The Smuggler Leasing Co., at Aspen, has ordered two 125-hp. motors and a switchboard panel from the General Electric Company.

TELLER COUNTY (CRIPPLE CREEK)

A total of 2750 men are employed in the mines, mills, samplers, and smelters connected with the Cripple Creek district, according to *The Cripple Creek Times*. This number does not include men employed by ore-hauling contractors. It is expected that 18 lessees will be working at the Golden Cycle mine in a few days. The Gold King Mining Co.'s annual report shows that the lessee of the mine, Owen Roberts, shipped 4038 tons of ore, worth \$57,155, from which the Company's royalty was \$14,817. A dividend of \$9368 was paid, equal to 1c. per share on 936,850 shares. The cash balance on hand is \$55,291. The total production to date is 95,492 tons, yielding \$1,924,971.

IDAHO

BLAINE COUNTY

Work is to be resumed at the Independence mine and mill by Harry J. Allen, managing owner, and about 30 men. All litigation in connection with the property is finished. It is reported that a snowslide has either destroyed or covered the mill, power-house, boarding and bunk houses, and other equipment of the El Oro mine, on Bear creek, 70 miles from Hailey.

IDAHO COUNTY

In an adit being driven on a vein in the Black Pine mine, two miles from Elk City, rich gold ore has been opened on the hanging wall. Frank Peck has also opened \$100 ore in the Oro Grande district, between 300 and 400 ft. Several thousand tons of \$12 to \$15 ore is blocked out in the Colonel Sellers, owned by Mrs. Parr. The Elk City district is fairly active just now.

SHOSHONE COUNTY

Although cut about a month ago, an official announcement of the opening of 8 ft. of lead ore in the Success mine, near Wallace, has only just been made. This property is fully equipped with a mill, and paid \$90,000 in dividends in 1913. H. F. Samuels is general manager. A large low-grade ore-body has been developed in the Star mine, adjoining the

Morning, and it is likely that the Federal company will buy the property, the present bond calling for \$750,000. The Hecla Mining Co., operating at Burke, has paid dividend No. 128, of 2c. per share, amounting to \$20,000. The motors running in and out of the Kellogg tunnel at the Bunker Hill & Sullivan mine will be operated in the near future by a block signal system now being installed. The 'safety first' policy at this property shows a reduction in the number of accidents during the past six months. Across the track near the Kellogg tunnel is a large sign, 'Safety First,' in electric lights. Following this policy, the Company is doing away with trolley wires in the mine, except in the Kellogg tunnel, having installed electric storage-battery locomotives. The third one of these locomotives, weighing eight tons, was put into service this week. One of these has been at work for

15,357 tons, returning \$66,399, showing a loss of \$7100. The surplus on January 1 was \$60,569.

NEVADA

ELKO COUNTY

In spite of bad weather and its isolated position, mining at Contact is being pushed along. The Seattle-Contact company is shipping high-grade copper ore. The Antelope mine has been opened by three 40-ft. shafts and drifts, and good ore is extracted.

The deputy state mine inspector, James W. Gaughan, reports that the camp of Bullion is a promising one. Both the Nevada Bunker Hill and Bullion Nevada companies have driven adits, which will be timbered and the ventilation improved.

ESMERALDA COUNTY

The annual report of the Florence Goldfield Mining Co., H. B. Clapp superintendent, contains the following information: During 1913, 4307 tons of ore was mined, and 3159 tons treated at the Jumbo Reduction Co.'s plant at Bonnie Claire, which is leased to the Florence company. The yield was \$9.11 per ton, with 86% recovery. The lease of this plant was discontinued by previous arrangement, and since November 988 tons of ore, worth \$12.22 per ton, was sent to the Western Ore Purchasing Co. and the Belmont Milling Co. The year's revenue was \$41,979, and expenses \$85,987. Cash on hand at the beginning of 1914 was \$11,191. Development covered

2324 ft., at a cost of \$4.64 per foot. Work at 800, 1000, and 1200 ft. was unprofitable, and has been stopped. The orebodies are irregular and ore reserves cannot be estimated. The upper levels should add considerably to the available ore. At present, the monthly output is from 700 to 1000 tons.

A 5-stamp mill is now working in the Diamondfield portion of the Goldfield district. It is at present crushing ore from dumps on leases held by the Diamondfield M. & M. Co. A mineralized vein has been cut at 735 ft. in the Oro shaft. The water has also increased. T. F. Manning is manager.

During January, the Goldfield Consolidated mill produced a net realization of \$164,914 from 30,198 tons of ore. Costs totaled \$5.85 per ton, of which mining was \$3.25 and treatment \$1.75 per ton. Development covered 2666 ft. at a cost of \$4.91 per foot. There was nothing of special note from this work, but the stopes are looking better than for three months past.

HUMBOLDT COUNTY

With a capital of \$100,000, the Winnemucca Milling & Ore Purchasing Co. has been formed. W. G. Adamson, John R. Turner, of Winnemucca, and H. J. Murrish, of Lovelocks, are principally interested. A mill is to be built and custom work done.

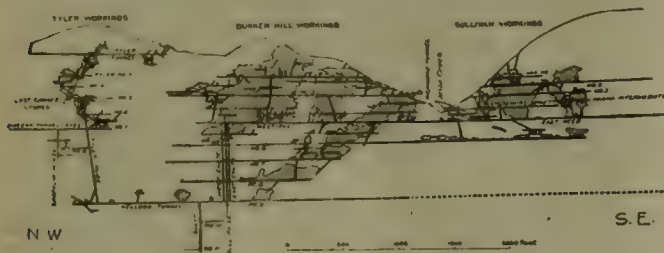
LANDER COUNTY

Placer mining in the Battle Mountain district is increasing, especially in Copper cañon, Eldorado cañon, Copper basin, Snow's gulch, Iron cañon, Mud Springs, and Tenabo.

NYE COUNTY

Ten mines at Tonopah produced 47,207 tons of ore worth \$896,933 in January. The Extension mill is to be enlarged by another 5 by 16-ft. tube-mill and a Dorr classifier, to increase the daily tonnage to 200 tons. The Jim Butler-West End extralateral right question is being discussed by the Companies' officials.

(Special Correspondence.)—About 27 miles from Luning, in Mineral county, is the Fairplay mining district. This district is attracting considerable attention again. During the past eight years considerable development has been done, and the veins have been proved to a depth of 230 ft. There are large bodies of ore available, assaying about \$25 per ton



SECTION OF BUNKER HILL & SULLIVAN MINE.

a year. Edison storage batteries operate the locomotives.

The Bullion and Copper Chief companies will drive a joint adit, costing \$34,000, to cut veins in the properties at about 434 ft. from the surface. John H. Nordquist, of Wallace, will superintend the work.

MISSOURI

ST. FRANCIS COUNTY

An appeal from the decision of Justice Cardoza, of the Appellate Court of New York, has been taken by Robert Holmes in his suit to restrain the St. Joseph Lead Co. from borrowing \$2,500,000.

MONTANA

DEER LODGE COUNTY

On February 20 a cave-in occurred at the Southern Cross mine, at Georgetown, burying two men. Rescue crews have been at work. This property is owned by the Anaconda company, ore being shipped to the Washoe plant for treatment.

FERGUS COUNTY

During January, the Barnes-King Development Co. produced 4324 tons of ore, yielding \$44,000 in gold. The profit was \$24,000. On March 4, the annual meeting will be held at Kendall.

SILVERBOW COUNTY

The Butte-Duluth mine has been sold to the American Metals Co. It was reported on by W. H. Weed. Twelve inches of copper glance has been opened 75 ft. below the 2000-ft. level of the Pilot-Butte. The ore assays 1.98% copper and 6 oz. silver per ton. The middle vein, at 1800 ft., is 30 in. wide, containing 7.4% copper and 12 oz. silver per ton. The shaft will be continued to 2600 ft. Water from the mine is only hoisted to the 1300-ft. level, from which it flows through a 700-ft. cross-cut to the Butte & Superior mill. The Anaconda company's suit against the Pilot-Butte, involving the South vein, is to be heard on March 20. The Tuolumne mine produced 184,394 lb. of copper, 9869 oz. silver, and 13 oz. gold in January from 3091 tons of ore. This came from the 800, 1800, 2000, and 2200-ft. levels. A vein was cut on No. 24 level on February 13, but was disappointing. From August 1, 1913, to January 1, 1914, ore shipments totaled

in gold and silver. The ore occurs in andesite and rhyolite. The outlook for this district is promising. By the addition of a cyanide plant to the present milling facilities at the Goldyke, the owners should be able to save the metals and realize good profits. A townsite has been located, called Butler. Fuel and water are found in the immediate vicinity.

The Nevada Chief Mining Co. is operating six claims and has a 15-hp hoist. An incline shaft has been sunk to a depth of 230 ft. The vein was crosscut at 150 ft. and assayed about \$20 per ton, and in the lower crosscut the vein is larger and contains better gold content. The shaft is to be sunk 100 ft. deeper.

The Nevada Chief Extension Co. has several promising claims and is preparing to develop them. The Excelsior Twilight Mining Co. has a good body of ore at a depth of 320 ft. and expects to install a 25-hp. hoist. The Contact Mining Co. has a 150-ft. shaft. On the 100-ft. level the vein is about 2½ ft. wide, assaying \$18 per ton. There are several other groups located and being developed by experienced mining men who have great faith in the district.

Luning, February 10.

STOREY COUNTY

Work is to be resumed in the Mexican and Union mines, which have not been operated of late on account of a difference with the United Comstock Pumping Association. The Pumping Association is keeping the water just below the 2700-ft. level with Starrett pumps. An earthquake of three seconds' duration shook Virginia City district on February 18. There was a fairly heavy shock at 2200 ft. in the Ophir winze, and rocks split off. On the 1000-ft. level of the Consolidated Virginia, 6 by 12-in. timber broke in several places. In the Yellow Jacket the movement was very perceptible, but not much in the Crown Point and Belcher. The Silver Hill Mining Co. has decided to erect a 50-ton mill and cyanide plant in lower Gold cañon. Walter Techow will design, erect, and operate the plant. During 1913 the Crown Point, Belcher, and Yellow Jacket companies produced 32,368 oz. of bullion from 23,943 tons of ore.

NEW MEXICO

GRANT COUNTY

The Lordsburg mining district has been described in *The Lordsburg Leader* of February 12. The 85 mine is producing about 4000 tons of copper ore per month, the output in 1913 being \$650,000. A treatment plant of some kind is contemplated. A branch of the A. & N. M. railway has been surveyed to this and other mines. A deal has been completed whereby the Metropolis mine and a group of claims, near the 85 mine, were taken over by the Amalgamated Lead & Copper Mining Co. from J. C. Waldmann, of San Francisco, California, and associates. A large tonnage of lead-silver ore, and copper ore, has been proved, and a concentrating plant may be erected next fall. Good copper-gold-silver ore has been opened in the Bonny mine, five miles south of Lordsburg. The Miser's Chest, adjoining, has a shaft over 400 ft. deep, the lower levels being under water. In the Atwood, near the 85 and Metropolis, there is a fair tonnage of medium-grade ore. It has produced \$300,000. In the Pyramid camp are a number of promising claims. In 1912 the Lordsburg mines produced 55,340 tons of ore yielding gold, \$144,859; silver, 275,251 oz.; copper, 3,155,585 lb.; and lead, 4562 lb., worth \$835,915.

OREGON

BAKER COUNTY

After being shut down for two years, the North Pole mine, near Sumpter, is being developed again. Ralph Clarke is in charge. It is likely that this and the E. & E. mine will be consolidated. Promising discoveries have been made in the New Eldorado district, southwest of Sumpter, in a little known part of the Greenhorn mountains.

UTAH

The radium-bearing ores of this state were discussed on February 20 by L. O. Howard before the Utah Society of Engineers. He said that in Utah the ores of vanadium, uranium, and radium are found in several localities in the eastern districts. These may be described as follows: In Utah county, near Independence, and extending into Wasatch county; in Grand county, at Moab, Dewey, Richardson, and 16 miles southeast of Thompson's, in Emery county, near the town of Greenriver, and at Table mountain, 45 miles southeast of Greenriver; in San Juan county carnotite has been reported from the vicinity of Monticello, near Dry cañon, and from Copper cañon in the southwest portion of Kane county, minerals similar to those at Richardson are found near Parash; in Wayne county, in the vicinity of Hanksville and Fruita, and in the Henry mountains, several carnotite claims have been located. At Table mountain, Beebe and Browning started prospecting work on their claims as early as 1903, and in the Greenriver field, location notices which were put up about the same time have been found. The ore occurs in a sedimentary formation. The beds have suffered considerable erosion, but when this has not been too deep a thin bed of quartzite lies on the highest portions. Beneath this is a medium coarse to fine conglomerate. Beneath the conglomerate lies a coarse-grained white sandstone, underlain by a thin seam of green shale. The ore is found principally as an impregnation of the sandstone and lies in any part of the same near the surface, sometimes immediately underneath the conglomerate, at others on top of the shale. The conglomerate is sometimes the source of valuable ore and occasionally the quartzite shows a slight mineralization. The principal mineral is the canary yellow carnotite, whose color is often obscured, and a variety of earthy minerals usually accompany it. The various minerals present a great variety of colors: black, all shades of green, yellow, and blood red. The black is sometimes glossy like coal, sometimes talcy, and sometimes dull earthy. These are usually the best grades of ore. It occurs in pockets from a few inches up to five or six feet thick.

JUAB COUNTY

The winze below the 1000-ft. level of the Tintic Standard is down 70 ft., and a foot of high-grade galena is being sunk on. A carload of gold-bearing ore is being shipped from the Victoria. It will average \$75 per ton.

SALT LAKE COUNTY

The Utah Copper Co. has ordered four 2500-kva., water-cooled transformers from the General Electric Company.

WASHINGTON

FERRY COUNTY

The Orion Mining Co., at Covada, has opened rich silver ore, 1400 ft. in the adit being driven. Good ore is showing in the Keystone, and lead ore in the Big Joker.

STEVENS COUNTY

Charles F. Soderling, of Spokane, and his associates have taken a bond on the Mayflower group of three claims in the Chewelah district, for \$30,000. The first payment is to be made in 12 months. The property has been operated under the name of the Big Bend Mining Co. by Dickey, Bramley, and Hyde. The lode has been traced on the surface of this group for 4500 ft. An 8-ft. vein containing copper and silver has been cut by a short adit. During 1913 the United Copper Mining Co. produced 14,938 tons of ore and concentrate, yielding 884,762 lb. of copper and 134,437 oz. of silver. Mining cost \$6.19 per ton, and freight and treatment to the Grand Forks and Trail smelters were \$3.50 and \$5 per ton, respectively. Developments at 400, 500, and 600 ft. are encouraging. The net earnings were \$149,831. Conrad Wolfe is president of the company.

CANADA

BRITISH COLUMBIA

(Special Correspondence.)—S. J. Eubank and D. F. Jones will diamond-drill their San Diego group of six claims, situated six miles from the head of Alice arm in the Cassiar district. There has been considerable development done on this property, and the showing is good. A horse trail has been completed from the head of the arm to the property, and a drill outfit with a capacity of 400 ft. depth has been ordered and will arrive about May 1.

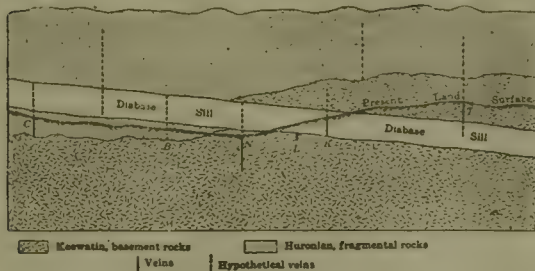
Anyox, February 16.

The new Hidden Creek smelter of the Granby company is practically completed, but weather conditions have seriously interfered with the blowing in of the furnaces. It was expected that it would have been started on February 10, but it may take several weeks yet, as there is not sufficient water in the reservoir for the hydro-electric plant. During the first two weeks of February the Grand Forks smelter treated 47,213 tons of ore and shipped 782,000 lb. of blister copper.

ONTARIO

Bullion shipments from three Cobalt mines during the past week totaled 258,359 oz., and 916,465 oz. for the year to date.

On the 460-ft. level of the Beaver Consolidated the granite intrudes into the Keewatin, and from 4 to 6 in. of ore has been opened for 15 ft. in the granite, containing about 3000 oz. silver per ton. This development in granite was not expected and has caused considerable discussion. During 1913 the Trethewey mine produced 619,427 oz. silver worth



GEOLOGICAL SECTION OF COBALT.

\$365,611. Freight, sampling, and smelter charges were \$32,000. Dividends amounted to \$150,000, and the surplus for the current year is \$146,148. Ore reserves contain 585,970 oz. silver.

The Dome, at Porcupine, treated 13,900 tons of ore in January, yielding \$111,500. The mill worked 93% of the possible time.

The following shipments were made in January: Casey Cobalt, at New Liskeard, 59 tons silver ore; gold ore from Haileybury, 35 tons; copper ore from the Dane mine, 66 tons; silver ore from Elk Lake, 32 tons; and nickel ore from the Alexo mine, Porquis junction, 744 tons.

COLOMBIA

The Pato dredge recovered gold worth \$10,600 from 14,500 cu. yd. during the week ended January 27.

MEXICO

SONORA

The Lucky Tiger-Combination Gold Mining Co., operating at El Tigre, reports that during January the mill crushed 6115 tons of ore, and the cyanide plant treated 7754 tons of tailing. The yield from shipping ore, concentrate, and bullion was \$135,749. The estimated profit was \$60,974. On February 1 all of the outstanding bonds of the Company were retired.

Personal

CHARLES J. GARVIN is in New York.

THOMAS B. STEARNS is in New York.

HOMER L. CARR has gone to Honduras.

L. D. MILLS has returned from South Africa.

C. W. GOODALE is expected in New York soon.

CHARLES PETER has returned to Salt Lake City.

H. DEWITT SMITH has gone to Kennicott, Alaska.

MORTON WEBBER, of New York, is at the St. Francis hotel.

T. J. ANDERSON sailed from New York for Panama on February 18.

CHARLES BUTTERS has returned from Salvador and is in New York City.

JACK HOFFMANN has gone to Tcherdin, in the Ural region, with CHARLES JANIN.

N. B. KNOX sailed on the *Kronprinzessin Cecelie*, February 21, returning to London.

F. C. MOORE, manager at the Star of the Congo mine, is visiting the United States.

JAMES DOUGLAS, L. D. RICKETTS, and WILLIAM THORNTON have been inspecting the Greene Cananea mines.

ERNEST RUTHERFORD, Langworthy professor of physics in the University of Manchester, has been made a knight, taking the title of K. B.

F. J. JANEY, J. M. HYDE, S. GREGORY, and A. M. HIGGINS were among those attending the argument of the case of Minerals Separation, Ltd., versus James Hyde on appeal at San Francisco last week.

J. M. HYDE has returned from a trip through Europe investigating the newer metallurgical processes and will be the American representative of Murex Magnetic Co., Ltd., at San Francisco.

ELWOOD MEAD, chairman of the Victorian Water Commission, left Sydney on February 7 on the *Sonoma* for San Francisco, for the purpose of securing, if possible, a cancellation of his agreement to undertake the duties of professor of Rural Institutions at the University of California, in order that he may be able to complete his work in Victoria. In his absence W. CATTANACH will act as chairman of the commission.

Schools and Societies

THE ENGINEERS' CLUB of Philadelphia met on February 21, when Arthur W. Goodspeed lectured on 'Radio-activity, with special reference to radium.'

The Civil Engineering Department of the UNIVERSITY OF ILLINOIS held a special short course in Highway Engineering during the last two weeks of January. The number registered was 191 students, of whom 63 were county superintendents of highways.

THE AMERICAN ELECTROCHEMICAL SOCIETY will hold its annual meeting and election on April 16. The spring meeting, to be held on April 16, 17, and 18 at New York, will be an interesting one. Questions to be discussed are, 'Power for Electrochemical Purposes,' and 'Hydro-electrometallurgical Processes.'

THE CLEVELAND ENGINEERING SOCIETY held its regular meeting, on February 10, at Cleveland, Ohio, when a paper on gas power was read by R. H. Fernald of the Bureau of Mines. A semi-monthly meeting will be held on February 24, when a paper on 'Acoustics and Engineering' will be read by Dayton C. Miller.

The Metal Markets

LOCAL METAL PRICES

San Francisco, February 26.

Antimony	9 — 9½c
Electrolytic copper	15½ — 15¾c
1½g lead	4.25 — 5.20c
Quicksilver (flask)	\$39.00
Tin	42½ — 44 c
Spelter	6½ — 6¾c
Zinc dust, 100 kg zinc-lined casks, 7½ to 8c per pound.	

EASTERN METAL MARKET.

(By wire from New York.)

NEW YORK, February 26. —Copper still shows a downward tendency, and little business is being transacted, buyers holding off. Lead is firm at 1c. per pound, and spelter is quiet at 5.20c., a slight reduction on last week's quotations. The Chino, Nevada, Ray, and Utah copper companies have declared their regular quarterly dividends, payable March 31. Trading on the Stock Exchange today covered 316,100 shares, and bonds worth \$2,678,500. Stocks generally were lower than last week. In London copper closed firm at £64 6s.3d. for spot, and £61 18s.9d. for futures, both small increases. Lead is £19 2s.6d., up 2s., and spelter is £21 10s., remaining unchanged.

SILVER

Below are given the average New York quotations in cents per ounce, of fine silver.

Date.	Average week ending.
Feb. 19.....	57.50
" 20.....	57.50
" 21.....	57.50
" 22 Sunday.....	57.46
" 23 Holiday.....	57.46
" 24.....	57.62
" 25.....	57.50

Monthly averages.

1913.		1914.		1913.		1914.	
Jan.	63.01	57.58	July	58.70			
Feb.	61.25		Aug.	59.32			
Mch.	57.87		Sept.	60.53			
Apr.	59.26		Oct.	60.88			
May	60.21		Nov.	58.76			
June	59.03		Dec.	57.73			

The tendency of London prices has been good, according to Samuel Montagu & Co. on February 5. The highest quotations of the week were on the 2nd, when cash silver was fixed at 26 11/16d. (54.4c.), and forward silver 1/4d. (0.5c.) lower. During the rest of the week 3/16d. (0.4c.) difference obtained. Business has been of an all-round character, but Indian buying orders have been only on a small scale. During the month of January, the market was not active. This is traceable, inter alia, to two causes, namely, the usual arrest of fresh business in China at the period of the Chinese New Year, and to the digestive process necessary in regard to the speculative stock once held by the Indian Specie Bank. Prices have been maintained within fairly narrow limits, 5/16d. (0.62c.) in the case of both cash delivery and two months' delivery. A certain proportion of the bear accounts, open at the end of last year, has been closed; but the most substantial part is still uncovered, or has been renewed. The Indian bazaars have kept a bearish sentiment throughout, and have only dealt from hand to mouth.

COPPER

Quotations on copper as published in this column represent average wholesale transactions on the New York market and refer to electrolytic copper. Lake copper commands normally 1-5 to 1-4c. per lb. more. Prices are in cents per pound.

Date.	Average week ending
Feb. 19.....	14.36
" 20.....	14.36
" 21.....	14.36
" 22 Sunday.....	14.35
" 23 Holiday.....	14.35
" 24.....	14.35
" 25.....	14.30

Monthly averages.

1913.		1914.		1913.		1914.	
Jan.	16.54	14.21	July	14.21			
Feb.	14.93		Aug.	15.42			
Mch.	14.72		Sept.	16.23			
Apr.	15.22		Oct.	16.31			
May	15.42		Nov.	15.08			
June	14.71		Dec.	14.25			

Stocks of copper in England and Europe at the end of January were as follows, according to Henry R. Merton & Co.: English standard copper in Liverpool, Swansea, and Port Talbot, 7925 tons; other standard at Liverpool and Swansea, 1251 tons; and standard at London, Newcastle, and Birmingham, 1113 tons; furnace material at Liverpool and Swansea, 130

tons, fine copper in Havre, France, 1512 tons, Rotterdam, 3650 tons, Hamburg, 3842 tons, and Bremen, 1621 tons, a total of 21,241 tons. Fine copper about from Chile and Australia was 1500 tons. Stocks at other European ports were estimated at 750 tons.

Everybody seems to be in more or less of a fog about the copper market, though there is really nothing very mystifying about it. Everyone has known that foreign shipments have been large, and not a few doubt whether they really reflect the present state of consumption in Europe. Domestic deliveries in January showed an encouraging increase over December, and certainly do not lag behind the revival in domestic industry for which everyone is hoping, for there is no denying that it has not yet given much clear evidence of its survival. Now that the Rio Tinto strike is finally settled and the winter weather, which cuts down the output of some mines, will soon end, production will probably increase, and it is good that consumption gives evidence of increasing as well.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.	Average week ending
Feb. 19.....	4.00
" 20.....	4.00
" 21.....	4.00
" 22 Sunday.....	4.10
" 23 Holiday.....	4.10
" 24.....	4.00
" 25.....	4.00

Monthly averages.

1913.		1914.		1913.		1914.	
Jan.	4.28	4.11	July	4.35			
Feb.	4.33		Aug.	4.60			
Mch.	4.32		Sept.	4.70			
Apr.	4.36		Oct.	4.37			
May	4.34		Nov.	4.16			
June	4.33		Dec.	4.02			

TIN

New York prices control in the American market for tin, since the metal is almost entirely imported. San Francisco quotations average about 5c. per lb. higher. Below are given average monthly New York quotations, in cents per pound:

Monthly averages.

	1913.	1914.		1913.	1914.
Jan.	50.45	37.85	July	40.70	.....
Feb.	49.07	.....	Aug.	41.75	.....
Mch.	46.95	.....	Sept.	42.45	.....
Apr.	49.00	.....	Oct.	40.61	.....
May	49.10	.....	Nov.	39.77	.....
June	45.10	.....	Dec.	37.57	.....

At the end of January, speculative interest in the tin market in London assumed large proportions, according to Henry R. Merton & Co. Bears have been frightened by the rapid advance into covering their commitments, while a good deal of buying for a further rise took place. There has been heavy buying on the part of American consumers. Transactions during the last week were 3500 tons. English ingot tin was £183 per ton.

QUICKSILVER

The primary market for quicksilver is San Francisco, California, being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending	Feb. 12.....	39.00
Jan. 29.....	" 19.....	39.00
Feb. 5.....	" 26.....	39.00

Monthly averages.

	1913.	1914.		1913.	1914.
Jan.	39.37	39.25	July	41.00	.....
Feb.	41.00	.....	Aug.	40.50	.....
Mch.	40.20	.....	Sept.	39.70	.....
Apr.	41.00	.....	Oct.	39.37	.....
May	40.25	.....	Nov.	39.40	.....
June	41.00	.....	Dec.	40.00	.....

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date.	Average week ending
Feb. 19.....	5.20
" 20.....	5.20
" 21.....	5.20
" 22 Sunday.....	5.25
" 23 Holiday.....	5.25
" 24.....	5.20
" 25.....	5.20

Monthly averages.

	1913.	1914.		1913.	1914.
Jan.	6.88	5.14	July	5.11	.....
Feb.	6.13	.....	Aug.	5.51	.....
Mch.	5.94	.....	Sept.	5.55	.....
Apr.	5.52	.....	Oct.	5.22	.....
May	5.22	.....	Nov.	5.09	.....
June	5.00	.....	Dec.	5.07	.....

The Stock Markets

SAN FRANCISCO STOCKS AND BONDS (San Francisco Stock and Bond Exchange.)

BONDS

February 25.

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Associated Oil 58	\$ 97½	—	Natomas Consol. 68	—	26
Unlisted.	—	—	Pac. Port. Cement 68	—	100½
Ass. Oil 68	—	82½	Santa Cruz Cement 68	85	90
General Petroleum 68	41	46	Union Oil	—	88

STOCKS

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Amalgamated Oil	—	86½	General Petroleum	4½	6
Associated Oil	42½	42½	Noble Electric Steel	5	—
E. I. du Pont pfd.	—	90	Natomas Consol.	1	2½
Giant	84½	—	Pac. Port. Cement	—	69
Pac. Oil Borax, pfd.	70	—	Riverside Cement	60	—
Pacific Crude Oil	—	—	Santa Cruz Cement	52½	60
Sterling O. & D.	1½	1½	Stand. Port. Cement	—	2½

NEVADA STOCKS

(By courtesy of San Francisco Stock Exchange.)

February 26.

Atlanta	\$.18	Montana-Tonopah	\$1.02
Belcher	.60	Nevada Hills	.37
Belmont	8.00	North Star	.39
Con. Virginia	.18	Ophir	.57
Florence	.56	Pittsburg Silver Peak	.35
Goldfield Con.	1.62	Round Mountain	.40
Goldfield Oro.	.12	Sierra Nevada	.14
Halifax	1.06	Tonopah Extension	1.47
Jim Butler	1.00	Tonopah Merger	.61
Jumbo Extension	.22	Tonopah of Nevada	7.12
MacNamara	.09	Union	.11
Mexican	1.21	Victor	.30
Midway	.37	West End	1.12
Mizpah Extension	.46	Yellow Jacket	.60

CALIFORNIA STOCKS

(Latest Quotations.)

Argonaut	\$2.75	Central Eureka	\$9.67
Brunswick Con.	\$1.05	South Eureka	2.10
Bunker Hill	1.85		

COPPER SHARES—BOSTON

(By courtesy of J. C. Wilson, Mills Building.)

February 26.

	Bid	Ask		Bid	Ask
Allouez.....	\$ 41	42	Mohawk.....	\$ 43½	44½
Ariz. Commercial.....	41	5	Nevada Con.....	16½	16½
Butte & Superior.....	35½	36½	North Butte.....	28½	28½
Calumet & Arizona.....	67	67½	Old Dominion.....	51	52
Calumet & Hecla.....	427	430	Osceola.....	80	81
Copper Range.....	37½	38	Quincy.....	64	66
Daly West.....	2½	2½	Shannon.....	6½	7
East Butte.....	11½	12½	Superior & Boston.....	2½	2½
Franklin.....	6½	6½	Tamarack.....	40½	40½
Granby.....	84½	85	U. S. Smelting, com.....	41½	41½
Greene Cananea.....	37½	38	Utah Con.....	12½	13
Idle-Royale.....	20½	21	Winona.....	4½	4½
Mass Copper.....	3	3½	Wolverine.....	45½	47

NEW YORK CURB QUOTATIONS

(By courtesy of E. F. Hutton & Co., Kohl Building.)

February 26.

	Bid.	Ask.		Bid.	Ask.
Braden Copper.....	7½	7½	Mason Valley.....	3¼	3¾
Braden Co.....	140	150	McKinley-Dar.....	1½	1½
B. C. Copper.....	1½	2	Mines Co. Am.....	3	3¼
Con. Cop. Mines.....	2½	2½	Nipissing.....	6¼	6½
Davis-Daly.....	1½	2½	Ohio Copper.....	¼	½
Ely Con.....	4	6	San Toy.....	15c.	25c.
First National.....	2¾	3¼	Stand. Oil of Cal.....	320	323
Gibson.....	1	1½	Tri Bullion.....	½	¾
Hollinger.....	16	18	Tuolumne.....	½	1
Iron Blossom.....	1¼	1¼	United Cop. com.....	½	¾
Kerr Lake.....	1½	5	Wetlauffer.....	6c.	8c.
La Rose.....	1½	1¾	Yukon Gold.....	2½	2¾

NEW YORK STOCK EXCHANGE

(By courtesy of J. C. Wilson, Mills Building.)

February 26.

	III	Ask	III	Ask	
Amalgamated	8 73 1/2	74	Miami	8 22 1/2	23 1/2
Anaconda	35 1/2	36 1/2	Nevada Con.	16 1/2	18
A. S. & R. com.	65 1/2	66	Quicksilver, com.	2	2 1/2
Calif. Pet., com.	26 1/2	27	Ray Con.	19 1/2	19 1/2
Chino	41 1/2	41 1/2	Tenn. Copper	35 1/2	35 1/2
Guggenheim Ex.	60 1/2	60 1/2	U. S. Steel, pfd.	100 1/2	110
Inspiration	16 1/2	16 1/2	U. S. Steel, com.	64 1/2	64 1/2
Mexican Pet., com.	63 1/2	64	Utah Copper	63 1/2	63 1/2

SULPHUR PRODUCTION of the Sicilian Sulphur Combine, during the year ended July 31, 1913, was 351,752 metric tons. This is a decrease of 15,489 tons compared with the previous year. Seven mines were shut down, and 16 in 1912. Stocks on hand were 354,169 against 444,381 tons. Total sales amounted to 497,246 against 603,255 tons. Exports declined from 447,638 to 434,473 tons. Those to the United States were only 1792 tons. Competition with the Union Sulphur Co., which will distribute American sulphur in Europe from headquarters at Rotterdam, has been keen. The general apprehensions that foreign competition is liable to seriously damage the Sicilian sulphur industry should be dismissed for the following reasons, according to the annual review of the Sicilian Sulphur Combine: (1) That the Freeport Sulphur Co., which began operations in 1911 in exploiting the sulphur deposits in Texas, failed to obtain the results it had anticipated, due chiefly to considerable technical difficulties; (2) that Japan has not increased its exports, which is evidenced by the increasing demand for sulphur from the Pacific markets; (3) that the rumors of large sulphur deposits on White Island, New Zealand, have not been confirmed; (4) that the sulphur deposits in Spain are completely exhausted; and (5) that no definite information has been received announcing the alleged increase of sulphur production in Mexico.

FINAL FIGURES of the gold output of the Rand are now available, and show the following results for 1913, compared with the previous year:

	1912.	1913.
Gold, fine ounces	9,124,299	8,794,824
Value	£38,757,560	£37,358,040
Dividends	8,277,862	8,500,000

Total dividends since 1886 amount to £100,049,158, and gold output since 1884, £401,242,675. At the end of December 1913 there were 150,012 native laborers at the gold mines, compared with 191,316 at the end of 1912.

PUBLIC LANDS in the United States, restored to entry in December, covered an area of 1,678,000 acres. The area standing as withdrawn from entry at the end of last year was 66,270,000 acres. The total area of lands which have been classified in western states up to the end of December aggregates nearly 295,700,000 acres.

PRICES of radium-bearing ores varied greatly in 1913, and returns to the U. S. Geological Survey showed that the price per pound for contained uranium oxide ranged from \$1 for ores carrying 0.6% uranium oxide to \$4.60 for one lot carrying 3.15% uranium oxide and 4.82% vanadium oxide.

RADIUM BROMIDE worth \$1,055,000 was the equivalent content of the uranium ores mined in the United States in 1913, according to the U. S. Geological Survey. The ore exported to Europe was 942, and that retained in this country was 1198 tons.

THE United States Steel Corporation, under its compensation plan, paid over \$2,200,000 in 1913 for injuries to its employees.

THE UNITED MINE WORKERS OF AMERICA has a membership of 415,142 men.

Company Reports

THE JUMBO GOLD MINING COMPANY, LTD.

This Company owns 20 claims in the Mazoe valley, about 30 miles north of Salisbury, Rhodesia. The report for the year ended June 30, 1913, gives the ore crushed as 37,180 tons, yielding £57,804. Operating costs were £57,830, divided as follows: mining, \$2.49; milling, \$1.37; sand treatment, 56c.; slime treatment, 32c.; and general charges, 56c. per short ton. The profit was £16,685.

RAY CONSOLIDATED COPPER COMPANY

The report of this Company, operating in Arizona, covers the last quarter of 1913. Underground work amounted to 21,042 ft., making 376,972 ft. to date. The orebodies tributary to No. 1, 2, and 3 shafts produced 62, 33, and 59, respectively, of the ore mined. Results were as follows:

Ore milled, tons	665,024
Average copper content, per cent	1.7152
Copper output, pounds	15,004,727
Recovery, per cent	65.773
Cost of mining, including coarse crushing, cents per ton	70.768
Cost of milling, including improvements, cents per ton	57.739
Cost of copper produced, cents per pound	9.9801
Mine development extinguishment, cents per ton...	12.5
Profits, including dividends of Ray & Gila Valley Railroad, etc.	\$ 744,018
Dividend	543,951
Dividends for 1913	1,631,504

The average price received for copper during the quarter was 14.831c. per pound. At present the mine is producing almost 8000 tons of ore per day. Practically all construction work is complete.

CHAMPION REEF GOLD MINING COMPANY OF INDIA, LIMITED

This Company operates one of the great gold mines of the world at Kolar, in the state of Mysore, India. The report for the year ended September 30, 1913, shows that 140 stamps crushed 220,511 tons of quartz, yielding 103,797 oz. gold, while 339,587 tons of tailing and slime yielded 29,122 oz. gold, the whole product being worth £510,737. Since 1892, there has been crushed 3,179,185 tons of ore yielding gold worth £10,620,037. Dividends in 1912-13 were £130,000, making a total of £4,018,966. Royalty paid to the Mysore government in 1913 amounted to £28,555. Material and stores at the end of the fiscal year were valued at £50,517; cash in London and India, £68,619; and reserve fund, £45,000. Total costs were \$6.37 per ton milled. The expenditure on shafts, buildings, and equipment was £64,917.

The report of the superintendent, H. J. Gifford, contains the following notes: Total work done covered 17,755 ft. Development south of Garland's shaft has been mostly unproductive owing to the intrusion of a cross-course. At No. 40 level this had not dipped north so rapidly, consequently the north drift on that level entered ore sooner than expected, and ore of good width and value has been opened. Ore will probably be cut again at lower levels south of the cross-course. Garland's shaft is 4289 ft. deep at an angle of 70°. Glen shaft was sunk 240 ft., or 41 ft. below No. 43 level. The country between these two shafts showed favorable results, and a continuous shoot of good width and value has been opened in each of the five deepest levels. Development south of Carmichael's shaft has been variable, but the ore is of good grade. The shoot is 1026 ft. long on No. 44 level. Air-blasts have been less frequent, but have caused loss of

life among the native miners. In order to minimize risks work has been temporarily suspended between No. 19 and 25 levels. Glen and Ribblesdale's shafts have been damaged by these shocks. The Circular shaft is down 3861 ft., and has been bricked for that distance. Ore reserves in the mine total 494,125 tons, not including 46,302 tons to be left to support certain areas where air-blasts are troublesome. The Champion Reef lode is not a wide one, being from one to several feet thick.

Details of the mill work will be published in another part of this journal. There were 6716 employees during the last month of the fiscal year, of whom only 143 were Europeans and 91 Eurastians. The report is accompanied by complete plans of the mine and other details of its operation. John Taylor & Sons, of London, are general managers of the property.

In January 1914 the mill crushed 18,070 tons of ore and treated 28,632 tons of sand and slime, yielding gold worth \$212,000.

BRUNSWICK CONSOLIDATED GOLD MINING COMPANY

This Company's mine and mill is at Grass Valley, Nevada county, California, and the report deals with the work done during 1913. The manager, R. Chester Turner, states that 1219 tons of low-grade ore was mined by lessees from the old mill ore-shoot, the balance of the 15,334 tons sent to the mill coming from No. 4 shoot, lessees taking out 2130 and the Company 11,985 tons. Development covered a total of 2076 ft. From 15 to 22 lessees have been working in the mine, but as No. 4 shoot is well developed, the tendency is to limit the quantity of tribute ore. This shoot maintains its length of from 400 to 500 ft. The vein dips south, and the upper or northern edge bends or curls over, forming what appears to be a saddle reef, with the vein dipping north and south from the apex of the saddle. Probably on account of this bending and flattening of the upper portion, the 600-ft. level cross-cut has not cut the vein. This will most likely be found considerably west of the cross-cut. The superintendent, C. H. Mallen, reports that No. 4 shoot continues to furnish the 20-stamp mill with a good grade of milling ore. From the present workings to the surface is about 900 ft. on the pitch of the vein. The vein is strong, with good walls and every indication of considerable extent. Little change has occurred since stoping commenced above the 1250-ft. level. No doubt is felt that this is one of the big ore-shoots of Grass Valley. It was found on the 1250-ft. level and about 2000 ft. east from the old incline shaft, and working toward the surface, as has been necessary, prevents the making of reliable estimates of tonnage. The new three-compartment shaft is completed to the 1250-ft. station. The rock is hard, but future repair work will be small. With the Company's facilities for handling ore and material for the mine through this shaft, it will be able to work as many stamps as the mine requires, with much less expense and greater speed. Sinking has been started under the floor of the 1250-ft. level, and the vein may be cut in about 200 ft., depending on its pitch. Mr. Turner also reported that the connection between the new vertical shaft and the vertical raise from the 1250-ft. level, in February 1913, was well done, the difficult surveys being made by E. C. Uren, of Nevada City. Ore reserves consist of about 15,000 tons, some varying from \$10 to \$25 per ton. Mining costs were \$5.14 per ton. Financial results were as follows:

Ore treated, tons	15,334
Gold and silver recovered	\$208,359
Output since 1897	866,705
Revenue in 1913, including bullion, 1912 balance, and sundries	220,583
Expenditure	152,888
Dividend No. 2	23,717
Balance	43,978

A New Rock-Drill Operated by Gasoline Engine

The 'Temple-Ingersoll Gasoline-Air' rock-drill has been placed on the American market during the past month by the Ingersoll-Rand Co. At present it is made in only one size, and the equipment employs the same type of drill and pulsator as are used with the 'Temple-Ingersoll Electric-Air' drilling unit. The electrical equipment of the latter type, however, is replaced by a 6-hp. single-cylinder gasoline engine. The gasoline motor, supply tank, and pulsator are all mounted on a four-wheeled truck to permit easy transportation. It is believed that the 'Temple-Ingersoll Gasoline-Air' drill possesses the advantages peculiar to the 'Electric-Air' drill, and also prove particularly suitable for use in situations where electric power cannot be economically or advantageously applied. The following description is furnished by the manufacturers:

The gasoline engine is of the jump spark type, the ignition spark being obtained from dry cells. The circulating water is obtained from any convenient receptacle placed near the equipment. A gasoline supply tank, of 1½ gal. capacity, surmounts the engine. The fuel consumption of the engine, running under load, is about two quarts of gasoline per hour, so that the average daily fuel consumption would be approximately three or four gallons.



TEMPLE-INGERSOLL GASOLINE-AIR DRILL.

The drill proper of the 'Gasoline-Air' unit is driven by pulsations of compressed air created by a pulsator actuated by the gasoline motor. Gearing transmits the power from motor to pulsator. The air is never exhausted, but is simply used over and over again, playing back and forth in a closed circuit. The pulsator is a simple machine, employing no water jackets.

The drill is the simplest type possible, a cylinder containing a moving piston and rotation device, with no valves, chest, buffers, springs, or side rods. The weight of the drill unit is about the same as or even less than that of the corresponding air drill. The ordinary air or steam-driven rock-drill takes a full cylinder of air or steam at full pressure each stroke and discharges it to atmosphere at practically full pressure. No advantage, therefore, is taken of the expansive properties of the air or steam, and as a result an amount of power is wasted without doing useful work. The 'Gasoline-Air' drill operates with a closed system filled with air under a low pressure, which is simply an agent for transmitting the effort of the pulsator piston to the drill piston. The air in the system has been aptly referred to as pneumatic 'spring.' That the saving in power is great is proved by the fact that, under ordinary conditions, the drill proper of the 'Gasoline-Air' unit uses about one-fourth the horse-power required for the usual air or steam drill, of the same work capacity. It has a stroke equal to or even greater than that of the air-

driven rock-drill of corresponding capacity. The length of stroke is varied simply by cranking forward in the shell, and both stroke and force of blow may be adjusted by the same means for fast drilling under any circumstances. If a hole should 'mud up,' the machine can be backed out without injury while running. The cushioning is such that the piston, in running, does not normally strike either front or back head. The system of lubrication of the pulsator is automatic and complete, the 'splash' method being employed. While most of the oil drains back to the crank chamber, a portion is atomized and carried through with the air into the drill.

The drill cylinder diameter is 4¾ in., and the stroke is 7 in. The drill will accommodate octagon steels of from 1 to 1¼-in. diameter, drilling holes of from 1¼ to 2-in. diameter. The drill feed is 24 in. The approximate strokes per minute are 440. The machine is designed to drill holes up to about 12 ft. in depth. Its field covers quarrying and contracting operations, particularly those in isolated locations where the high cost of coal forms a serious handicap to operations. Its advantages for winter operations in quarries will also be apparent to those who have experienced trouble from the freezing of ordinary drills.

Catalogues Received

THE NATIONAL TUBE CO. has prepared a bulletin, No. 19, which includes a complete list of National products, arranged conveniently for quick reference.

THE PLATT IRON WORKS CO. is now distributing a special bulletin, No. 741, descriptive of the 'Smith-Valle' line of pumps which are now made in wide variety of style and size to meet all conditions of drive and service. Particular attention is invited to the heavy standard frames, and the heavy pressures used with both the single and double acting pumps.

THE DORR CYANIDE MACHINERY CO. catalogue for 1914, now available, begins appropriately enough with a picture of the Lundberg, Dorr & Wilson mill at Terry in which Mr. Dorr's early experiments were conducted. Following this are description of Dorr classifiers, continuous thickeners, agitators, and the counter-current system of decantation with lists of the leading mines in which each is used.

THE PELTON WATER WHEEL CO. catalogue for 1914 includes not only excellent pictures and descriptions of the various types of wheels, valves, and other machinery built by this pioneer Pacific Coast concern, but numerous tables and other data of wide use to engineers. Among other features may be mentioned tables of weir measurements, tangential water-wheel tables, and safe working heads and weights of riveted steel pipes.

C. F. BRAUN & CO., Pacific sales manager for the Alberger Pump & Condenser Co. is sending out bulletin 100, containing a complete description of 'Hammond' water meters, with the following special bulletins: No. 1, 'Blackburn-Smith' feed water filter and grease extractor; No. 2, 'American' water softener; No. 3, 'American' pressure filters; No. 4, 'Wainwright' feed water heaters for marine service; No. 5, 'Centrifugal Pumps for Irrigation' the latter being a reprint of an excellent article published in *Western Engineering*.

THE MARION STEAM SHOVEL CO. has built some of the largest shovels and dredges in use but it also builds small shovels and has recently issued an attractive booklet of particularly convenient size, 4½ by 8¾ in., describing the Marion revolving shovel and illustrating the great variety of work now being economically accomplished with it. The catalogue is especially concise, and contains a good index as well as a table of working dimensions that furnishes a quick and easy method of obtaining necessary specification data.

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EDITORIAL

ACKNOWLEDGMENT should have been made to the *Weekly Trinity Journal* for the description of the Globe mine and mill printed in our issue of February 14. Owing to a misunderstanding of letters, this was not done at the time the article was printed.

OUR congratulations are extended to the Institution of Mining and Metallurgy which is now conveniently housed in its own building, No. 1 West street, Finsbury Circus, London. We trust that the new building will prove a home rather than a new house. The rooms in Salisbury House, 722 to 724 inclusive, made vacant by the removal of the Institution, are now occupied by *The Mining Magazine*, so we may fairly claim to be following in the footsteps of the Institution.

ANONYMOUS contributions can not be published for the simple reason that publication of any matter involves legal responsibility and a rule that is once broken is almost certain to lead through growing exceptions to trouble. Where there is any good reason, as there may well be, why the name of the author should not be used, an editor will gladly preserve his incognito; but material that comes to the editor with no name, a fanciful name, or an unknown name, must be sent to the waste basket even though it be often with regret. We have now a very clever letter regarding 'ore' that we are unable to use for these reasons.

NEW theories of ore genesis are constantly "tossed off" by those who develop them "while smoking a quiet pipe," but who seemingly are content to leave to others the critical testing of such hypotheses. Not long ago we saw a letter written to one of the larger exploration companies from an amateur scientist who had decided that in all gold-bearing districts the gold must eventually gravitate to the pools below waterfalls, and who thereupon submitted the idea as a final solution to the problem of gold finding. With rare generosity he did not "ask for any amount down, but a reasonable percentage of what it may yield," in Canada and the United States. He also reserved all rights in other countries, such as Australia, New Zealand, and South Africa. We consider this infringement. Long ago we came to the conclusion that placer gold was found in placers and, not to be outdone in generosity, we offer the theory to anyone who cares

for it and shall only ask a modest royalty on any gold that may be found as a result.

JAVA is to hold a General Colonial Exposition, August to November, inclusive, this year. Elaborate preparations are being made at Semarang. A park of 70 acres has been set aside for gardens and buildings. The Dutch have made a notable success of their colonial enterprises, and to Americans, whose minds are in two ways regarding colonies, the exposition will be especially interesting. It will also afford a good opportunity to cultivate foreign trade in the Far East. Those who wish detailed information may obtain it from Mr. T. Greidanus, 136 Water street, New York City.

DESULPHURIZING ores without roasting is accomplished at the 'low-grade' mill of the Nipissing Mines Company by an interesting process described for our readers by Mr. J. J. Denny, September 27 last. We understood at the time that the process, which involves the use of metallic aluminum to break down the sulphides, was neither patented nor patentable. We are now informed that application for patents in the United States and the principal foreign countries had been made in behalf of the Butters-Johnston Engineering Syndicate, even before the publication of Mr. Denny's article. Intending users of the process should therefore make sure of their ground before adopting it.

MUCH as we admire our brilliant contemporary, *Metallurgical and Chemical Engineering*, we cannot accompany it on its forays into the realms of natural history. Recently it sought to illustrate the present situation at Niagara Falls by means of a fable in which a beaver and an eagle enter into an agreement to divide the fish they catch, an arrangement which worked admirably until a tiger appeared and demanded a share of the spoil. Possibly the metamorphoses effected by the metropolitan fur dealers, who without difficulty transmute a raccoon into a Hudson seal, have so bewildered the New York editor that he confuses a beaver with an otter and an eagle with an osprey, but where does the tiger come in? Fortunately Mr. Theodore Roosevelt is still in South America and the life of the nature-faking chemical engineer is therefore not in immediate danger, but we advise him to accept an engagement which will take him to the Lena goldfields, or some equally inaccessible place, at the earliest possible moment.

WORKMEN'S compensation acts are beginning to be productive of interesting judicial rulings. The courts have held that rattlesnakes indigenous to the country constitute an industrial hazard, and a workman bitten is entitled to compensation. Whether this should be in liquid form, the New York *Sun*, which reports the ruling, does not state. Similarly, a boy who shot a workman in the eye with an airgun was considered an industrial hazard, but a brutal boss who whipped his workman was not, nor was compen-

sation allowed to the relatives of a workman whose enemy waylaid him and shot him while at work. This reminds us of the young woman who brought suit for damages against a railroad company in the West. It appeared that a brakeman, smitten by her charms, had thrown her a note tied to a torpedo. The maiden thrust them both into the kitchen stove and was severely injured by the resulting explosion. The court, after careful consideration, ruled that the brakeman's act was not in the performance of his normal duties, and the suit was dismissed.

STATISTICS are an infallible means of conveying misconceptions, especially when hastily considered. The carefully compiled and accurate statistics of the Copper Producers' Association show the stocks of copper on hand at the refineries on the first day of each month. Probably many people regard this as an index of what may be called the liquid stock of copper available in this country. We recommend to all such, consideration of the fact that the Association's report of marketable copper on January 1 was 91,000,000 pounds, while the quarterly reports of the Utah, Chino, Ray Consolidated, and Nevada Consolidated companies showed that on the same date they held a total of 109,000,000 pounds of copper. The difference is, of course, due to the fact that two different things are represented, the former being refined copper, the latter blister as well as refined metal. Just as the long large pipes of a waterworks system have considerable storage capacity, so the yards of smelters, freight cars, and warehouses serve to hold a large stock of copper, which is, in part at least, effective as a reserve stock, but which does not figure in trade statistics.

IT is not uncommon experience that gold mines turn into copper mines in depth, the Mount Morgan being the most notable example, and it is natural, therefore, to find a gold mining company turning its attention toward copper. These reflections are prompted by the announcement that the Exploration Company, Ltd., has invested \$450,000 in the bonds of the Chile Copper Company, the big new mine which the Guggenheim Exploration Company has developed at Chuquibambata, Chile. The chairman of the Exploration Company, in his speech at the general meeting of the Company in London, on February 17, stated his belief that the estimated cost of 6 cents per pound of copper laid down in Europe is on the safe side, and estimated that with a plant treating 10,000 tons per day of the 2 per cent ore, 120,000,000 pounds of copper per year could be produced at a profit of about \$10,000,000 yearly. The Exploration Company had previously acquired investments in copper mining companies in this country, and its present policy is to increase its copper mining interests. The advent of so well established a company into a field where many reputable large organizations are already engaged is cause for mutual felicitation. Meanwhile those who are inclined to read between the lines are likely to consider this

action as evidence of a belief by well informed persons that a larger field for expansion of operations exists in copper mining than in gold mining, a belief with which we agree.

PUBLICATION of the third edition of 'Lindley on Mines' is an event. The new edition, which was given to the public February 27, shows extensive revision and rewriting. The three bulky volumes are notable not only for the new matter included, but for the incisive presentation of a vast amount of material, here reduced to system and order. They also make fascinating reading even for the layman, as Mr. Curtis H. Lindley is no mere 'dry as dust' lawyer. He knows men, history, and times as well as law, and this, as well as much diligence, has contributed to making his book a notable one. Such a work can not be reviewed in the conventional sense, but we hope at another time to present an appreciation of it which shall be adequate in spirit if not in subject-matter.

Vocational Training and Miners

Discussing educational matters a few weeks ago, we mentioned the contradictory expressions of opinion by Mr. Nicholas Murray Butler, president of Columbia University, and Mr. T. W. Robinson, as regards vocational training. Mr. Butler sees in it a dangerous agency working toward a stratified social order and the extinction of individual initiative. On the other hand, Mr. Robinson believes that it results in greater industrial efficiency and increased truth, morality, and attention to civic duty. This conflict of opinion illustrates how little has really been determined regarding the best way to correlate education with life. In the old days, of household industries vocational training was obtained at home. The school could well afford to devote itself exclusively to stimulation of the intellectual life of the pupils, because the other work was done. As the factories grew up the school held its own, but the specialization of industry cut off the factory employee from that broad training which his father had acquired while learning how to earn his living. The very absence of such stimulus led him to value it the more, and America has come to be known for the lavish expenditure made upon schools. Yet no reflecting person feels sure that the public school system is doing for future citizens what may rightly and properly be expected.

We have received from Mr. G. McM. Ross a thoughtful letter-discussing this fact and calling attention to the Virginia City School of Mines, an outgrowth of the 'Comstock Class of Mining and Metallurgy,' of which Mr. Ross was the originator. We have had occasion previously to commend the work of this school and to express the wish that others of its type might be founded. It is a school for working miners and is designed to afford to the men in the mines an opportunity to learn about the things that concern them most in their daily life. It is akin to the continuation schools

of the German system, though its pupils do not necessarily come to it with the same thorough preparation. In Illinois, with the hearty cooperation of miners and operators, the State University is taking up the work of miners' institutes, and in various parts of the country there is a feeling of distinct need of a closer relation between the schools and the lives of miners as well as of mechanics in general. It is not that more colleges of mines are wanted, for there are more than enough now. More engineers are trained than can be absorbed by the industry, but the man in the ranks does not get the attention that he deserves. It is not too much to say that private correspondence schools afford now the most effective means that we have for meeting the needs of the miners, though the larger manufacturing companies make provision for helping their men to learn. It is well known that the great majority of the students in the public schools never get beyond the grades. They go into the mines, mills, and factories with only the elements of an education, and they face there a wholly new discipline and a wholly new set of ideals. In an effort to hold the boys and at the same time to bring shop and school together, the University of Cincinnati has arranged with owners of large plants for a coöperative course. One set of scholars works in the shops in the morning and in the schools in the afternoon, and exchanges places with another set at midday. In this way there is no interruption of routine, and yet school and work are taught at the same time. Mr. Ross proposes a similar plan for all lines of work, but would extend it to the lower grades as well as the high school and college. This is in accord with sound pedagogy, since Madam Montessori has shown that such training should be begun at the earliest possible moment. Mr. Ross points out that in each community it would be possible thus to give at the same time both vocational training and a general education to each child. The suggestion is worthy of the most careful consideration of professional educators. To our way of thinking, it is the absence of vocational training that endangers the present free rise of a workman from the ranks to leadership. There is nothing which would seem likely to make a man more 'class conscious' in the disagreeable sense of the term, than the knowledge that he had, somehow, been cheated out of the learning and broad training that would permit him to rise from the dead level. Some years ago the farmers woke up to the fact that the schools and colleges were not doing for them what they had a right to expect. The result was the system of agricultural colleges, short courses, farmers' institutes, experimental farms, and the whole system of agricultural education which is the newest and in many ways the most interesting phase of the American educational system. The first attempts were crude, and the system is far from perfect even yet, but it has abundantly justified itself in returns both of money and human character. If Mr. Ross' suggestion as a whole is too radical for us now, why, at least, cannot the miners have what the farmers already have?



THIRD BEACH LINE OF WINTER DUMPS.

Drift Mining in the Frozen Gravel Deposits of Cape Nome

By ARTHUR GIBSON

The following data were collected from and based on actual mining operations at some of the best and most successful mines on Seward Peninsula, Alaska. The numbers 1 to 5, inclusive, refer to the columns and properties in the accompanying tables.

No. 1. All work was performed during the winter, except sluicing and extracting the gold from the pay-dirt, which latter process was performed in the spring.

No. 2 and 3. All work was performed during the summer.

No. 4 and 5. Preparatory work was performed during the early spring, and all stoping, actual mining and sluicing was performed during the summer.

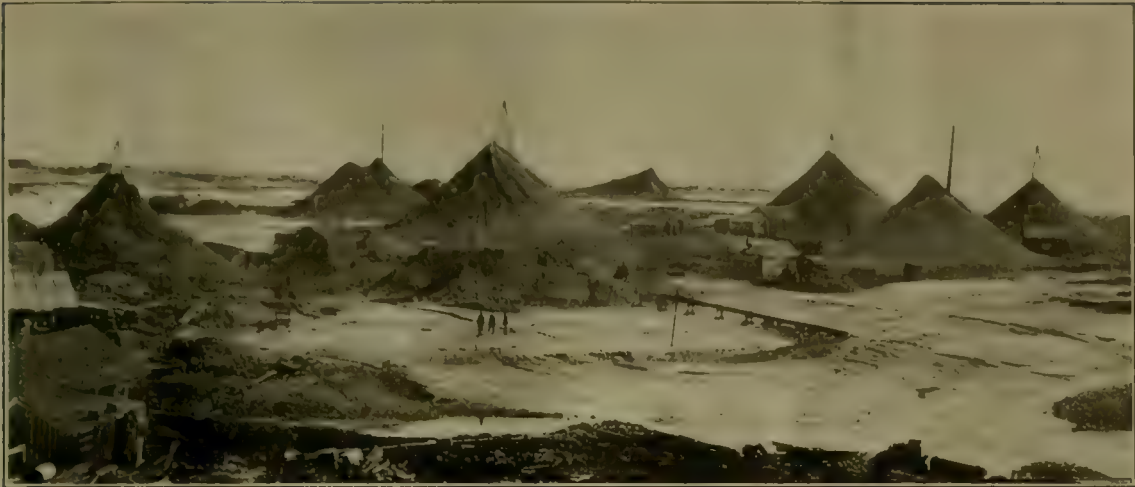
The preparatory work consists in sinking shafts, driving one or more main drifts through the pay-dirt from the bottom of the shaft, and cross-drifts from the main drifts, together with all necessary timbering and lagging. A sump is provided to collect the water from condensed steam and melted ice. All necessary mining machinery must be installed and the necessary buildings for the workmen erected during the early spring.

All thawing of the frozen auriferous deposits was performed during the night shift. All excavation or actual mining was performed during the day shift. The waste or overburden necessary to be removed in order to provide head-room for the workmen was thrown back or behind the workmen as the stope progressed toward the shaft; the pay-dirt was shoveled into dump-cars, holding from 8 to 13½ cu. ft., which run on light steel rails and are handled by manual labor. The pay-dirt is dumped into self-dumping buckets at the bottom of the shaft and hoisted to the surface by means of steam-driven hoists and steel

cables, and deposited or emptied during the winter season in a dump, at property No. 1; and during the summer season either in large wooden hoppers (in capacities from 70 to over 200 cu. yd.), at No. 2, 3, and 4, or directly into a large mud-box at the head of the string of sluice-boxes, as at No. 5.

The dump of pay-dirt at No. 1 was piped or hydraulicked down with a giant or nozzle, and the concentration or bottom of the dump was shoveled into sluice-boxes by manual labor, and the tailing was removed by horse teams and scrapers. This work was conducted day and night continuously until completed. At properties No. 2, 3, and 4 the pay-dirt was sluiced intermittently, whenever the hoppers were filled, or about once each day, and at No. 5 the pay-dirt was sluiced as fast as it was hoisted and deposited or emptied into the mud-box. The water required for sluicing purposes was in all cases supplied by independent distillate engines driving pumping plants, except at properties No. 2 and 3, which being worked together had one pumping plant in common.

At property No. 1 the pay-dirt averages 1 ft. above and 1½ ft. in bedrock. The deposit above bedrock appears to be an ancient sea bottom, and is composed of coarse gravel and sand with a great deal of white quartz and plenty of well preserved pecten shells. At properties No. 2 and 3 the pay-dirt averages 1¼ ft. above and 1¼ ft. in bedrock. The deposit above bedrock here also appears to be an ancient sea bottom, composed of sand, gravel, and boulders, with plenty of well preserved pecten shells. At No. 4 the pay-dirt averages 2 ft. above and 1½ ft. in bedrock. The deposit above bedrock is composed of well washed coarse gravel and sand. At No. 5 the pay-dirt aver-



ON LITTLE CREEK IN 1906.

DETAILED COST OF DRIFT MINING AT CAPE NOME

Name of Operators	Joe Wise & Co. (Joe Wise, Mgr.)	Joe Wise & Co. (Chas. A. Vogel, Mgr.)	Joe Wise & Co. (Chas. A. Vogel, Mgr.)	New Eagle Mining Co. (A. B. Brown, Mgr.)	Otto Olson
Number	1.	2.	3.	4.	5.
Depth of shaft, feet	53	81	81	45	50
Thickness of pay-dirt, feet	2.5	2.5	2.5	3.5	2.166
Thickness of waste, feet	1.5	2	2	1.5	2.333
Total depth of stope, feet	4	4.5	4.5	5	4.5
Number of boilers	1	2	2	1	1
Total boiler horse-power	45	70	70	35	50
Ground thawed per day, cu. yd.	128	205	257	128.57	327.13
Pay-dirt hoisted per day, cu. yd.	80	114	143	90	157.5
Capacity of self-dumping bucket, cu. ft.	18	16	24	13.5	13.5
Average number of buckets hoisted per day	120	192.4	161	180	315
Crude or fuel oil consumed per day:					
For thawing, gallons	168	168	168	84	210
For hoisting, gallons	52.50	42	42	31.50	52.50
Total gallons	220.50	210	210	115.50	262.50
Per cubic yard thawed, gallons	1.3125	0.81951	0.6537	0.65334	0.64195
Per cubic yard hoisted, gallons	0.656	0.368	0.294	0.35	0.333
Total per cubic yard of pay-dirt, gallons	2.756	1.842	1.469	1.283	1.667
Duty per barrel of crude oil, cu. yd. thawed	32	51.25	64.25	64.28	65.426
Duty per barrel of crude oil, cu. yd. hoisted	64	114	143	120	126
Distillate consumed per day pumping water, gallons.	132.8	30	30	14	18
Duty per gallon of distillate, cu. yd. sluiced	2.726	3.8	4.767	6.429	8.756
Number of men employed per day:					
Thawing—					
Pointmen	3	3	4	2	2
Fireman	1	1	1	1	1
Total	4	4	5	3	3
Mining—					
Manager	1	1½	1½	1	1
Foreman	1	1	1	1	1
Engineer	1	1	1	1	1
Laborers	16	17	17	0	20
Total	19	19½	19½	12	23

DETAILED COST OF DRIFT MINING AT CAPE NOME—(Continued)

Name of Operators	Joe Wise & Co. (Joe Wise, Mgr.)	Joe Wise & Co. (Chas. A. Vogel, Mgr.)	Joe Wise & Co. (Chas. A. Vogel, Mgr.)	New Earle Mining Co. (A. R. Brown, Mgr.)	Otto Olson
Number	1.	2.	3.	4.	5.
Sluicing—					
Engineer .....	..	1½	1½	..	1
Laborer	?	1	1	1	..
Total .....	..	1½	1½	1	1
Grand total men per day .....	..	25	26	16	27
Duty per man per day in cubic yards:					
Thawing waste and pay-dirt	32	51.25	51.4	42.85	109.04
Mining waste and pay-dirt	7.11	10.79	13.53	11.69	14.87
Mining waste and pay-dirt	8	12.06	15.12	14.28	16.36
Mining pay-dirt only	4.44	6	7.53	8.18	7.16
Mining pay-dirt only	5	6.7	8.41	10	7.87
Sluicing pay-dirt	18.11	76	95.33	90	157.5
Final combined, for pay-dirt .....	..	4.65	5.61	6.00	6.06
Cost of crude oil delivered, per barrel	\$2.97	\$3.30	\$3.30	\$2.90	\$2.71
Cost of distillate delivered, per gallon, cents	24.25	25.17	25.17	25.5	25.83
Rate of wages per day:					
Winter—					
Pointmen	\$4.00	..	..	\$4.00	\$4.00
Firemen	3.50	..	..	3.50	3.50
Manager	10.00	..	..	10.00	10.00
Foreman	5.00	..	..	5.00	5.00
Engineer	4.00	..	..	4.00	4.00
Common labor	3.00	..	..	3.00	3.00
Cook	4.00	..	..	4.00	\$3 to \$4
Summer—					
Pointmen .....	..	\$6.00	\$6.00	\$6.00	\$6.00
Assistant Pointmen .....	..	..	..	5.50	..
Firemen .....	..	5.50	5.50	5.50	5.50
Manager	10.00	10.00	10.00	10.00	10.00
Foreman .....	..	7.00	7.00	6.50	6.67
Engineer	6.00	6.00	6.00	6.00	6.00
Common labor	6.00	5.00	5.00	5.00	5.00
Cook	6.00	6.00	6.00	6.00	\$5 to \$6
Cook's helper	5.00	5.00	5.00	..	2.50
Average cost of board per man per day, including fuel and cooks' wages	\$1.25	\$1.08	\$1.08	\$1.15	\$1.35
Thawing, average cost per day:					
Crude or fuel oil	\$11.88	\$13.20	\$13.20	\$5.80	\$13.55
Labor and board	20.50	27.82	34.90	20.45	21.05
Repairs and renewals	7.50	7.50	7.50	2.50	7.50
Total operating cost	\$39.88	\$48.52	\$55.60	\$28.75	\$42.10
Mining, average cost per day:					
Crude or fuel oil	\$3.71	\$3.30	\$3.30	\$2.18	\$3.39
Management and board	11.25	5.54	5.54	11.15	11.35
Labor and board	79.50	118.52	118.52	70.15	142.37
Repairs and renewals	7.50	7.50	7.50	7.50	7.50
Total operating cost	\$101.96	\$134.86	\$134.86	\$90.98	\$164.61
Sluicing, average cost per day:					
Distillate .....	..	\$7.55	\$7.55	\$3.57	\$4.65
Labor and board	?	9.62	9.62	6.15	7.35
Repairs and renewals .....	..	2.50	2.50	1.50	1.50
Total operating cost .....	..	\$19.67	\$19.67	\$11.22	\$13.50

DETAILED COST OF DRIFT MINING AT CAPE NOME (Continued)

Name of Operators	Joe Wise & Co. (Chas. A. Vogel, Mgr.)	Joe Wise & Co. (Chas. A. Vogel, Mgr.)	Joe Wise & Co. (Chas. A. Vogel, Mgr.)	New Eagle Mining Co. (A. H. Brown, Mgr.)	Otter Creek
Number	1.	2.	3.	4.	5.
Cost per cubic yard of pay-dirt (cents).					
Thawing—					
Crude or fuel oil	14.85	11.58	9.23	6.44	8.60
Labor and board	25.62	24.40	24.41	22.72	13.37
Repairs and renewals	9.38	6.58	5.24	2.78	4.76
Total operating cost	49.85	42.56	38.88	31.94	26.73
Mining—					
Crude or fuel oil	4.64	2.89	2.31	2.42	2.15
Management and board	14.06	4.86	3.87	12.39	7.21
Labor and board	99.37	103.97	82.88	77.95	90.39
Repairs and renewals	9.37	6.58	5.25	8.33	4.76
Total operating cost	127.44	118.30	94.31	101.09	104.51
Sluicing—					
Distillate	8.89	6.62	5.28	3.97	2.95
Management and board	3.10	..	..	..	..
Labor and board	42.64	8.44	6.72	6.83	4.67
Repairs and renewals	9.27	2.19	1.75	1.67	0.95
Total operating cost	63.90	17.25	13.75	12.47	8.57
Recapitulation:					
Thawing	49.85	42.56	38.88	31.94	26.73
Mining	127.44	118.30	94.31	101.09	104.51
Sluicing	63.90	17.25	13.75	12.47	8.57
Grand total operating cost per cu. yd. of pay-dirt	241.19	178.11	146.94	145.50	139.81
Value of mining outfit	\$5,000	\$7,500		\$2,000	\$2,000
Value of pumping outfit	2,500	2,500		1,200	1,000
Total value	\$7,500	\$10,000		\$3,200	\$3,000

Columns No. 1, 2, and 3 refer to the Linda Association claim on Center creek; No. 4, Bench 1, Center creek; and No. 5, the Otter creek property.

ages 2 in. above and 2 ft. in bedrock. The deposit above bedrock is a fine or small black graphite-stained gravel, and sand in places.

The bedrock in properties No. 1, 2, 3, and 4 is a more or less broken-up mica schist. At No. 5 it is a broken-up black slate, which, when exposed to the air gives off a peculiar sulphurous odor. The waste or overburden at properties No. 1, 2, and 3 is a coarse gray sand; at No. 4 a light gray-brown sand and clay; and at No. 5, a fine light red gravel or gray sand.

All fuel used for thawing and hoisting in each of the cases hereinafter cited was California crude oil. The variation in cost of fuel noted in the annexed table is partly due to the fact that the initial price was raised during the last year, although the former and lower prices were maintained in some cases because of contracts which had not yet expired; and partly to

the different freight rates, which are proportional to the various distances between the supply station at Nome and the mines, and are lower during the winter than in the summer. The price of distillate at Nome was 23½c. per gallon. The additional cost hereafter noted is due to freight charges.

The cost data tabulated above cover only the total operating expense during actual mining operations, and do not include interest on the investment, depreciation, or any expense incurred through prospecting or preparatory work.

1. Cubic yards thawed includes both pay-dirt and waste. Wherever reference is made in this article to cubic yards, the same is based on loose or excavated dirt, measured by the number of buckets of pay-dirt hoisted. The quantity of waste is estimated according to the relative thickness of waste compared with

the thickness of the pay-dirt in this case.

2. Number of men employed and cost per day for sluicing up the pay-dirt in No. 1 property cannot be tabulated. However, the following statement gives the total number of men employed and the total expense of sluicing all of the pay-dirt, amounting to 6520 cu. yd. hoisted during the winter: 10 men were employed per day during the ground-sluicing process and 21 men per day during the shoveling in process. The wages paid were \$6 per man per day on account of working 12-hour shifts.

3. Duty per man per day in cubic yards, exclusive of manager.

4. Duty per man per day in cubic yards, based on number of laborers only.

Repairs and renewals are in some cases closely estimated, no true records being available.

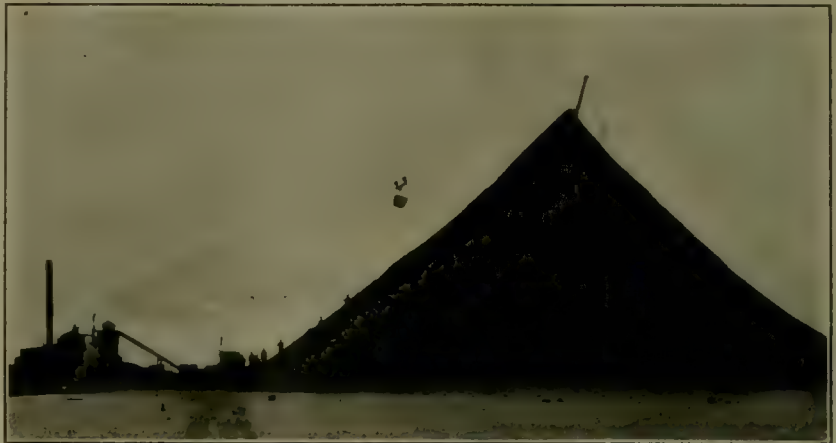
The large consumption of distillate while sluicing the pay-dirt on No. 1 property was due to pumping water continuously for 24 hours per day for 18 days and handling 6520 cu. yd. of dirt with a considerably larger volume of water than was necessary under the conditions obtaining as shown at No. 2, 3, 4, and 5 properties.

No. 2 and 3 properties had approximately twice the head to pump against that No. 4 and 5 had, which explains the greater consumption of distillate. Property No. 4 pumped intermittently, while No. 5 pumped continuously during the day shift, which explains the greater consumption of distillate of the later. Properties No. 2 and 3, being operated under one management, reduces the operating expense for No. 2 by 7.98c. and No. 3 by 6.35c. per cubic yard below what it would have been had each of these plants been operated independently; or, in other words, the total operating cost per cubic yard of pay-dirt of No. 2 and 3, if operated independently, would have been 186.09c. and 153.29c., in place of 178.11c. and 146.94c., respectively, as actually obtaining.

The following conclusions may be drawn:

(A) The cost of thawing is unquestionably higher during the winter than the summer season.

(B) Actual mining likewise is apparently more expensive during the winter than the summer.



A WINTER DUMP; THE BUCKET DROPS DOWN A VERTICAL SHAFT AND LOADS FROM A SUMP.



GROUND SLUICING A WINTER DUMP.

(C) Sluicing the pay-dirt mined and hoisted during the winter necessitates rehandling the dirt, which greatly increases the operating cost of winter mining. It is also evident that plants operating with hoppers require more labor than do those where the pay-dirt is deposited directly into a mud-box.

(D) The total operating cost proves beyond a doubt that winter mining is the more expensive. Preparing

or blocking out the ground in the spring, under the low winter rate of wages, and mining the gravel during the summer under the system of property No. 5, is the most profitable method.

E The pay-streaks herein cited average in thickness from 2 ft. 2 in. to 3 ft. 6 in., and the waste or

overburden necessary to be removed in order to provide head-room for the workmen averages in thickness from 1 ft. 6 in. to 2 ft. 4 in. It is therefore evident that the operating cost per cubic yard of pay-dirt will be materially reduced according to any increase in the thickness of the paystreak.

Eighty Years of the Silver Market

Owners of silver-producing mines in Australia, Canada, Mexico, and the United States keep a close watch on the prices of this metal and the causes of fluctuations. The following valuable table, compiled by Pixley and Abell, bullion brokers of London, shows the movements of the silver and causes thereof, from

1833 to the end of 1913. The average prices are in pence per ounce, and to convert into United States coinage multiply by 2. The imports and exports refer to transactions in London, which is the great market for silver. Quotations since the first of the year appear in our market pages.

YEARS.	AVERAGE.	Imports of bars and coin.	Exports to the East.	Remarks.
1833	59 ³ / ₁₆	.....	£1,895,023	Continuance of East India Co. Slavery abolished, compensation to owners, £20,000,000. Renewal of bank charter, bank notes a legal tender.
1834	59 ¹ / ₁₆	.....	2,146,465	Great importation of gold into New York. Substitution of metallic currency for paper in the United States.
1835	59 ¹ / ₁₆	.....	2,036,167	Extinction of United States national debt. Bank of United States wound up, owing to refusal of Congress to re-charter it.
1836	60	.....	2,610,101	Banking and commercial embarrassments in United States. Spanish civil war.
1837	59 ³ / ₁₆	.....	3,010,190	Commencement of panic in London. Discounts refused. Many houses trading with the United States stop payment. Accession of Queen Victoria. Rebellion in Canada.
1838	59 ¹ / ₂	.....	1,945,264	Resumption of specie payments in United States. Famine in various parts of British India. Afghan war.
1839	60 ³ / ₈	.....	1,786,253	Banks in United States suspend payments in specie. War with China.
1840	60 ³ / ₈	.....	1,841,335	Misunderstanding with France. Treaty of London for settlement of Eastern question.
1841	60 ¹ / ₁₆	.....	3,143,292	Great depression in every branch of manufacturing industry.
1842	59 ⁷ / ₁₆	.....	4,794,678	Peace with China. Income Tax Act passed.
1843	59 ³ / ₁₆	.....	3,752,472	Treaty of commerce opens China to all nations.
1844	59 ¹ / ₂	.....	2,495,959	Bank Charter Act passed. Consols 101 ¹ / ₄ . Prior to September this year, the bank never reduced the rate below 4 per cent.
1845	59 ¹ / ₄	.....	2,939,922	Railway mania. Sikh war.
1846	59 ⁵ / ₁₆	.....	1,973,391	Commercial and railway panic. Repeal of corn laws.
1847	59 ¹ / ₁₆	.....	4,204,503	Year of panic. £10,000,000 granted for relief of famine in Ireland. Gold discovered in California.
1848	59 ¹ / ₂	.....	3,396,807	Sikh war.
1849	59 ³ / ₄	.....	3,811,809	First importation of Californian gold into England. Annexation of the Punjab.
1850	60 ¹ / ₁₆	.....	5,052,059	Average of consols 96 ¹ / ₂ .
1851	61	.....	1,715,100	Discovery of gold in Australia.
1852	60 ¹ / ₂	.....	2,447,450	Consols touched 102, and averaged 99 ¹ / ₂ .
1853	61 ¹ / ₂	.....	3,117,980	Australian mint established.
1854	61 ¹ / ₂	.....	3,095,490	Russian war began.
1855	61 ⁵ / ₁₆	.....	6,431,733	Loan of 16 millions. Fall of Sebastopol.
1856	61 ⁵ / ₁₆	.....	12,113,991	Russian war ends.
1857	61 ³ / ₄	.....	16,731,915	Panic. Suspension of Bank Charter Act. Indian mutiny. Loan of £1,000,000 to East India Co.
1858	61 ⁵ / ₁₆	£6,700,000	4,753,933	End of Indian mutiny.
1859	62 ¹ / ₁₆	14,772,460	14,828,521	Loan of £5,216,528 to East India Co.
1860	61 ¹ / ₁₆	10,394,000	8,478,739	Commercial treaty with France.
1861	60 ¹ / ₁₆	6,590,000	6,824,807	Financial depression in India. American Civil War begins.
1862	61 ⁷ / ₁₆	10,753,000	10,091,460	Great distress in cotton manufacturing districts. Panic.
1863	61 ³ / ₈	10,888,130	8,263,011	Large exports of gold to the Continent to pay for silver.
1864	61 ³ / ₈	10,827,300	6,254,004	£13,000,000 silver exported from France.
1865	61 ¹ / ₁₆	6,980,000	3,598,058	Close of American war.
1866	61 ¹ / ₈	10,778,000	2,365,626	Commercial and joint stock companies panic. Bank declined to sell bar gold.
1867	60 ³ / ₁₆	8,020,000	642,912	Great decline in export of silver, only £2,500,000 sent from France.
1868	60 ¹ / ₂	7,716,420	1,635,642	Abyssinian expedition.

No statistics of imports of silver obtainable prior to 1858.

EIGHTY YEARS OF THE SILVER MARKET—Continued

Year	Average	Imports of Silver and Gold	Exports to the East	Remarks.
1869	60 $\frac{7}{16}$	£6,730,000	£2,362,943	Distress in Lancashire.
1870	60 $\frac{9}{16}$	10,649,000	1,579,473	Franco-Prussian war. Panic.
1871	60 $\frac{1}{2}$	16,520,000	3,712,473	(£500,000 gold exported to Hanse towns. (Peace between France and Germany.)
1872	60 $\frac{5}{16}$	11,140,500	5,654,451	(£650,000 gold exported to Hanse towns. Commencement of decline in price of silver.)
1873	59 $\frac{1}{2}$	12,302,220	2,497,576	(10,000,000 gold exported to Hanse towns. German Government announces the demonetization of silver.)
1874	58 $\frac{5}{16}$	11,797,990	7,092,726	Enormous increase of bullion in Bank of France, £2,000,000 mostly gold.
1875	56 $\frac{1}{2}$	9,506,757	3,714,404	Heavy commercial failures. Large export of gold to Germany.
1876	52 $\frac{1}{2}$	13,585,608	10,914,407	Continued decline in price of silver. Remarkable fluctuations in rates of Indian exchange and for silver.
1877	54 $\frac{1}{2}$	21,625,652	17,007,458	Great famine in India. Russo-Turkish war.
1878	52 $\frac{3}{16}$	11,453,105	5,842,577	General depression in trade. Large bank failures. Russo-Turkish war ended.
1879	51 $\frac{1}{2}$	10,520,012	7,034,967	Suspension of sales by German Government. Marked diminution in production of Californian mines.
1880	52 $\frac{1}{2}$	6,827,471	6,135,520	Consols touched 100 $\frac{1}{2}$. Reported existence of large quantities of gold in south India.
1881	51 $\frac{11}{16}$	6,902,210	4,288,000	Meeting of conference in Paris respecting bimetalism, which adjourned without coming to any practical conclusion.
1882	51 $\frac{1}{2}$	9,243,375	6,423,270	War with Egypt.
1883	50 $\frac{3}{16}$	9,468,002	7,125,454	Completion of Italian order for gold.
1884	50 $\frac{1}{2}$	9,546,496	8,418,522	War in Egypt, income tax increased. Franco-Chinese complications.
1885	48 $\frac{1}{2}$	9,377,601	8,010,927	Suspension of the coinage of the United States, recommended by the President of the United States.
1886	45 $\frac{3}{16}$	8,166,249	5,846,222	Great depression in trade.
1887	44 $\frac{1}{2}$	7,471,639	6,327,113	Depression in trade continued, assisted by war rumors.
1888	42 $\frac{1}{2}$	7,825,380	7,807,400	Deaths of two German emperors successively caused great uneasiness. War rumors subsided later. Stringency of money earlier than usual toward close of the year.
1889	42 $\frac{1}{16}$	9,184,940	8,575,713	Home coinage of silver unusually large.
1890	47 $\frac{1}{16}$	10,385,659	8,456,709	Severe panics in London and New York. Extension of silver legislation in the United States.
1891	45 $\frac{1}{16}$	9,316,200	7,082,719	Chinese revolution. Failure of United States Legislature to maintain silver prices. Large Continental orders.
1892	39 $\frac{1}{4}$	10,746,382	11,881,885	Further depression in silver. Inoperative monetary conference at Brussels.
1893	35 $\frac{1}{2}$	11,913,395	11,649,411	Indian mints closed to free coinage of silver. Repeal of Sherman Act. Australian bank crisis.
1894	28 $\frac{1}{2}$	11,005,507	10,041,162	Duty of 5% imposed on silver entering India. War between China and Japan.
1895	29 $\frac{1}{2}$	10,669,682	6,484,933	Speculation in African mines. Large indemnity to Japan. Consols touched 100 $\frac{1}{2}$. U. S. currency difficulties.
1896	30 $\frac{3}{4}$	14,329,116	6,897,015	Consols touched 111. Defeat of silver party in U. S. election. Extensive coinage of silver by Russia.
1897	27 $\frac{9}{16}$	18,032,091	7,223,397	Turco-Greek war. Famine and plague in India. Gold standard adopted by Japan.
1898	26 $\frac{1}{8}$	14,677,799	5,949,285	Spanish-American war. Indian Monetary Conference. European extension in China. Sudan reconquered.
1899	27 $\frac{7}{16}$	12,727,989	7,742,829	Boer war. 6% bank rate in December. Consols down to 95 $\frac{1}{2}$.
1900	28 $\frac{1}{4}$	13,322,300	9,985,642	Continuation of Boer war. Large coinage of rupees. Boxer rebellion in China.
1901	27 $\frac{3}{16}$	11,501,678	9,018,419	Death of Queen Victoria. Assassination of President McKinley. Continuation of Boer war. Combination of American smelters.
1902	24 $\frac{1}{16}$	9,764,296	7,565,305	End of Boer war. Heavy fall in silver. War indemnity unsettles China trade.
1903	24 $\frac{1}{2}$	10,310,330	8,051,780	Straits Settlements and Siam adopt gold standard. Large purchases by the Indian Government. U. S. buys for new Philippine coinage. Mexican Currency Commission.
1904	26 $\frac{1}{2}$	11,687,339	10,038,319	Russo-Japanese war. Monetary reform in Mexico. Continued buying by Indian Government.
1905	27 $\frac{1}{16}$	12,992,014	8,643,405	Mexican mints closed to free coinage of silver. End of Russo-Japanese war. Internal troubles in Russia. Continued buying by Indian Government.
1906	30 $\frac{1}{2}$	17,288,063	15,565,334	Heavy purchases by Indian Government. Large exports of dollars from Mexico. Resumption of purchases by U. S. Government. Straits exchange fixed at 2/4 per dollar.
1907	30 $\frac{3}{16}$	15,983,892	12,752,230	Cessation of Indian buying. Sharp fall in silver. Financial crisis in U. S. Bank rate 7%.
1908	24 $\frac{3}{4}$	10,326,889	10,243,968	Large gold exports to Paris. General depression of trade. Political unrest in southeastern Europe.
1909	23 $\frac{1}{16}$	11,814,889	8,936,715	Some improvement in trade. Good crops, especially of cotton, in India.
1910	24 $\frac{1}{2}$	14,100,310	8,648,443	Death of King Edward VII. Indian import duty on silver increased from 5% ad val. to 1 annas per ounce.
1911	24 $\frac{3}{16}$	14,293,747	9,865,796	Strikes and labor unrest in England. Rebellion in China. Italian war in Tripoli.
1912	28 $\frac{1}{2}$	16,778,304	14,345,474	Establishment of provisional government in China. Indian Government purchased 15,000,000 silver. War between Turkey and Balkan States.
1913	27 $\frac{9}{16}$	14,495,049	10,739,978	China loan of £25,000,000. Indian Government bought £5,500,000 silver. Failure of Indian Specie Bank. Civil war in Mexico.

Assembling and Erecting Wooden Tanks

By J. M. LULLIGREN

Redwood tanks are an important part of the equipment of many reduction plants. The general features connected with the erection are familiar, but in the making of a good tank there are many details known only to those who have had the experience. Particularly is a knowledge of details essential in erecting a tank with warped material.

The first important consideration is the selection of material. Whatever the number and size of tanks may be, the contract with the mill should call for well seasoned material because this class and no other will give the best results. The manufacturer generally turns out first-class stock, and the shipments leave the plant in good condition, whether seasoned or unseasoned. Owing to the softness of the wood, the transfer and haulage to the mine or mill should be under intelligent direction to avoid damage. When the material arrives at its destination it should be piled and protected from rain, snow, and direct sunshine to prevent shrinkage and warping. Where possible, the mill furnishing the redwood delays shipment purposely so that the material may have no chance to check, warp, shrink, or become water-soaked. However, it is not always possible to arrange shipments to out-of-the-way places so that material will arrive as used, and some warping and shrinkage will usually occur, especially in wood not properly seasoned. Warped material adds greatly to the difficulties of erection, and as the minimum of twist is met with in well seasoned stock, the necessity of specifying this grade in ordering, and taking proper care of it at the plant afterward, will be appreciated.

Foundations

The foundation may be either of timber or concrete, but whatever class is used there are two essentials to be observed. First, that the tank bottom be supported by chine joists or stringers, at intervals of not more than 30 in. for tanks about 12 ft. high, and 24 in. for 20-ft. tanks. The joists may vary in size, though it is customary to use 6 by 8-in. or 6 by 10-in. timber. The centres for joists on tanks of different size can be proportioned from the two given as the height of ordinary tanks does not often run above 20 ft. The limit of distance apart for low tanks can be considered as 36 in. The second essential to be noted is carrying the joists out to within at least 3 in. of the stave chine; all should be level, and without projecting nails. The foundation should be built up sufficiently high to give plenty of room under the tank for free circulation of air. Rot is the most deadly enemy of redwood tanks, and if the circulation of air is not provided the life of the tank is materially lessened.

Laying Out Bottom

With the bottom supports sufficient in number and properly spaced and cut, the next step is laying out the bottom. The line from which the work starts is struck at right angles to the joists and marked across all of them by pencil. The line is determined by first finding the exact centre of the foundation, and then measuring from this point a distance equal to the distance of the trammel mark from the edge of the centre plank. The trammel mark is a point on the centre plank and is the centre of the tank bottom; it is made at the mill at the time the bottom is laid out for cutting. Any convenient piece such as a 2 by 4 in. is nailed flush to the line to serve as a backing in laying the first half.

Bottom planks are generally marked with a letter and number, the letter denoting the tank, while the number gives the position of the plank starting from one side. When bringing in the bottom pieces they may be placed roughly in their respective positions, piling three high to allow room to lay out the centre; this also permits the guard pieces at each end to be conveniently knocked off. The two outside pieces, known as cants, are carefully placed to one side to avoid injury, as the points, being slender, are easily damaged.

Starting from the 2 by 4 in., the planks are laid on both sides as their numbers indicate, snugly against each other. This is to observe any warping or wide cracks. When planks are in two pieces, as they generally are in large tanks, they should be of exactly the same width where they butt together. When they are not, they are taken up, scribed, and dressed down to the line with a plane, the finishing being done with a jointer.

In finishing a plank, the outer end should be slightly wider than the butt, because in tightening up the tank after the staves and bands are in position a tight joint is assured at the ends of the bottom pieces. If the pieces are true, a tight joint will result along the entire length of the plank, but if a difference in width makes it necessary to dress down one or both, it is best to have a very light taper run from butt to outside end; the difference in width between butt and end is taken care of when the bottom is drawn together.

When a small amount of water is first put in a finished tank the bottom may have a tendency to lift up at one or more places due to the crosswise swelling of the planks. In a measure, the spring of the bottom can be almost entirely avoided by cutting out about three-eighths of an inch from that plank which is distant about one-sixth of the diameter from each end-piece; tapering the cut from centre to outer ends

should be carefully observed. This is illustrated at *a*, Fig. 1. At first glance it would seem that cutting out this amount from the piece would leave an open seam, but the fact is that the tightening process brings the pieces together to a good joint, and in the subsequent swelling there is less tendency for the bottom to rise.

When all the bottom planks have been carefully looked over and trued up, the pieces are again roughly piled to make room at the centre, and the work started of laying the bottom permanently. Beginning at the

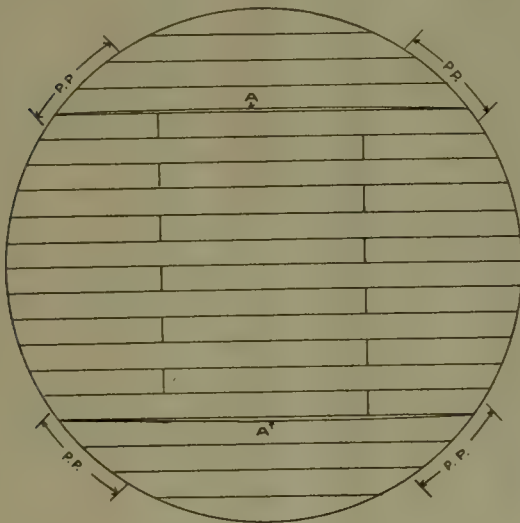


FIG. 1.

centre and on that side of the centre line from which the numbers start, the two centre planks are laid down snug against the strip, the outer ends equally distant from the joists. Wooden pins are then inserted in the dowel holes, and the next set plank laid on to a close fit. Where two planks form one bottom piece, the butts are sawed for inserting a flat iron or wooden slip tongue. Care must be used in driving the iron ones, as there is a chance that they will run either up or down, thus making a bad butt joint. Wooden slip-tongues are preferable to iron, for the wood will swell and give a tight joint. If there is need for driving the plank to make a close fit, a block of wood should be used as a buffer; under no circumstances should the edges of the plank be struck with a hammer.

Laying the pieces, proceed until all of the first half is in place. This is then tied together by nailing a piece of 2 by 4-in. timber from cant to centre at approximately right angles to the lengths, the purpose being to hold this half of the bottom until the second half has been laid. The strip marking the centre line is then removed and the balance of the bottom put in place. The entire bottom is then tied together with a second piece of 2 by 4-in. timber. A line is then scribed around the rim of the bottom the depth

of the croze, to serve as a mark for determining when the staves and bottom come together.

Setting Staves

The diameter and height of tank determine the character of scaffolding required in setting up the staves. This is largely a matter of individual taste, but the scaffold should be strong, well braced, and with platforms at suitable heights for convenient and rapid work. On low tanks, and even on tanks of considerable height, where the staves are all quite straight, it is possible to do the erecting without a scaffold by toe-nailing the staves to each other from the inside, and using the usual inside bracing. However, as a matter of general safety, it is best to use a scaffold on all tanks higher than eight or ten feet. The arrangement of staves preparatory to erection depends upon the proportion of height to diameter. If the diameter is considerably greater than the height, the staves are laid on the finished bottom in eight piles, as shown in Fig. 2, four consisting of 'straights,' two

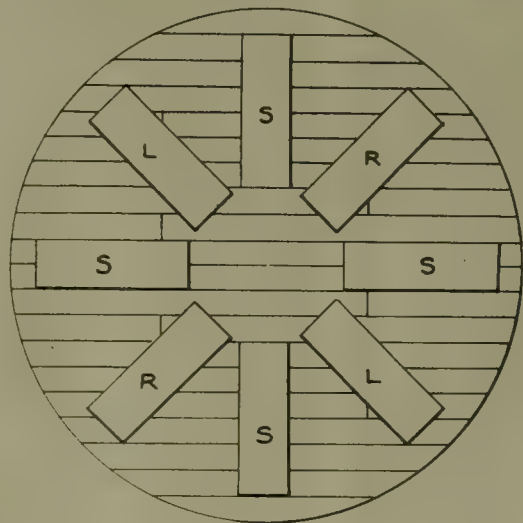


FIG. 2.

of 'lefts,' and two of 'rights.' The warp of a stave, looking at it from the inside chine end, determines whether it is 'right,' 'left,' or 'straight.' Fig. 3 illustrates this in a somewhat exaggerated form.

A glance at Fig. 2 shows the straight staves are so piled that they can readily be set up at each of the cant pieces, and at opposite sides of the centre. There are several reasons for so placing them. The rim of the cant pieces are the weakest parts in the bottom, and partly because of this the straight staves are used, as they can be set very close together and held in position with the least strain on the rim. It is essential that straight staves be provided for opposite sides of the centre, because between each section the 'rights' and 'lefts' are erected.

Fig. 3 shows 'right' and 'left' staves on opposite sides of a straight one. If a number of staves of the same warp were set up each side of a section of

straight staves, as shown in Fig. 4, there would be a tendency, when the tank is tightened, to pull one way and thus give a lop-sided tank; whereas, when they are set up as shown in Fig. 3, there is an equal

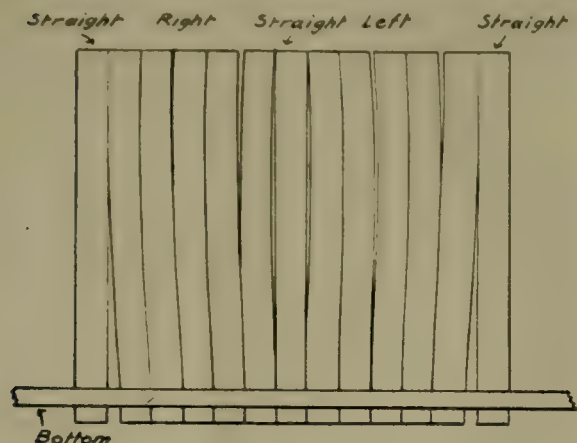


FIG. 3.

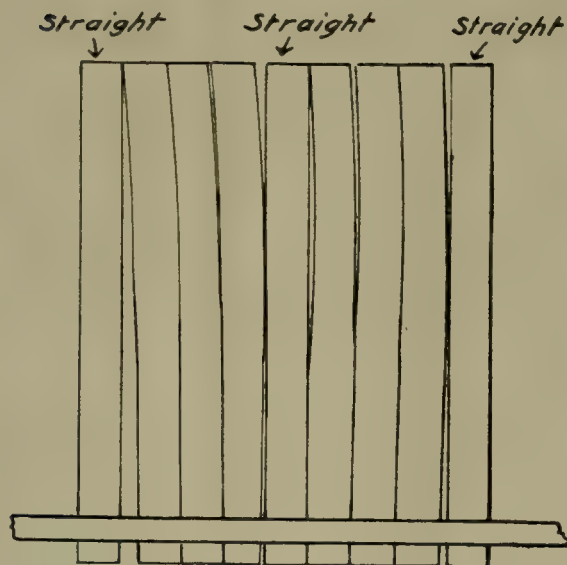


FIG. 4.

pull on both sides of the straight staves. If there is a preponderance of 'rights,' which is likely, more care must be used to insure an acceptable tank. If the length of a stave is too great to permit piling them on the bottom, they are set on end against the scaffold or placed outside around the bottom within easy reach. In any event, they are to be set up according to the diagram in Fig. 2.

If the staves are not marked at the mill, from 15 to 18 straight ones are selected for use in marking the position of the bands. The distance apart of each band is marked with pencil or chalk, and as the erection proceeds these staves are set in at more or less regular intervals. The placing of the bands is thus easily and rapidly done.

Obviously, the first stave set in position should be straight. To be assured the staves will not fall in while being set and before enough bands are on to hold them, it is usual to set them out of plumb in the proportion of 4 in. to 12 ft. in height, as shown in Fig. 5. A side brace is nailed to the first stave only, while the inside braces are nailed on at regular intervals until all staves have been placed in position. The braces serve the purpose of steadying the staves and overcoming any tendency of pitching in. Narrow strips of wood are laid on the stave tops and nailed, holding the stave in position after being set. The member of the crew whose duty it is to do this also takes care that the alignment and spacing of the tops is correct.

The stave croze is so cut that it will slip over the

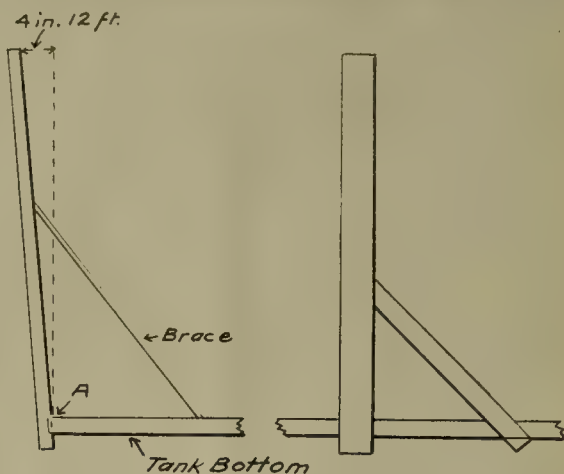


FIG. 5.

rim one-third its distance, as indicated at *a*, Fig. 5, and a tap with a hammer drives it in half its depth, which is the proper distance in first setting the stave. This proves true only of properly seasoned and well cared for material. In poorly seasoned stock, or that which has been exposed to rain or sunshine, the croze may be large or small, depending upon conditions. If large, it becomes necessary to insert a strip of canvas or burlap to care for the shrinkage; if small, the edge of the croze must be battered a little. In the latter case there is danger of the chine breaking off; while in the first case there is a good chance that leaks will develop. All of which emphasizes the necessity of getting the right material in the first place and taking care of it afterward.

A very important matter is to encourage a uniformly close contact between all the staves, which is absolutely necessary in getting a tight tank. The staves are always set as close together as possible, especially on the cants, and when pulled in by the bands, draw closer until the stave and rim touch; if drawn more than this, the wood is crushed. The line previously scribed around the circumference is a good indicator for determining when the stave is up. The

compression gained by drawing the bottom plank together affects the staves at the ends of the plank, but does not have an equal influence at the cant pieces. At each of these the staves are brought closer together by providing four pressure points, as shown in Fig. 1. When the staves are being set, several of the bottom planks are opened a little at the ends and a thin wedge or shingle slipped into the seam, particular care being taken that the staves are set very close at each of the four points. Later, the shingle or wedge is removed. When the staves are finally drawn in by the bands, and the bottom planks come together, the staves at each of the four points exert a pressure upon the staves to each side. The point of least resistance is along the smoother rim of the cant pieces rather than along the cross grain of the plank ends, and consequently the staves at the cants are moved to a close contact.

Even when considerable care has been taken in setting the staves and drawing up the tank, small openings may be observed near the bottom. If they are few, a simple and effective emergency remedy is to drive a chisel into the stave from inside about one-half inch from the edge. This presses the wood out, closing the opening; a redwood wedge is then driven into the chisel mark and the opening permanently closed. If there are several small openings together, the procedure is to cut a short length of 4 by 6-in. lumber to fit the diameter of the inside. Placing this block on the bottom and against the side of the tank, it is beaten with a hammer from a point where the staves are tight toward the openings. The staves will "work" in the direction of the open spaces. The bottom bands must be loosened to give the staves room to spring out and move. When this has been done, and the bands are finally tightened for the last pull, the joints will come together tight.

Banding and Trimming

Putting on the bands begins immediately after the last stave is in place. The second band from the bottom is the first to go on, and when drawn up snug will usually hold the staves in position. Before the inside braces are knocked off, a second band is put on about three feet above the first. If the staves flare out too much to allow this band to come together, the connection is made by using a short bolt and lug, the extension being removed later. With two bands on, the braces and top strips can be removed, and the staves drawn together to approximately a vertical position, after which the bands are put on in regular order.

The marked staves indicate the position of the bands, and each full band is made up of several sections, the number in each depending upon the diameter of the tank. The line of the lugs connecting the sections should be carried up at a uniform angle. If the lugs were placed directly one over the other, forming a vertical line, there would be one stave each side of the lug that would not be touched by the band. As

a result, when the bands were drawn up, the untouched staves would buckle, leaving open joints. When the lugs are carried forward and upward progressively, all staves are in contact with some of the bands and there is no inclination to buckle. The threaded end of each section should project through the lug to the left, as this gives a downward pull in tightening the nuts, a matter of some importance from the viewpoint of labor saved when it is considered that there may be as many as 300 nuts on one tank.

When several bands have been placed in position and drawn fairly tight, trimming the staves begins. This is done with a block of hard wood and a hammer. Starting at the bottom, the staves are beaten into position all around the tank, care being taken from the first that the staves come together without a staggered or saw-tooth effect. As the trimming proceeds upward, the bands above are kept just tight enough to permit working the staves into place by light blows of the hammer. Some staves may be bowed enough to require beating from the inside, but it is usually possible to work them out by hammering the adjoining staves alternately. With bands at proper tension, a light blow on the block is more effective than a hard one.

By the time the tank has been trimmed, all the bands will be quite tight, and everything about ready for the final pull. During the time the bands were being put on and when the tank was assuming final form, any tendency to list should be remedied by bracing the side opposite and drawing up the bands on that side; this pulls the listed side into position. All sections of each band should be tightened uniformly. When all is complete, the final tightening of the bands begins at the top and ends at the bottom.

Cone Bottoms

Cone bottoms are put in tanks to facilitate sluicing out whatever may be put into them. The use to which the tank will be put determines the pitch of the cone, which may vary from very flat to 45° or more. A few years ago cone-bottom tanks were made in such shape that the cone was watertight and supported the entire weight of the contained material. Present practice is to put the cone in on top of the flat bottom and leave space between the staves so the weight of the material will be on the well supported flat bottom and not on the cone.

Fig. 6 shows three ways in which the cone may be arranged. The first, "A," is generally used, as this does not involve a special stave. The opening between the staves at the circumference of the tank should be sufficient to allow the material going into the tank to settle through freely. The number of rings supporting the cone varies with the diameter; a 20-ft. tank may be supplied with one or two, while in a wider tank there may be three. The rings are made up of segments cut from 2-in. lumber and are 4 in. wide. As a rule, the number of segments to a ring are marked on several of the pieces, so there will be

no confusion in getting the right ones for the different diameters. Before laying out the segments the circle is marked on the tank bottom and the ring built around this mark. The ring supports may be either of 2 by 4 in. or 4 by 4-in. lumber; the weight to be supported is not great, but the supports should

out. This gives a good opening and one large enough for all purposes.

A cast iron cone for the bottom is usually provided (b, Fig. 7), and to this the staves are fitted. If no casting is furnished, the points of the stave can be protected by fitting on a flat iron ring. A ribbon of 1 by 4 in. nailed around the inside of the tank (a, Fig. 7, and Fig. 6) supports the ends of the stave. All staves are well nailed to the rings, and the ends are nailed to the bottom and sides of the tank.

In concluding these notes, it is well to emphasize the necessity of specifying the class and condition of material when ordering tanks, irrespective of size or number. If the proper foresight is observed at this time, and due precaution taken in handling the material later, little trouble will be experienced in erecting satisfactory tanks. The wood should be clear, straight grained, containing no knots, sap, or gum-holes. If possible, it should be from air-dried lumber, as kiln-dried material does not possess the 'life' found in the other. The ends of all staves and bottom pieces should be painted with an air-tight paint to prevent shrinkage and rot. The bottom planks should be cut from long lengths, and the ends well guarded against damage. It is well, also, to have the chines-nailed, as they are easily damaged and not very easily patched up. These are the important points for consideration; by keeping them in mind from the first, a great deal of time and labor will be saved.

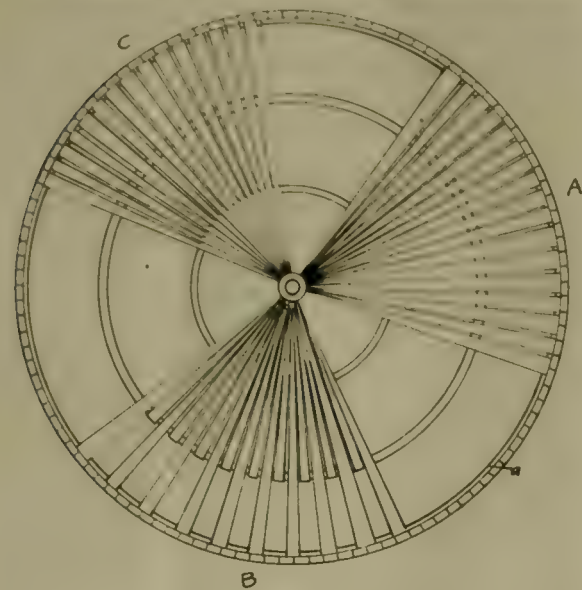


FIG. 6.

be well nailed to the ring and bottom to overcome the buoyancy of the wood. When the ring is raised and the supports put under, the circle indicates the position very readily. The second arrangement of staves, shown at 'B,' is sometimes used. This involves a

Costs at the Mexican Mill

This plant operates at Virginia City, Nevada, and gave the following results during the year ended October 31:

Ore treated, tons	29,247
Value of heads, gold, ounces per ton.....	from 0.156 to 1.19
Value of heads, silver, ounces per ton.....	from 5.09 to 21.45
Extraction, per cent	89.20 to 93.44
Gold recovered, ounces	17,870
Silver recovered, ounces	322,758
Value of bullion	\$564,258
Costs per ton:	
Crushing and convey-	\$0.074
ing	
Power	0.479
Labor	0.593
Repairs and renewals..	0.338
Chemicals	0.666
Water	0.177
Lubricants	0.015
Heating	\$0.166
General mill expense...	0.239
Melting	0.075
Marketing bullion.....	0.207
Assaying	0.062
Taxes and insurance...	0.109
Total	\$3.200

Plumbago prices in Ceylon are increasing, as shown by the following table from a *Daily Consular Report*:

Quality.	Per ton.		
	January, 1912.	January, 1913.	October, 1913.
Medium lump	\$85.97	\$123.27	\$162.20
Superior flying dust	45.42	68.13	113.54
Common dust	25.95	26.76	56.50
Medium ordinary lump....	97.32	134.63	197.88
Superior chip	94.08	131.38	194.64
Superior ordinary lump...	154.09	178.42	235.18

58 to 60% carbon test. 56 to 57% carbon test.

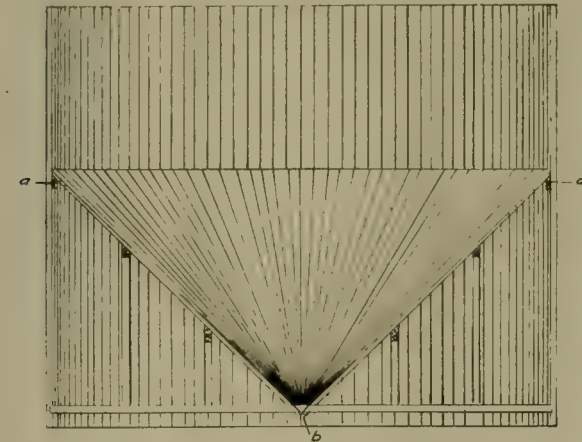


FIG. 7.

long and short stave. The area of openings is larger than in the first arrangement and is equally efficient in letting the material settle through to the bottom. 'C' shows a somewhat similar arrangement to 'A,' only in this case each stave is cut about two-thirds its length and a strip about one-half inch wide taken

Lead Smelting at East Helena, Montana

By BANCROFT GORE

Investigation of methods to overcome silver-lead losses in fume discharged into the atmosphere from pot roasting and Dwight-Lloyd sintering departments was under way at East Helena in 1913, use being made of an experimental baghouse in the hope that the gases from these departments could be filtered as in the case of the blast-furnace fumes, without destruction to the cotton bags. The long life of the bags for the blast-furnace is said to be due to the very low temperature of the gases (so low that during very severe winter weather, recourse is had to preheating them at entrance to baghouse to prevent freezing of the cotton fabric) and to the neutral character of these fumes, the greater part of the SO_2 being neutralized by the excess of lead and zinc oxides. An important clue to this smoke problem was discovered when an attempt was made to obtain a good mechanical mixture of the gases from the two departments. The resulting mixture, due to lead content of gases from the sintering department, gave favorable results with the experimental bags, and there is little doubt that during the present year all these fumes at present escaping will be diverted to a separate baghouse. This improvement will not only bring in a large revenue each year in the form of silver-lead recovered in the baghouse fume, but will eliminate any possible claims for damages from owners of adjacent agricultural land, which is fast becoming valuable for intensive farming, under irrigation.

Blast-furnace work at this plant has reached a high degree of perfection, in spite of the difficulties arising from the extremely high content of lead in material smelted consisting mainly of concentration products from the Coeur d'Alene lead mining district in Idaho. It is a pleasure for anyone who has tried to get good work out of a blast-furnace feeding it any kind of material that happened to be on hand, such as raw flue-dust, fine ores, crude slime, mud, pasty briquettes, and other rubbish, to see these furnaces running along so merrily on 'predigested food' in the form of sintered and semi-fused products from the pot-roasting and Dwight-Lloyd sintering departments.

These products, along with some coarse oxidized ore, slag-shells, and a little limerock with some scrap iron and occasional fragments of receiver-bottoms, make an ideal mixture for the blast-furnace, giving it a high capacity, even sinking of the charge, clean, cool shaft, with fire showing in all the tuyeres. It has been found that under present conditions more material can be smelted with less fuel in three blast-furnaces than was formerly handled by four when treating crude or unsintered material.

An interesting attempt was made to adapt the trapped slag spout of copper work to the local con-

ditions, eliminating the labor of intermittent tapping of slag and matte. Owing to the heavy flow of matte and slag from these furnaces, this would have been a most desirable improvement. The first trial proved a failure, and the spout was removed, but its defects in design were made clear, and whenever a good opportunity is available, the spout, improved in design, will be tried again.

Contrary to predictions of many metallurgists, pre-roasting and sintering in pots has not been driven out by developments in the automatic sintering machines of the Dwight-Lloyd type. Each process seems to hold its own, the total product of pre-roasted material being about equally divided. It would appear at first sight that the labor needed to attend the pots, the constant vigilance needed to prevent blow-holes and accomplish even roasting, the intermittent operation of these pots, and the cost of breaking up the sintered 'buttons' would work out to their disadvantage. The contrary is the case, however, the automatic sinterers being used only for very fine material containing under 11% sulphur. The machines are very sensitive to slight variations in the charge, due probably to the lead content, which at times reaches 40%, and unless the analysis of the feed is kept within very narrow limits, the charge either fuses fast to the grates or passes to the stock bins with a large proportion of fine material and crude charge. The pots find favor because of their less exacting requirements, the material fed being somewhat coarser than that sent to the machines, with the exception of the fine roasted matte, practically all of which goes to the pot roasters.

One of the difficulties incidental to the automatic roasters was the clogging of the herring-bone slits in the grate bars. This was overcome at the East Helena plant by a simple but effective labor-saving device consisting of a heavy steel roller made up of individual sharp-edged discs spaced to correspond with the grate slits which were made to run parallel with the motion of the pallets. Heavy weights on this roller, which extended over the hearth a few feet ahead of the feed box, pressed the sharp edge of each steel disc into the corresponding hearth slot, forcing out any obstruction to the blast.

Coal in Chile costs from \$7 to \$8 per ton. Imported fuel pays no duty. The consumption of fuel oil is increasing, especially at nitrate works and mines. Fifty per cent of the oil comes from the United States, the balance from Peru, while 66% of the coal comes from England. During the first half-year of 1913 the consumption of fuels was as follows: domestic coal, 585,942; foreign coal, 653,667; coke, 23,050; and fuel oil, about 160,000 metric tons.

Increasing the Efficiency of a Grinding Pan

By JOHN RANDALL

The experiments here noted were conducted at the mill of the Beck Mining Co., near Atlantic City, Wyoming. The ore consists of a quartz mixed with tough hard schist with a variable amount of soft oxidized material. The mill has four Nissen stamps crushing in cyanide solution 26 tons of ore per day to 16-mesh screens, but various screens, some as fine as 32 mesh, have been used. The pulp from the stamps goes to a mechanical classifier, the sand from the classifier is discharged into a 5-ft. grinding pan, and thence formerly joined the slime in an agitator, and from the agitator went through a series of three Dorr thickeners for washing under the counter-current system. The product from the pan is thence returned to the classifier and travels in a closed circuit until ground fine enough to be classified as slime. I would state at the outset that the performance of the pan, although considerably improved, is at present by no means good, my reason for making this incomplete work public being that there are some details that seem instructive and likely to lead to further improvement by others.

Construction of Pan Tested

The pan as originally built had but four shoes and a solid ring die with no channels, and when first started was principally occupied in grinding iron, with little or no effect upon the ore. This construction was improved by D. C. Kelso, the Company's superintendent, by having a new muller and die-ring cast carrying 8 shoes and 8 dies with $1\frac{1}{2}$ -in. channels between.

Another important defect in the construction of the pan is that found in pans of a number of different makes, namely, that of connecting the driving yoke to the muller by means of 4 prominent lugs on top of the latter. These lugs act precisely like the vanes of a centrifugal pump to induce a strong outward current over instead of under the muller and shoes, this action being clearly discerned in this case by the wear in the top of the muller. It no doubt tends to reduce the circulation of the pulp under the shoes. As this defect could not be remedied without considerable expense, it was allowed to remain.

With the improved shoes and dies the pan was sliming 1.7 tons of ore per day to 150 mesh when I took charge of it in August 1913. The desirability of decreasing the amount of sand going to the thickeners and securing better gold extraction was the chief incentive to a study of its operation. No further changes were made in the pan's construction, but the usual plowshare-shaped baffles set around the sides of this as well as most other pans were taken out. These baffles were found to be unnecessary, as the pulp thrown outward by the shoe channels rises up

the sides of the pan and is forced to return to the centre, this vortex action seeming to be more regular without the baffles. A very heavy and elaborately made cast iron feed hopper was also removed as being wholly unnecessary and adding too much weight to the shoes. No changes were made in the speed of the pan, which runs at 68 r.p.m. Experiments were then made in running the pan on thick pulp, my theory being that thickening the pulp would cause a greater number of sand grains to occupy a given space under the shoes and thus increase the grinding capacity. This produced surprising results, making an estimated increase in the duty of the pan of over 50% and greatly lessening difficulties arising from sand in the Dorr thickeners. On this particular ore and with 16-mesh battery screens, which were then put on, as low as 30% moisture in the pan was found to be most satisfactory, a pulp thicker than this causing a higher consumption of power without any corresponding advantage. This amount of moisture seems very low, but was about 5% more than enough to fill the voids between the ore particles when settled without shaking. I am inclined to the belief that the proper amount of moisture for a tube-mill as well as a pan is not a fixed quantity as generally supposed, but depends upon the percentage of voids in the material. The amount of moisture going to the pan is regulated by adjusting the spray near the sand-discharge end of the classifier. Under these conditions, with the pan feed containing 82.6% on 100 mesh and 17.4% through 100 mesh, the pan product was 50.6% on 100 and 49.4% through 100 mesh. Moisture samples were taken from various points at and near the surface while the pan was in motion, and corresponded with that in the feed and discharge. Whether there was a zone below the surface containing more moisture or finer material was not ascertained.

Removing Material

All the sizings given in this article were made by panning the slime from the sample through the finest screen used until the sand was clean, separately drying the two portions, and then sifting the sand in the usual manner. The next improvement determined upon was a means of removing as fast as possible the 49.4% of fine material shown by the sizing of the pan product to be continually circulating under the shoes and occupying space there to no useful purpose. Accordingly, a 6-in. belt elevator with 5-in. buckets was planned to return the pan product to the classifier. The elevator was put in operation September 24, 1913, and since that time the pan has taken care of the entire product of the stamps with coarser

150	58.1
	100.0

Subtracting the amount slimed by the stamps from the total amount slimed to 150 mesh, the amount slimed to 150 mesh by the pan is 17.8%, or 4.6 tons. This low duty of the pan to 150 mesh is offset by the fact that it is grinding all but 1.1% of the mill product to -80 mesh, allowing the entire mill tonnage to be treated as slime.

Data collected by Harley B. Wright in 1909 give the average duty of Kalgoorlie 5-ft. pans at 5.6 tons to 150 mesh. M. W. von Bernewitz has given the average duty of the same pans to 150 mesh at 7.5 tons, which no doubt represents improved practice in a country which probably has the best pan practice.

These investigations upon the pan at Atlantic City were incomplete when the mill was obliged to shut down on account of bad roads and consequent shortage of fuel which had to be hauled by wagon 38 miles. However, plans are under way for the improvement of the pan, the chief defect being the rigid connec-

150	75.9
	100.0

TABLE II.—Sizing of pan product returned to classifier; moisture 28.6 per cent.

Size, mesh.	Per cent.
+ 40	21.3
40 + 80	45.6
80 + 100	17.0
100 + 150	4.0
150	12.1
	100.0

TABLE III.—Average of four sizings of the battery product of the Nissen stamps, the first and second being taken from four 16-mesh rolled slot wire screens, opening 0.031 in.; the third from three 16-mesh and one 10-mesh rolled slot, opening 0.046 in.; and the fourth from two 16-mesh square-opening 21-gage wire and two 10-mesh rolled slot. There was no marked difference in the samples, the 150 mesh running from 54 to 63.3 per cent.

Size, mesh.	Per cent.
+ 40	13.2
40 + 80	13.9
80 + 100	8.8
100 + 150	5.9

battery screens, 16 to 10-mesh displacing the 20-mesh formerly used. It was found that the sand passing through the 80-mesh screen yielded good extraction, and, in order to make the classifier separate at this point, Mr. Kelso adopted the expedient of cutting a square notch 4 in. wide and 4 in. deep in the overflow weir of the classifier. The good classification thus effected at the desired point is shown by the following sizing:

TABLE I.—Sizing of slime overflow from classifier, being the entire mill tonnage as sent to the agitator and Dorr thickeners for treatment.

Size, mesh.	Per cent.
+ 40 + 80	1.1
80 + 100	13.0
100 + 150	10.0

tion of the driving spider or yoke with the muller, causing the shoes to groove, wear rapidly, and consume an unnecessary amount of power. In this particular pan it seems to cause the shoes to chatter on the dies at times and consume nearly four times the necessary amount of power. This defect, although not in all cases producing such marked results, is found in most pans made in the United States. Indeed, I know of but one maker in the country, a firm at Colorado Springs, that builds a pan with the universal joint connection used in Western Australia. Two of these Colorado Springs pans, 5 ft. in diameter, are running at 42 r.p.m. at the Vulture mill, near Wickenburg, Arizona. Each is grinding 35 tons per day, 85% of the product being fine enough to pass through a 100-mesh screen. In reply to an inquiry on the pan subject, I have a letter from A. L. Bloomfield, superintendent at the Golden Cycle mill, Colorado Springs, in which he says: "The pans were a complete failure in Western Australia until the universal joint connection between yoke and muller was put on. Under no circumstances could you induce me to run a pan with the old rigid attachment."

The Freeman pan described by Mr. von Bernewitz in the *Mining and Scientific Press*, May 17, 1913, secures a good circulation and prevents slime from getting under the shoes by means of a cylindrical baffle fastened to the muller and extending above the level of the pulp, thus forcing all the unground material to pass under the shoes. There are various opinions as to the advantage of this arrangement, which probably depends upon other details for its success. In constructing a pan of this type, it is necessary that there should be no die channels, else the pulp will be thrown rapidly out through the shoe channels and return through the stationary die channels. It would also seem best that a pan of this type should have inward shoe channels which would leave the pulp-current under the shoes to be determined as much as possible by the feed alone and thus it would move so slowly as to give each particle of sand many chances to be ground before passing out. With good outside classification and a considerable amount of pulp moving in the closed circuit, so as to keep the amount of slime in the pan down to a low point, there might not be much advantage in the use of the baffle. The work of Mr. Söhnelein in changing a pan to this type and providing outside classification has lately shown excellent results, and indications are not wanting that the grinding pan is destined to make good in this country, particularly where small units are desirable. The slow progress so far made seems to be due principally to the fact that the construction which answered fairly well when pans were used for amalgamation has since been too closely followed where grinding is the object aimed at.

Thanks are due O. M. Beck, the manager, and Mr. Kelso, the superintendent, for permission to publish the results obtained at the mill near Atlantic City.

A New Battery Frame

A large volume could be published on the subject of battery frames, including those which have been suggested, those discarded, and those at present preferred. The constant effort has been to decrease the breakages inherent in the stamp-mill, and to gain greater efficiency in crushing. Including old and new installations throughout the world there are the following types of battery frames: 'H' and 'A' frame of cast iron; 'A' front knee, and standard wood frame; Nis-

mortar block. The cross pieces, holding the guides, are planed at the ends to fit the posts accurately. The cam shafts are 6½ in. diameter, the stamps weigh 1250 lb. each, and have 31½-in. stems. Such a battery is self-contained, requires no support from orebins or by knee framing, and will have no 'give'. It should result in a small repair bill. Ten stamps constructed from this design are now working satisfactorily at the Tightner mine, near Alleghany, Sierra county, California. Results of the performance of this plant will be published when available.



WORKING MODEL OF STAMPS IN NEW BATTERY FRAME.

sen; Holman pneumatic; reinforced concrete and iron standards as tried at the City Deep on the Rand; and 'H' construction of box girders. Even this list does not include all. The question of foundations has been all important in the framing; but concrete is rapidly superseding everything else. Frames of wood are used in the majority of mills, but due to shrinkage of this material, and its being somewhat elastic, the breakages of cam shafts and stamp stems continue. Another fault in battery framing is the joining of ore-bins to the frame by timber which supports the cam and feeder floors, and is also supposed to be a means of stiffening the battery frame. Orebins are empty some days and full on others. Consequently, various strains are set up which result in the frame being pulled out of line, which eventually reacts on the working parts. Many efforts have been made toward constructing a self-contained battery, and the accompanying cut shows such a type as designed by A. D. Foote of Grass Valley, and made by the Taylor Foundry & Engineering Co. The main battery posts are of cast steel weighing 4500 lb. each. They are bolted to a concrete

Wet Crushing in Ball Mills

By A. W. ALLEN

The wet crushing Krupp ball-mill is a machine whose merits of high efficiency, combined with simplicity of operation, have hardly been sufficiently recognized. The mill itself does not differ materially from the machine used for dry crushing. In addition to the ordinary casing, the wet crusher is provided with a water spray which delivers over the whole width of the fine outer screening, just after the latter leaves the trough at the bottom of the mill. This trough consists of a spitzkasten in which the water-level is maintained at a fixed, but adjustable, level by means of a constant overflow. The discharge from the spitzkasten terminates in a 'gooseneck'; and nozzles of varying aperture are available for the purpose of regulating the percentage of water that goes out in the discharge.

A certain amount of classification takes place in the spitzkasten, and advantage may be taken of this fact by keeping the underflow separate from the overflow. As the mill revolves, a certain amount of water is caught and delivered into the centre of the mill, to assist grinding. At the same time the outer screening is kept clear, and an immediate discharge of ground product ensured by the large area of clean screening exposed, the operation being helped by the vibration of the mill. As in the dry-crushing machine, the power is conveyed through toothed gearing. The best work with the wet crusher is obtained on a uniformly compact ore, broken to about a 1½-in. ring. A coarser feed is only feasible with a friable ore. The wear on liners is high, but not disproportionate to the tonnage ground. A set of liners lasts about five months; and, under normal conditions, the additional steel consumption in a No. 5 mill amounts to about 16 lb. per 24 hours, this being the maximum weight of the balls used for grinding purposes. Outer screens last for several weeks without attention; and instances have been recorded where the mill has been run for some months without a shut-down for any cause whatever. The correct feed is determined by the sound of the mill; and the result of under or overfeeding is immediately recognized by the experienced millman. The feeder used is of the bumper type, and is capable of delicate adjustment.

Discussion

Readers of the *MINING AND SCIENTIFIC PRESS* are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment. Insertion of any contribution is determined by its probable interest to the readers of this journal.

The Rand Banket

The Editor:

Sir—The wealth of detail in the series of articles by Mr. Horwood, together with the excellent photographs, makes local knowledge almost superfluous. I have read the articles with much enjoyment. At the same time, some points raised are not quite convincing, and, as the subject has been so fully and ably discussed by those with local knowledge, the doubts raised by an outsider or any healthy criticism may at least help to make the discussion interesting. The most striking statement, to my mind, is contained in the first 14 lines of the second column on page 965.¹ In the course of exploration and prospecting work, I have frequently noticed pyritic and other concretions in sedimentary rocks, under such conditions as to render the concretions devoid of economic importance, but I have had no difficulty in understanding their mode of formation, at least to my own satisfaction.

This matter of concretions has been fully discussed by J. E. Todd in a paper read before the Geological Society of America in 1903,² and, as the conditions prevailing during the mineralization of the banket and formation of buckshot pebbles are quite in accordance with those required by Mr. Todd, and are those generally accepted, I see no reason in straining after a more complex origin, and rather wonder that the paper in question has been overlooked apparently by Mr. Horwood.

By the courtesy of the curators at the Geological Museum, London, I have had an opportunity of handling at leisure, the specimen marked 'Rietfontein Mine A. Buckshot Reef,' presented in March 1905, by F. H. Hatch, and I noted that the pyritic pebbles are hard, irregularly disposed, and at times close together, though never actually coalescing. The conditions necessary for the formation of these buckshot pebbles, I take to have been: (1) A slowly moving solution—because the pebbles are so very round, and this is further confirmed by Mr. Horwood's statement that the replacement of quartz pebbles by pyrite in many cases has been by equal volumes; (2) presence of nuclei—because of the irregular disposition of the pebbles; (3) hot or concentrated solution—because the pebbles are so close together.

As to the nuclei, I have read Mr. Horwood's earlier paper on the mode of occurrence and genesis of the

carbon in the Rand banket, but from the method of collection adopted in the tests, it is impossible to say whether any of the carbon was originally present in the pebbles as nuclei, though it is possible.

In the summary on page 614,³ Mr. Horwood has evidently forgotten for the moment the definite rejection of the 'molecule for molecule' idea of Mr. Lindgren in the paper he quotes. Radiate structure is, of course, a common type of concretion. The growth of either type of pebble is quite simple, once a start has been made, but the starting is the interesting point, and any further information of a definite character as to nuclei in the one case or of the selection of particular pebbles for replacement, when there are so many others available, in the other case, will be welcome. There is, of course, an appreciable difference in the specific heat and conductivity of various kinds of quartz, as there is between one and another mineral, and if the mineralizing solutions were in a sufficiently critical state, these properties might be involved. However, there are other possible reasons for the selection of particular pebbles for replacement, and to these I shall now refer.

J. D. Irving says:⁴ "The least easily attacked rocks among the sediments are those containing high percentages of alumina," and R. B. Young, in discussing Mr. Horwood's paper on the carbon in the Rand banket, says: "There is abundant evidence all throughout the banket that aluminum silicates offer great resistance to replacement by pyrite, if, indeed, they are ever replaced at all, whereas no constituent is more easily replaced than quartz." He then goes on to give perfectly logical reasons why, owing to sub-capillary spaces in the quartzite, these pebbles should be singled out for attack. Against Messrs. Young and Irving, there is Mr. Horwood's statement on page 678,⁵ that "pyrite more readily replaces silicates, such as those of aluminum and the alkalis than it does quartz." In the absence of definite proof, the contention of Mr. Young and Mr. Irving seems more reasonable, and I would ask Mr. Horwood whether he has dissolved any of the replaced portion of these slaty quartzite pebbles and proved the absence of aluminum silicates.

Evidently there is an intimate genetic association of the gold, carbon, and pyrite, but, though the pyrite or the carbon, particularly the former, might precipitate the gold, the reverse may be, and possibly is, what happened in both cases, that is, the gold may have caused the precipitation of some of the carbon and of the pyrite, as indicated below. Mr. Young has recorded the association of much gold with a markedly unusual amount of tourmaline. Also he says that muscovite in sericitic aggregates or in large flakes is always present in banket showing coarse gold. With tourmaline and sericite, by reason of their mode of formation, we may associate gelatinous silica, and we then have a favorable medium for the concentration or collection of

¹See *Mining and Scientific Press*, December 20, 1913.

²'Concretions and Their Geological Effects,' by J. E. Todd, *Bull. Geol. Society of America*, Vol. XIV, pp. 353, 368, September 12, 1913.

³*Mining and Scientific Press*, October 18, 1913.

⁴'Replacement Orebodies,' J. D. Irving, 'Types of Ore Deposits,' page 251.

⁵*Mining and Scientific Press*, November 1, 1913.

gold,* and one, moreover, that might account for some of the carbon. The carbon that lines the fissures and "does not soil the fingers" is probably deposited under pressure and at a considerable temperature in a manner similar to the 'gas carbon' deposited in retorts during the manufacture of illuminating gas.

I refer above to the authigenic tourmaline which, as Mr. Young says, forms the bulk of the tourmaline in the blanket, though there is some of allogenetic origin.

In the matrix we also have a porous medium and one which could impede the diffusion of the reducing hydrocarbons, though not to anything like the same extent as gelatinous silica, and so, while we would have precipitation of the gold, it would be in a fine state of division, though not ultra-microscopic. Much of the blanket gold is in a fine state of division. I am seeking in this connection to establish a reason for the concentration of coarse gold with sericite and tourmaline; high temperature alone will not suffice, for the temperature, etc., necessary for the formation of tourmaline would be unfavorable to the deposition of gold.

I am aware that Messrs. Hatschek and Simon, in experimenting with gold, only precipitated pure gold, but they had precipitated various insoluble compounds, and there seems to me to be no reason why an alloy of gold and silver should not be precipitated, as has been suggested by A. N. Winchell⁸ in another case, under circumstances that might have prevailed at one time during the mineralization of the blanket. The enrichment of replaced slaty quartzite pebbles could be explained on similar grounds, the sub-capillary openings providing the porous medium inducing a preliminary deposit of gold previous to the replacement of the pebble by pyrite; or the incomplete replacement according as to whether pyrite does or does not replace aluminum silicate.

While on this matter of gelatinous silica, it is interesting to recall a paper by W. M. Courtis,⁹ in which he says, when trying to find some characteristic microscopic features of rich gold-quartz as compared with low-grade quartz: "From the examination of many rich gold-quartz specimens, the conclusion was formed that the quartz was in a gelatinous condition when the gold was introduced." Mr. Hatschek, in the paper already quoted, laid stress on the perfectly natural fact, and one previously recognized in the case of sandstones, that segregations in gels have a great tendency to form a spheroidal shape.

On page 721¹⁰ Mr. Horwood quotes J. P. Iddings, but Mr. Iddings would not obliterate the rough outlines of pebbles in the way Mr. Horwood suggests, for he (Iddings) says:¹¹ "Nor does it follow that curved,

or rounded, surfaces develop only through solution of plane-faced crystals. There may be interference with the regular development of crystal faces and plane surfaces due to irregularities of diffusion of crystallizing molecules and also to the viscosity of the liquid."

If the coloration of pebbles is due to chromium, and the presence of coloration is a measure of the richness of the blanket, then, an increase in chromium content should show a diminished gold content, for gold is much more volatile than chromium and would travel farther from its ultimate source before depositing; moreover, a marked increase of chromium would mean an end of the gold. If, as suggested on page 811,¹² the pyrite and gold were deposited from an eutectic mixture, we would expect a fixed ratio between the gold and pyrite. Does this exist?

Another point in connection with this eutectic mixture and one which, like the chromium, may be of immense economic importance, where such vast interests are at stake—and in any case is of great interest—before the eutectic point is reached one or other mineral is usually in excess and is deposited alone until that point is reached. If then the ratio of gold and pyrite in an eutectic mixture is determined, we should know that as soon as a point was reached in the lodes where the proportion of pyrite—presumably the mineral originally in excess—showed a marked increase, that point would mark the vertical limit of the gold in depth. In this connection it is important to differentiate between a mere decrease in assay-value of the lode, which might only indicate the approach of a poor zone, and an increase in the proportion of pyrite to gold. Mr. Young, in one of his papers, says: "In one case there is not only a ring of pyrite surrounding the carbon, but also another within the carbon itself." From this it would appear as though the mineralization was intermittent, that is, had been due to a pulsating action, and so the Rand in common with other gold-fields may yet experience alternating rich and poor zones and eventually will come to an end; when this will be, is a question for the men with local knowledge.

STEPHEN J. LETT.

London, January 15.

Solution Control in Cyanidation

The Editor:

Sir—Mr. Allen, in his letter published in the *Mining and Scientific Press*, February 21, takes me as well as himself much more seriously than I do. My statements are in general qualified and I admit room for argument, upon which point only we seem to be in accord. My letter in your issue of October 11, 1913, is couched in the simple phraseology of the cyanide plant and does not admit of misconstruction by an operator. Any pretended misunderstanding as to the meaning of "zinc in solution" or "throwing away cyanide solution" is mere quibbling and evidently intended as a criticism

⁶'Gels in Relation to the Deposits', E. Hatschek and A. L. Simon, *Proc. Inst. M. & M.*, Vol. XXI, April 18, 1912.

⁷*Jour. of Geol. Soc. So. Af.*, Vol. XII, page 83.

⁸'Geology of the National Mining District, Nevada,' A. N. Winchell, *Mining and Scientific Press*, November 23, 1912.

⁹'Gold Quartz,' by W. M. Courtis, *Trans. Am. Inst. Min. Eng.*, Vol. XVIII, 1889-90, pp. 639-644.

¹⁰*Mining and Scientific Press*, November 8, 1913.

¹¹'Igneous Rocks,' J. P. Iddings, Vol. I, 1909.

¹²*Mining and Scientific Press*, November 22, 1913.

of the writing rather than of the matter under discussion. I would respectfully suggest that the argument, if continued, be limited to the question of "direct determination of free cyanide by titration with silver nitrate." My contention is that it can be determined with a fair degree of accuracy regardless of ordinary zinc content and alkalinity; and I further contend that conditions may exist which do not permit of the use of this or any other simple method. In other words, it might be impossible for an operator to determine free cyanide. I have been in such a position and venture to assume others have.

The success of this method depends largely on the ability of the operator to detect a very faint but definite change in the transparency of the solution. Mr. Allen's statement, "in the presence of zinc compounds there is no definite end point to be observed," would indicate that he neglected my "elementary" precaution to have flask and solution perfectly clear. Referring to quotation from Clemmell's 'Chemistry of Cyanide Solutions,' this work was written many years ago, and I am inclined to believe that the quotation does not apply to the point in question. At any rate, the method has been used continuously for six or seven years at a plant which has been for a considerable part of the time under Mr. Clemmell's supervision. Furthermore, it was E. M. Hamilton, who evidently enjoys the esteem of Mr. Allen judging from his complimentary reference, who first brought the method under discussion to my attention some six or seven years ago, and I know from personal association with Mr. Hamilton covering a period of years that he uses this method.

Does Mr. Allen still most emphatically disagree?

JAMES S. COLBATH,

Los Angeles, February 25.

Revision of the Mining Law

The Editor:

Sir—I believe there would be a greater activity in prospecting if the United States mining laws were fashioned after the Australian mining laws.

Owners of all mining claims should be required to employ at least two men to every full claim of 600 by 1500 ft. The Australian law requires five men to each 25 acres. All mining claims should be in districts in charge of some mining warden or land office agent. The title should be in the form of a lease for 21 years; the lease renewable at the end of that time if the owners wish to continue work. If the owner does not comply with the working conditions of two men per claim for a period of 30 days, unless otherwise granted exemption by the warden, the claim should be considered abandoned and subject to relocation by giving notice to the warden and posting notice on the claim by the new locator. Relocation by old owners should not be allowed. All United States patented mining claims should be regulated by state laws compelling the owners to develop the ground.

I know that the miner or prospector at first will consider a law of this character severe, but in practice he would find that it has many advantages, and the state will be assured that its mineral resources are not being shepherded by those who will not develop them. The mining warden should have certain discretionary power, and in the case of the prospector who is anxious to develop his claim a working time limit could be given which would entitle him to exemption for six months.

The principal fault with the United States mining law is that it is too liberal, and the average locator of a mining claim has concluded that his title was secure when he put up his notice of location. He throws a stone at a point where he guesses his monuments should be, and files for record a statement of discovery which does not exist. The prospector who is honest in his location and does a certain amount of work on a fair showing has too often been discouraged and abandoned his claim, or sold it out to some local resident who holds the ground by a semblance of work or by false affidavits as to assessment work. I know of mining claims in California that have been held for 30 years, and the total value of the development during that time performed by so-called annual assessment work amounts to nil.

It is true that there is but little new territory to be explored by the prospector, and the young and venturesome have no chance. The so-called 'grub-staker' or the grubstaked prospector did but little to develop the country. There are as many men as ever who are willing to do their own work and pay their own way if given a chance, and if protected by better laws when they develop a mine. The greatest trouble is that there are any number of good mining properties and undeveloped ground tied up either by the United States patent or unpatented claims, owned or pretended to be owned by people who will not develop the ground or let others do so.

The mining territories of the United States should be formed into mining districts, and the federal government or each state could well afford to keep up a court, including a mining warden, clerks, and mining surveyors, who for a small fee would adjust the mining claims and titles under the new law, so that the prospector would be protected in his claim so long as he performed the necessary work according to law.

In my mining experience, extending for a considerable time in Australia, I knew of no mining lawsuits as to the title of the ground, and no disputes but such as could be settled in the warden's court. In this country it is safe to say that no development or discovery is safe from any number of mining lawsuits, and the owners are often tied up for years on the questions of title. These conditions are all brought about by our poor mining laws and constitute a great disadvantage to the prospector.

H. C. CALLAHAN.

San Francisco, February 12.

Concentrates

Most of these are in reply to questions received by mail. Our readers are invited to ask questions and give information dealing with the practice of mining, milling and smelting.

Slag produced at Mt. Morgan contains 45% silica.

Horse traction has superseded electric traction in the Mt. Morgan mine, as the latter system was too costly and a source of danger.

Of 2,113,080 tons of ore treated during the last quarter of 1913 by the Utah Copper Co., 56% was handled by the Magna, and 44% by the Arthur plant.

Stripping overburden at the Utah Copper Co.'s property during 1913, when 90% of the ore was mined by steam-shovels, amounted to 4,835,489 cubic yards.

Abrasive wheels, such as used in all machine shops, should be encased by steel plates, except at the point used for grinding, to prevent their flying and injuring mechanics.

Wage reductions to meet the cost of insurance under the Workmen's Compensation Act have been declared illegal by the California Industrial Accident Commission.

Carbide ash, that is, carbide after having been used in a lamp, has a greater coefficient of friction than resin, and makes excellent dressing for a friction clutch that tends to slip.

Working time at the Great Cobar copper mines, New South Wales, allowing for Christmas holidays, Sundays, abstentions, and minor accidents, only amounts to about 290 days per year.

The deposit of niter on Camp creek, near Melrose, Montana, while probably not of commercial importance, affords an example of a nitrate deposit in a region having a fairly heavy rainfall.

Associated with lead ore on the 600-ft. level of the Shattuck-Arizona mine are small 'kidneys' of vanadium ore. Copper ore is also intermixed, and although a complex ore, a method of treatment is being devised.

Railroads caused nearly half the forest fires in Colorado and Wyoming last year, and nearly one-sixth were started by lightning. In California, lightning started more than half, with railroads a comparatively insignificant cause.

Saw-tooth buildings have a low cost when compared with any other type of building. Complete with cement floor and roof, the cost is about \$1 per square foot. This style of construction has the disadvantage

of not affording means for transport of material by overhead cranes.

Electricity plays an important part in the transmission of power in a modern cyanide plant. Tube-mills and other machines may be arranged irrespective of their position as regards line shafting, and ammeter readings are a valuable check on power consumption. They can be used as an indication of pebble load in tube-mills, or for the purpose of estimating the thickness of pulp in mechanical agitators.

Cup grease instead of white lead can be used with satisfactory and economical results in air-line connections. Cup grease costs less per pound and the amount used will be less in weight. In a large mine where air-lines are being constantly extended, changed, and repaired, the saving effected will be no small item. The economy in using some dressing in connections to prevent the threads from rusting tight is apparent.

Compressed air is a useful and often necessary commodity around a modern reduction plant. One of the reasons for its comparatively high cost is the fact that small losses around the mill are unnoticeable, although in the aggregate they may represent a considerable amount of wasted power. A contributory cause to such loss is the practice of laying compressed air mains and branch connections underground. Valve fittings and piping are liable to leak under such conditions and such loss is unavoidable and difficult to detect.

Pulp agitation by most systems yields a higher solution of metal with a higher dilution. A thick pulp generally means slow extraction coupled with increased horse-power for agitation. The preferable method is to agitate with a pulp of a thinness to give maximum solution in the minimum of time, afterward dewatering before filtration. The efficiency as well as the capacity of the filter is largely influenced by the condition of the pulp. With a thin pulp containing appreciable amounts of sand, the operation of filtration is slow and inefficient.

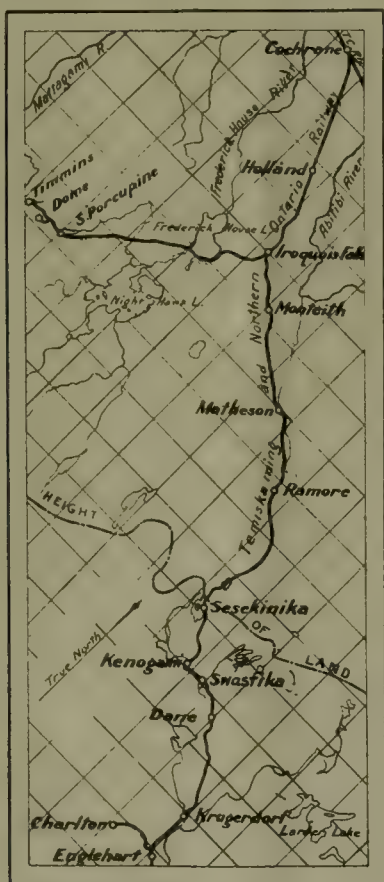
Troubles usually encountered in the working of a wet Krupp ball-mill are mostly due to a variation in the class of ore and to insufficient water-supply. Unless the ore is uniform, it will be necessary to give constant attention to the question of feed. A change from fine to hard rock without a readjustment of the feed will result in overloading the mill, with cumulative ill effects. On the other hand, it is necessary that the water in the spitzkasten be kept at the required level. To this end the box should be supplied with a valve operated by a float, connected with the water-supply, in addition to the ordinary equipment. Should the water-level in the box get below normal, there will be an immediate drop in output from the mill. As a result, the rate of feed will exceed the rate of output and the mill will rapidly clog up.

Special Correspondence

NEW YORK

TEMISKAMING COMPANY'S AFFAIRS.—TENNESSEE COPPER REPORT.
—GUGGENHEIM EXPLORATION DIVIDEND.—BUTTE & SUPERIOR
OUTPUT.—BRITISH COLUMBIA COPPER AFFAIRS.—IRON AND
STEEL, OIL AND GAS MEETINGS OF THE A. I. M. E.

A storm is brewing in the management of the Temiskaming. The annual report for last year showed gross receipts \$438,500 and a net profit of \$117,500, dividends during the year amounting to \$75,000. There is much dissatisfaction with this lean shaving, and Hamilton B. Wills will lead a movement for a change of control. He calls attention to the fact that the present directors only hold together 1375 shares out of the total of 2,500,000, and urges that the interests of the Company will be better served if its management is in the hands of men who have a larger interest in the Company than



PART OF THE ONTARIO MINING DISTRICT.

in the stock market, and that a larger representation of mining men is necessary. The mill is now treating 100 tons of ore per day, and it is stated that the total gross cost per ounce of silver produced is 42 cents. There would certainly seem to be room for improvement in this, and it is openly intimated that any new management could certainly do as well as the old.

The Tennessee Copper Co. has made its annual report, showing an output of 17,797,338 lb. copper, at a cost of 10.2c. per pound or \$2.93 per ton of ore. Of this, 4,257,822 lb. was from custom ore. The acid production was 197,713 tons. The gross receipts of the Company were \$1,158,503, net profits \$968,000, and dividends \$450,000, the total surplus now being \$1,865,000. The announcement was also made that the contract with the International Agricultural Corporation had been modified, so that the excess of acid not required by that Company will hereafter be marketed by the Tennessee company. There has been much discussion over this contract, some of the International shareholders complaining that they were burdened with a white elephant in being obliged to take all the acid the mining company could make, while the latter people point out that they have handled it all right so far. The matter is settled now, anyway. Utey Wedge has succeeded E. H. Westlake as vice-president, presaging closer relations with the Pennsylvania Salt Manufacturing Co., that may perhaps open another market for the Tennessee acid. Mr. Westlake has been active in the gold-mining interests of the General Development Co., and now that it has sold its dredging property in Colorado it may be that this Company is planning to give some active attention to South America, especially Colombia, where it has been dabbling in gold properties.

It is reported that the Guggenheim Exploration Co. will increase its dividend rate to 14%, or \$3.50 per share. Certainly the Company has been doing well, and it has a surplus of \$24,811,000 over its \$20,800,000 in shares outstanding.

The Butte & Superior continues to do well, and it is stated that the output for February will be 10,250,000 lb. of zinc, 260,000 oz. of silver, and 500 oz. of gold.

British Columbia shareholders seem to be in a good deal of a fog as to what is going to happen to them after they pay over their \$1 per share for the new debentures of the Canada Copper Corporation, and exchange their stock. In a recent circular, Newman Erb assures them that the British Columbia has no money in its treasury, and unless they do fork out it is likely to lose its options on additional property and therewith the money that has been spent on them. Under the circumstances the minority shareholder feels very much in the position of the Presbyterian: 'damned if you do, and damned if you don't.'

At the morning session of the iron and steel meeting of the American Institute of Mining Engineers, held on February 18, Albert Sauveur presided. The first paper was by H. M. Howe and A. G. Levy, entitled, 'Notes on Plastic Determination of Steel During Overstrain.' The paper was essentially a series of fine and instructive microphotographs with explanations by Mr. Howe. The discussion was opened by R. C. Carpenter, of London, who spoke at some length and called attention to the work of Mr. Bellby. Brief remarks were also made by H. D. Hibbard, Mr. Webster, W. S. Lindgren, and R. H. Sweetser, and the discussion was closed by Mr. Howe. The exchange of international pleasantries between Mr. Carpenter on one side and Mr. Sauveur and Mr. Howe on the other side, added to the good feeling. A. Sauveur's paper was 'Notes on Some Heating and Cooling Curves of Carpenter's Electrolytic Iron.' The discussion by Mr. Carpenter and Mr. Howe centred around the real existence of the point A2 in the iron diagram. J. E. Johnson, Jr.'s paper dealt with the 'Influence on Quality of Cast Iron Exerted by Oxygen, Nitrogen, Etc.' This was probably the most sensational paper of the session. It was discussed at considerable length. Mr. Johnson showed a series of microphotographs, always two side by side, the two being of the same chemical composition with the only exception that in one the oxygen content was higher than in the other. In all these pairs of diagrams the iron with the smaller oxygen content showed the graphite in large flakes, indicating little strength, while in the iron with the higher oxygen content

the graphite was broken up into smaller particles so as to give a much stronger structure. The discussion was opened by R. Moldenke, who said that he agreed with much that was in Mr. Johnson's paper, but that he could not agree with the main result that oxygen is beneficial. Mr. Hibbard and Mr. Webster spoke briefly. Mr. Howe thought that Mr. Johnson simply claimed that not the oxygen itself, but the accompanying reduction of the graphite from large flakes to smaller particles, was the really beneficial element. John Howe called attention to the new test figures given by Mr. Johnson which were not in the published paper and which appeared to strongly confirm Mr. Johnson's claims. Bradley Stoughton answered R. Moldenke and expressed himself as being impressed with Mr. Johnson's results. In Mr. Johnson's microphotographs the irons with more oxygen have a better structure. The oxygen may have an influence in throwing the eutectic point to the right, though there is no evidence to that effect, but only inference. W. Campbell suggested a possible means through which throwing out of the graphite (resulting in the all-important structure) might be affected by the oxygen content. Mr. Sweetser and Mr. Hibbard spoke briefly, and Mr. Johnson concluded, describing how recently he had actually improved iron by adding oxygen.

B. Hopkinson and Sir Robert Hadfield's paper covered the 'Research with Regard to the Non-Magnetic and Magnetic Conditions of Manganese Steel.' In the absence of the authors, the paper was read by J. W. Richards. It was discussed by W. S. Potter, A. Sauveur, H. M. Howe, and J. W. Richards. 'On the Heat Treatment of Steel Castings,' a paper by C. D. Young, O. D. A. Pease, and C. H. Strand, was presented by Mr. Pease. The discussion was by E. F. Cone and John Howe.

C. M. Weld read by title 'Notes on Iron Ore Deposits near Hongkong, China.' The concluding paper of the morning session was presented by W. S. Potter on 'Manganese Steel, with Special Reference to the Relation of Physical Properties of Microstructure and Critical Ranges.' This was a very long paper with a great number of microphotographs. The presentation lasted until 1:30 p.m., and the audience had dwindled down to 14, including the author, chairman, and the newspapermen. There was no discussion, but the chairman, Mr. Sauveur, complimented the author on the enormous amount of information contained in the paper.

At the afternoon session, J. W. Richards presided. 'The American Steel Rail Situation,' by R. W. Hunt, was read by title in the absence of the author. 'Manganese Steel Rails,' by Sir Robert Hadfield, was read by title, and discussed by W. S. Potter and J. W. Richards. 'Blast-furnace Operation with a Turbo-Blower,' by S. G. Valentine, was the next paper, with discussion by J. E. Johnson, Jr., J. W. Richards, K. Nibecker, and L. Waldo. Some of the speakers doubted the correctness of the figures given by the author, as being possibly based on wrong calibrations of instruments. 'Gas Cleaning at Duquesne Blast-furnace' was read by A. N. Diehl. This rather interesting paper elicited considerable discussion which brought out a full account of gas cleaning at the Edgar Thompson works of the Carnegie Steel Co. 'Pig Steel from Ore in Electric Furnaces,' by R. M. Keeney, was read by title. Mr. Richards expressed his great interest in the paper. Heinrich J. Freyn's paper, 'On the Utilization of Blast-Furnace and Coke-Oven Gas for Power Purposes,' was an interesting and elaborate one, which resulted in considerable discussion. The paper by C. B. Murray on 'Need of Uniform Methods of Sampling Lake Superior Iron Ore,' was read by title, but gave some extended discussion by Mr. Kelley and Mr. Sweetser, to which Mr. Murray replied.

At the oil and gas meeting there was a large number of papers read by title or in abstract. These included 'Geology and Technology of the California Oilfields,' by Ralph Arnold and V. R. Garfias; 'Chlorides in Oilfield Waters,' by C. W. Washburne; 'Water Intrusion and Methods of Preven-

tion in California Oilfields,' by Franklin W. Oatman; 'The Age and Manner of Formation of Petroleum Deposits,' by E. T. Dumble; 'The Killing of the Burning Gas Well in the Caddo Oilfield, Louisiana,' by C. D. Keen; 'Is It Feasible to Make Common Carriers of Natural-Gas Transmission Lines?' by Samuel S. Wyer; 'Rock Disturbances Theory of Petroleum Emanations v. Anticline or Structural Theory of Petroleum Emanations,' by Eugene Coste; 'The Russian Oilfields,' by A. Adiassevlch, presented in abstract by Mr. Coste, and an illustrated address on 'Oil and Gas Sands' by I. N. Knapp. The organic and inorganic theories of the origin of oil were discussed by Mr. Coste, who favors the latter theory, while Mr. von Hofer's paper backed the organic theory.

TORONTO, CANADA

SPECULATION IN STOCKS AND PETERSON LAKE.—NIPISSING'S

FUTURE PROFITS.—SCHUMACHER AND LALLY COMPANIES.—

IRON ORE ON ISLANDS IN HUDSON BAY.

There has lately been a marked revival of activity in the demand for Cobalt stocks, and a large number of the cheaper issues have changed hands at advancing prices. The most noteworthy feature was the sudden rise in Peterson Lake, which about a week ago advanced from 25c. to 50c. on the news of a discovery of high-grade ore on the former Kerry leasehold, which is now being operated by the Peterson Lake. An old drift was followed from the Keewatin into the conglomerate formation, where two veins, 3 and 4 ft. wide, of high-grade ore were cut. On the strength of the demand created by this find, about 200,000 shares were sold in one day. The price has since dropped considerably, as the result of profit taking by shareholders tired of waiting for dividends. While the lower-priced stocks are looking up, Nipissing has been rather under a cloud and subject to depression, owing to the likelihood that the present dividend rate of 7½% per quarter may be cut. To maintain this rate requires an annual profit of \$1,800,000, and the present production barely reaches that point. The output for 1913 was approximately 4,600,000 oz., which was produced at a cost of 17.39c. per ounce. This year it is estimated that the cost will be at least 18c., while the average price of silver is not likely to exceed 57c. per ounce, so that, allowing that the output is maintained, the profit is calculated at \$1,794,000. As the management is disposed to be conservative and will certainly provide against the possibility of running short of funds for development, a reduction in the dividend rate appears probable in default of important new discoveries of high-grade ore.

The Schumacher, hitherto a private enterprise, which has 160 acres adjoining the Dixon claims and the McIntyre, has been incorporated with an authorized capital of \$2,000,000, and will put its stock on the market. Another new incorporation is the Lally Gold Mines, Ltd., which takes over the Lally mine in Turnbull township, where considerable development has been done and a quantity of ore is on the dump. Machinery is ready for installation. The authorized capital is \$3,000,000.

The Ungava Miners & Traders, Ltd., a Montreal company, has been granted by the Canadian government 30 mining claims on Clarke, Armstrong, and Curran islands in Hudson bay, about five miles from the mainland on the eastern shore of the bay. W. Tees Curran, the manager for the Company, has made several exploring expeditions in that region to search for minerals, and upward of \$50,000 is said to have been spent in work on the islands where extensive iron ore deposits have been found. The iron ore content of the beds on two of the islands, which vary from 7 to 15 ft. in thickness, is estimated at 465,000,000 tons, and the ore is stated to be of fine quality. An expedition will leave Montreal for the islands before long.

PORCUPINE, ONTARIO

HOLLINGER MEETING. — MCINTYRE DEVELOPMENT. — PORCUPINE CROWN DIVIDEND. — CROWN RESERVE MEETING. — MANN MINE SOLD.

The third annual meeting of the Hollinger Gold Mines, Ltd., was held at Montreal on February 2. N. A. Timmins presiding. The past year has been a prosperous one, details of which were given in this journal of February 14. The McIntyre company is developing its lower levels from the Pearl Lake shaft with good results. A vein 8 ft. wide has been cut at the 600-ft. level. This is the deepest working in the camp. The Porcupine Crown company has paid its initial dividend of 3%, and will be put on a 12% per year basis. The annual report shows a profit of \$150,572. The Company has added \$124,048 to the value of its equipment during the year. The president, Mr. Carson, stated that the mill would shortly be treating 180 tons of ore per day.

At the annual meeting of the Crown Reserve, held at Montreal on January 29, Mr. Carson, the president, announced that it was proposed to continue the payment of dividends on the present basis of 2% per month and to explore the bottom of Kerr lake. Development work done during the year was far in excess of any previous year's record, totaling 5345 ft. The production of the year was 1,776,678 oz., and the net value of shipments \$1,040,117. The profits were \$528,287. The Temiskaming is again shipping ore, several short shoots of high-grade ore having recently been cut. The main shaft is being sunk to 800 ft. Negotiations which have been carried on for some time for the purchase of the Mann mine, Gowganda, by an English syndicate headed by Claude Maitland, have been satisfactorily closed, and the purchasers have assumed control. The syndicate includes Sir John Graham of Glasgow and Hudson Bros. of Newcastle, and it is understood that they are preparing to spend a large sum in development. The purchase price is said to be \$500,000.

In connection with new regulations concerning oil in Canada, the Dominion parliament has been requested by the British Government to adopt legislation prohibiting the export of oil in time of war. New regulations have also been promulgated as to the disposal of petroleum and of natural gas rights on Dominion lands, under which the price of leases is fixed at 25c. per acre for the first year and 50c. per acre for each subsequent year, the leases to last for 21 years, and to be renewable for a similar term. The maximum area to be leased to any one person is fixed at 1920 acres, and lessees must have on their property an equipment to the value of \$5000 within one year and begin operations within 15 months. Where several locations are grouped, the equipment need not exceed in value \$10,000.

LUNING, NEVADA

SITUATION, ORE PRODUCTION, AND PROSPECTS OF THE LUNING MINING DISTRICT.—SHIPPER, LUNING GOLD, LUNING-IDAHO, CHAMPION, ALAMEDA, COPPER QUEEN, WAGNER AZURITE, AND ANDERSON MINES.

The Luning district, that portion of Mineral county lying east of Hawthorne and north of Mina, and the adjacent part of Nye county, so named from the fact that Luning is the natural distributing and shipping point for the territory, has long been known to possess remarkable surface copper showings as well as promising prospects for other metals. Until recently development work has been of such a character, and done in such a manner, that no real benefit has accrued therefrom. Within 18 months, systematic development has been started by well financed companies or individuals, and in every case the results obtained have more than justified the operators in their undertakings. During the past year

9759 tons of copper ore was shipped from the district. This ore contained from 3 to 16% copper, 10 to 30 oz. silver per ton, as well as small amounts of gold. A leaching plant is now being constructed by the Wagner-Azurite company, and local operators are awaiting with great interest the results of this undertaking, as the successful operation of such a plant, with its low treatment cost, as compared to the existing freight and smelter rates, will render commercially valuable a large tonnage of ore that cannot under present conditions be worked at a profit. This will mean increased mining activity, and the coming season should witness developments of note in this district. Ancient limestone, cut by monzonite and granitic intrusions and flows, forms the surface in the vicinity of Luning, though different local areas show exposures of porphyritic rocks and later intrusions.

The Shipper Copper Mining Co. owns two claims situated about 3 $\frac{1}{4}$ miles southeast of Luning. Control of the Company was secured by a group of operators from Spokane and other towns of eastern Washington, in July 1913, and the property financed for development. Traversing the claims in a northeasterly and southwesterly direction are two, and sometimes three, parallel outcrops. These are easily traced for 3000 ft., and show commercial copper ore at intervals throughout their length. They are in dolomite, though a bed of blue limestone may ultimately prove to be the hanging wall of the deposit. An incline shaft has been sunk to the 400-ft. level, giving a vertical depth of 300 ft. below the surface, and several hundred feet of laterals have been driven. This work has demonstrated that the veins cut the limestone beds at a slight angle and that the grade of the ore is improving as depth is attained, though the veins still show evidence of prolonged leaching action. Cross-cuts will soon be driven to determine the width of the mineralized zone, and work on a 3000-ft. adit will be commenced early this summer. This will develop the property 900 ft. below the present workings, and preliminary work has shown that ore of a shipping grade occurs at the point selected to begin work. The Shipper has produced about \$17,000 worth of ore during the past two years.

A reorganization of the Luning Gold Mines Syndicate is complete, it having 13 claims situated about six miles northeast of Luning. Extensive development has been done on the property. Large bodies of ore have been blocked out, of sufficient value to pay a good profit, could it be worked on the property, but not of high enough grade to stand the expense of shipment to Salt Lake. These veins contain gold, silver, and lead. The veins run nearly north and south. About two years ago a cross-vein was discovered, carrying considerable gold and silver, and about \$7000 worth of ore has been shipped since, from above the 50-ft. level. Little work has been done recently, but the Company expects to start work on a larger scale soon and cut the vein with an adit about 400 ft. below the croppings. The adit necessary would be about 450 ft. long. On its completion the Company will be able to make a large production of ore that will pay a handsome profit. Some of the former carload shipments yielded \$50 per ton.

The Luning-Idaho Mining Co. has 13 claims adjoining the property of the Luning Gold Mines Co., and several of those veins enter its property, and sufficient work has been done to prove the continuation of the veins. The claims have a good copper showing, and most of the work has been done on the copper veins or deposits. The deposit is about 250 ft. wide, and appears to have a granite hanging and quartzite foot-wall, and can be traced on the surface for about 3000 ft. The work done consists of several open-cuts, trenches, and shafts, dug to determine the proper place to sink a working shaft. A shaft is being sunk and is down about 30 ft., all in 5 to 12% copper ore. Sulphides are just making their appearance. As soon as roads are completed to ore dumps, shipping will be started. This seems to be a well defined vein,

and should make a large producer with a small expenditure.

The Champion property consists of seven patented claims, and has been developed to a depth of 100 ft. Considerable ore has been shipped in past years, and there are about 2000 tons of commercial ore on the dumps at present.

C. R. Dwight and T. R. Davies have recently undertaken the development of the Alameda property under a lease and bond agreement. The 13 claims comprising this group include the old Lime Point mine that is credited locally with a production of \$800,000. The present operators are developing two veins whose outcrops are traceable on the surface for about 2000 ft. These are apparently fissure veins in limestone, and recent work indicates that the property is one of great merit. Seventy-three tons of copper ore, carrying 8% copper and 4 oz. silver, extracted during development work, was shipped to the smelter last month.

The Copper Queen group, consisting of 64 claims, has recently been bonded by A. C. James and associates. Considerable surface work has been done preparatory to inaugurating an extensive plan of developing the promising surface showings that were uncovered by Fermina Sarrias.

Company is now erecting a plant for the treatment of these ores and expects to be operating within about 30 days. The plant was designed by John D. Fields, and is to have a capacity of 100 tons per day. It is a departure from the usual leaching practice in that the ore is ground fine and leached in a specially designed agitator containing an acid-proof filter. The pulp, after treatment with sulphuric acid, is treated by amalgamation to recover the gold and silver content. The copper is recovered from the solution by iron precipitation, but it is expected that electric power will be obtained in a short time, which will permit the installation of electrical equipment to produce the highest grade of electrolytic copper.

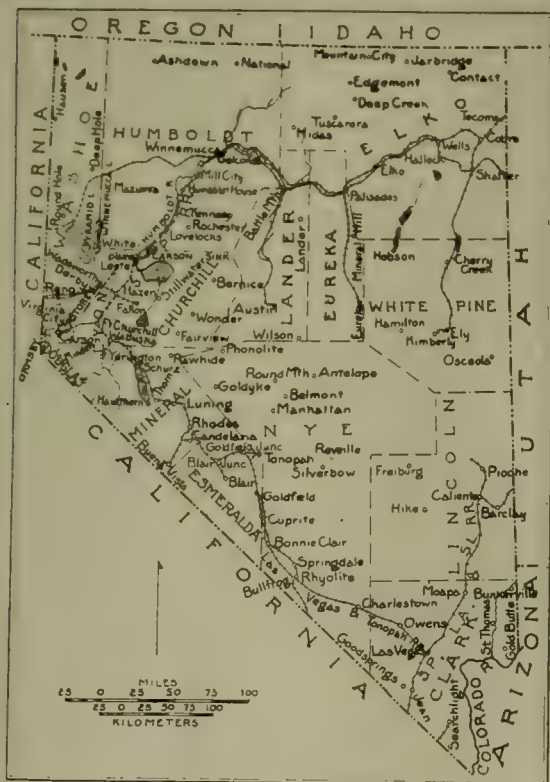
The Anderson mine, situated 4½ miles due east of Luning, was taken over upon a lease and bond by the Mason Valley Mines Co. about a year ago. The Company has worked it continuously since that time, and has shipped 6000 tons of ore with an average copper content of 3% and 1 oz. silver.

MELBOURNE, AUSTRALIA

RESULTS IN 1913.—A GENERAL DECLINE IN STOCKS.—DIVIDENDS PAID.—GREAT COBAR AFFAIRS.

The year 1913 is not one to be looked back to with pleasure by holders of mining stocks. In view of the decline in the price of the chief industrial metals, the drop in the mining shares outside of gold mining is not surprising. The Barrier, Broken Hill, shares show a decided fall. The decline in the value of Broken Hill Proprietary shares amounts to approximately \$2,500,000, or about \$2.50 per share, equal to more than 23% on the price ruling at the beginning of last year. That is not, proportionally, the most serious decline. Setting aside Junction shares, which have declined from \$2 to 60c., equal to a total drop of \$280,000, for reasons not connected with movements in the metal market, the greater percentage decline has been in Block 14, which has dropped almost \$1 on a price of about \$2.75 per share, that is to say, over 36%, equal to a total of \$100,000. Zinc Corporation shares have not moved, and North have appreciated slightly, a little over 3%; but everything else has dropped, the total fall for the 10 important big companies operating in the field being \$6,711,143, making the present value of \$42,886,610. The dividends paid during the year totaled \$7,170,124, or including investment companies dependent upon the success of the mines, about \$8,250,000. The Broken Hill South paid its shareholders nearly \$1,500,000 in dividends, the North Broken Hill, \$1,200,000, and the Proprietary over \$1,000,000; and the Sulphide Corporation, Zinc Corporation, Amalgamated Zinc, the Silvertown Tramway Co., and British Broken Hill, all between \$500,000 and \$1,000,000, the three first named being much nearer the larger amount than the smaller. Most of the shares in all the leading companies are held in Great Britain and Europe.

In view of the easing in the price of copper, it is not remarkable that copper shares have followed the lead of the Broken Hill silver-lead companies along the downward path. The principal copper mines are, in Queensland, Mt. Elliott and Hampden; in New South Wales, Great Cobar; and in Tasmania, Mt. Lyell; and all these are materially lower than they were a year ago, though it is only in the case of the last named that the state of the metal market must be held responsible. Among tin shares, the chief market movements have been in those of the Ardlethan field, New South Wales, where an unwarranted boom suffered an ignominious collapse. Gold shares have not been much in favor and have ruled generally lower. Among the companies mentioned above as having experienced a heavy decline in market values is the Great Cobar. The \$25 shares a year ago were as low as \$1.25, and the accounts will probably show loss for the year just ended. The Company has been considerably overcapitalized.



MAP OF NEVADA.

the owner. The ore occurs in the form of carbonates, oxides, silicates, and some sulphides, occurring in the garnetized lime, along its contact with the granitic intrusions.

The Wagner Azurite Copper Co. owns 16 claims adjoining the Nevada Champion and Anderson properties, about four miles east of Luning. By a system of open-cuts and shafts, the property has been opened for a length of ¼ mile and a width of 1500 ft., between a monzonite foot and quartzite hanging wall. The orebodies show strong on the surface, giving an average of 2½% copper. The ore carries ¾ oz. of silver to 1% of copper, and also some gold. The working shaft at present is only 100 ft. deep, with cross-cuts at the 50 and 100-ft. levels. With the present development there is apparently 50,000 tons of commercial ore available. The

General Mining News

ALASKA

Dogs are mostly used in Alaska for transport in winter; but Pete Bucholz, of Fairbanks, who has gone to the Beaver district, is trying to use a tame moose for this purpose. This will be the first time that these animals have been employed.

JUNEAU

January gold returns from the mines working on Douglas Island are as follows:

	Alaska Mexican.	Alaska Treadwell.	Alaska United.
Development, feet	34	252	1377
Stock of broken ore, tons ..	+2399	-51,846	-19,924
Stamps working	120	540	240
Ore crushed, tons	19,656	69,930	37,039
Concentrate saved, tons	377	1445	742
Gold by amalgamation	\$20,593	\$120,576	\$41,614
Gold by cyanidation	18,635	75,785	27,437
Total realizable value	38,836	194,398	68,361
Estimated net profit	8,288	114,544	13,257

There was a loss of \$247 in working the 700-Ft. claim, which produced ore worth \$1.53 per ton. Development in this property, operated by the Alaska United, covered 1236 ft. The work on the 1570, 1750, and 2100-ft. levels consisted of, principally, skip-chute raises and cutting the station and orebins at the central shaft.

RUBY

Mining on the creeks around Ruby is progressing fairly well, according to E. C. Hill, United States commissioner at this centre. Not so many winter dumps will be taken out on Long creek as last winter, but the summer will be busy enough. The Greenstone ground has been bonded by T. J. Coffey and associates to J. Holmgren, Duncan Michie, and Pete Jenson for \$65,000, and great interest is taken in developments. Ruby is dull at present, owing to the number of people going to new fields. About 400 went taking over \$200,000. Some are returning to the district, which produced about \$600,000 last season. This year's output will be higher.

ARIZONA

COCHISE COUNTY

The Calumet & Arizona mine is sending 2200 tons of ore daily to the smelter and stockpile. Transport of ore from the Briggs to the Junction shaft by electric locomotives is about to start. This line will be extended to the Hoatson. A 25-lb. rail is used in the C. & A. underground electric lines. On the 1400-ft. level it is 3300 ft. long, and on to the Hoatson will be another 2200 feet. Installing the pump at 1800 ft. in the Junction is under way, and is a trying job. Prospecting on the 1400-ft. level is promising. Sulphide ore is soon to be extracted from the Pittsburg & Duluth area, entered from the Cole shaft. There is a large tonnage of oxidized ore developed at 900 and 1000 ft. at this shaft.

GILA COUNTY

(Special Correspondence.)—Experiments are still being continued in the old mill of the Old Dominion, with the view to determining the method of concentration best adapted to the ores, but it is anticipated that a definite decision will soon be arrived at, and the remainder of the equipment necessary for the new plant will shortly be ordered. In the mine, ore production and development work are being increased somewhat. Motor haulage is being installed on the 1200-ft. level, and heavy rails are now being laid and the trolley wire strung along the drifts. Two new 3-ton locomotives have been or-

dered for this service. On the 1800-ft. level, the foundation for a Worthington pump has been finished and the pump will soon be working. Excavation for the big pump station on that level will commence immediately, and a drift will be run over to the 'A' shaft. Three furnaces are in blast at the smelter.

Globe, February 21.

(Special Correspondence.)—The U. S. Reclamation Service has the copper wire for transmission of power strung up to the tower at the millsite of the Inspiration. However, this wire has yet to be tightened and the insulators placed before it will be ready for service.

Miami, February 21.

The Gibson mine has been acquired under bond and lease by G. A. Whitford and O. B. Kemp, of Nevada and California for J. R. Davis of San Francisco and B. F. Carney of Berkeley, California. A mill, using a flotation process, of 60 to 80-ton daily capacity, will be erected. The mine, which is in the Pinal mountains, 9 miles west of Miami, and 16 miles from Globe, has produced \$1,600,000 since 1906.

Fine samples of asbestos have been discovered in the Ash Creek district, 35 miles northwest of Globe, by West & Sons.

The property of the London Arizona Consolidated Copper Co., consisting of approximately 2357 acres of mineral lands, is situated in the Banner mining district, in the recognized copper belt of the state. The Globe district lies about 25 miles north; the Hayden plant of the American Smelting & Refining Co. is about 3½ miles from the property, and the district is served by the Phoenix & Eastern railway, a branch of the Southern Pacific. The ores contain copper, with less important quantities of lead and silver. The veins have been proved to 1200 and 1400 ft. The property has been favorably reported on by S. F. Parrish of Los Angeles, Henry Kehoe of Spokane, E. W. Brooks of Los Angeles, W. B. Potter of St. Louis, R. D. O. Johnson of Winkelman, Walter G. Swart of Denver, and Edmund Juessen of San Francisco.

Reserves in the Southwest Miami, according to the superintendent, Mr. Hoar, are 981,000 tons of 1.5% copper ore, and probably 895,000 tons of 1.4% ore. The developed and probable ore is estimated at 4,294,000 tons containing 1.2% copper. Drilling is to be continued with two machines, there being funds for about six months.

A contract has been let to the General Electric Co. for three 6000-kw. turbo-generators for the joint power station of the Inspiration Consolidated and International Smelting & Refining companies. This plant will be between Globe and Miami. C. C. Moore, of Los Angeles, will supply the steel building.

MOHAVE COUNTY

Four shafts and other work has opened good ore in the Arabian Consolidated mines, in the Union Pass district. Sulphide ore has just been reached in the Arizona Southwestern mine, and the shaft is to be sunk within 30 days. Some good copper ore is to be sent to the Copper Queen smelter from J. J. Connolly of Bobtail Basin. The Rainbow Mountain Mining Co.'s property, at Chloride, is opening well, especially at 400 feet. Shipments will be made soon. The ore contains gold, silver, and lead.

PINAL COUNTY

(Special Correspondence.)—The management of the Magma mine states that the company intends to build an aerial tram from Superior to one of three points, Miami, Ray, or a point on the desert to which a spur will be laid from the main line of the Southern Pacific. The final choice of route depends on several conditions, principally what encouragement the officials of Pinal and Gila counties give, and the terms and length of contracts they will be able to secure from the three different smelters involved, namely, the International Smelting & Refining Co.'s plant now building at Miami, the El Paso smelter, and the one at Hayden. The line to Miami would be 15

miles long, that out on the desert would be 10 miles, and the one to Ray would be the longest of the three. The contemplated line's importance is best understood when it is stated that the present rate paid for freight from the Superior district to the railway at Florence is \$10 per ton, and that the cost of delivering it by an aerial tram to Miami, for instance, would be about \$1 per ton. The line will not only carry the Magna's output but will have a considerable revenue for that company in handling of output of the entire Pioneer district, and incoming supplies at only half the present freight rate. Estimates have already been secured from steel companies and the management has practically finished its estimates, although it will not give out the approximate cost of such a line. That to Miami, however, probably would cost somewhere from \$200,000 to \$400,000, according to the size of towers, weight of equipment, and general details of construction.

Superior, February 28.

YAVAPAI COUNTY

In the Silver Cord and Brooks claims, gold-silver-lead ore has been proved to continue for a great length by adits, open-cuts, and cross-cuts. Rich gold-copper ore has been opened in the claims owned by F. Williams and J. Hobbs, two miles from Copper Basin. A deal is pending for 800,000 tons of tailing of the Congress mine. Developments in the Pocahontas mine have been good. Improvements at the Blue Bell mine and Humboldt smelter continue.

CALIFORNIA

Occurrence of graphite has been reported at various times from Calaveras, Fresno, Los Angeles, Mendocino, San Bernardino, Siskiyou, Sonoma, and Tuolumne counties, according to F. McN. Hamilton, of the State Mining Bureau. In 1913, Calaveras county produced 2500 lb. of graphite having a spot value of \$20 per ton. Save a small amount mined in Sonoma county in 1901-2, this is the first commercial yield of the mineral. Prices vary from \$10 to \$200 per ton for impure and high grades respectively.

Deposits of iron ore of varying size and quality are known to exist in 31 of the 58 counties in the state. The production during 1913 amounted to 2343 short tons valued at \$4485, as compared with the 1912 output of 2508 tons with a spot value of \$1 per ton.

AMADOR COUNTY

Work on foundations for the new Plymouth mill is still under way, and concrete is being poured. Several contracts have been let for the plant, among which are the stamps and boxes by D. D. Demarest Co.; two 8 ft. diameter by 22-in. cylinder Hardinge pebble mills by the Hardinge Conical Mill Co.; and Isbell vanners by the Isbell Mining Machinery Company.

BUTTE COUNTY

The Natomas Consolidated of California, which operates dredges at Thermalito, near Oroville, is taking steps to exterminate the mosquito there. Charles Thurman has men engaged in pouring crude oil on the surface of the abandoned ponds to prevent the mosquitoes from breeding.

Two dredges of the Oroville Dredging Co. recovered \$5699 during the last week of January.

ELDORADO COUNTY

W. H. Friendhoff of the U. S. Geological Survey, and E. L. Scott of the Forest Service, have been examining mineral claims on the Georgetown divide. A field deputy from the division office at San Francisco, with E. E. Jones of the Forest Service, is inspecting the forest reserve in the eastern part of Eldorado and the northern part of Amador counties.

INYO COUNTY

The annual report of the Tecopa Consolidated company, operating at Resting Springs, shows that the Gunsite mine

produced 10,000 tons of ore worth \$128,000. Of this, \$40,000 was paid for freight. Net profits from this mine were \$52,000. The Noon Day produced 1000 tons yielding \$1499 profit. Mining cost from \$1.66 to \$3.62 per ton. The monthly payroll is \$4000 at present. A plant of 30 to 50-ton capacity, costing about \$25,000, will probably be built. This would concentrate low-grade ores. The mines are opening satisfactorily. N. L. Graves is president.

NEVADA COUNTY

(Special Correspondence.)—A hoist with a capacity of 4 to 5 tons, from a depth of 7500 ft. on an incline of 30°, is to be installed at the Empire mines, Grass Valley. A 60-stamp mill will be erected during the current year; but the plans are not yet complete.

Grass Valley, February 25.

On February 26, masked and armed bandits held up the night shift in the Central cyanide plant of the North Star Mines and stole from 50 to 100 lb. of gold precipitate worth



VIEW OF GRASS VALLEY FROM EMPIRE MINE.

from \$2000 to \$3000. The robbers cut the telephone wires from the plant, so that an early alarm could not be given. Evidently they knew of the routine work of the mill, as a clean-up was to have been made on the day of the robbery. A. B. Foote is superintendent of the North Star Mines.

The men who robbed the North Star Mines cyanide plant have since been captured.

PLACER COUNTY

Over 400 acres of land in the Gold Hill district, in Auburn ravine, has been purchased by L. Gardella of Oroville, who will drill it and erect a dredge during the current year.

SISKIYOU COUNTY

The Butte Dredging Co. is sending lumber and material to Greenhorn gulch, near Yreka, and will construct a dredge to cost \$150,000. In charge of operations are L. T. Parkes of San Francisco, B. F. Masten and E. W. Stebbins of Oakland.

TRINITY COUNTY

Ten to twelve inches of specimen ore and four feet of low-grade material has been opened at a depth of 135 ft. in the Democrat No. 1 mine, two miles from Weaverville. E. E. Harrigan is owner of the property.

TUOLUMNE COUNTY

The O. K. group of claims, joining the Tarantula on the north, have been bonded to Los Angeles people. Several men have started work at the property. An experimental cyanide plant is being installed near the Harvard mine, by W. H. Staver, formerly of the Liberty Bell mine, Colorado. He will show that concentrate can be more economically treated locally than by shipping to smelters. O. E. Prestegard is assisting Mr. Staver.

COLORADO

TELLER COUNTY (CRIPPLE CREEK)

The annual report of the Acacia Gold Mining Co. shows that, with the exception of the south Burns shaft, the property was worked by lessees. Fair ore was opened on No. 9 level at this shaft. Total receipts were \$10,303, including \$2032 for royalties. There was a deficit of \$4173 for the year. Cash on hand amounts to \$3358. R. MacKenzie is manager. No annual meeting of the Jennie Sample Consolidated Mining Co. is to be held; but the report shows that lessees mined 1440 tons of ore yielding \$27,571, producing \$4177 net royalty for the Company. Cash on hand is \$2341, with no debts. The Beacon Hill property of the El Paso Consolidated is expected to produce 3500 tons of \$30 ore in February. A dividend of 10c. per share and 490,000 shares has been paid. Henry Martin, a sub-lessee at the W. P. H. mine on Ironclad hill, has opened 12 ft. of rich ore between the 200 and 300-ft. levels. This is supposed to be the faulted Harrison and Sevier shoot, which produced \$315,000 in 1904.

Estimates of the February gold output of the district show 71,293 tons treated, worth \$988,578. Dividends totaled \$145,000.

IDAHO

BLAINE COUNTY

There will be considerable activity in the Wood River district in the spring and summer, especially at the Plughoff and Reed at Glendale, Minnie Moore, Queen of the Hills and Queen Extension, Croesus, Clipper, Hidden Treasure, Donahue and Warning, Red Elephant, Bullion, Nay Aug, Boston-Idaho, Boulder, Million, Independence, Noonday, North Star, and others.

SHOSHONE COUNTY

On March 4 the Bunker Hill & Sullivan company paid dividend No. 198, amounting to \$81,750. Developments in the Wisconsin mine, 2½ miles northeast of Kellogg, are extremely good, and if they continue, a mill will be erected later on. Louis Bolduc is manager.

MICHIGAN

HOUGHTON COUNTY

Copper shipped over the South Shore railway during the first three weeks of February shows an increase of about 720,000 lb. over the same period of 1913. The old Allouez conglomerate lode has been opened by a cross-cut in the Franklin mine, at a depth of 3200 ft., and contains more copper than in the upper levels. On March 20, the Calumet & Hecla Mining Co. will pay a dividend of \$5 per share, amounting to \$500,000. The total paid to date amounts to \$129,400,000. The annual report of the Victoria Mining Co. shows the following:

Development, feet	7,428
'Rock' hoisted, tons	159,565
Sorted out (14%), tons	22,402
Copper production, pounds	1,428,693
Revenue from all sources	\$228,335
Loss on operations	7,494

Labor troubles caused the loss, but development and output were ahead of the previous year. Seven Ingersoll water Leyner drills, operated by one man each, were started during the latter part of the year 1913.

NEVADA

According to A. F. Gegan, Nevada representative of the Hercules Powder Co., and who covers the districts west of Palisade, mining generally in the state is sound and steadily increasing. The consumption of dynamite is considerably heavier than a year ago. Goldfield is more active; Tonopah is very busy; Manhattan is quieter, but will improve soon; Round Mountain is developing well; Battle Mountain, Copper Cañon, and Kimberley are promising; Buckhorn has its new mill work-

ing; Yerington copper is temporarily quieter; more miners are being employed at Luning, which is described in the 'Special Correspondence' portion of this journal; and the Pioneer and Good Springs districts are improving.

CHURCHILL COUNTY

The Nevada Hills mill produced \$36,304 from 4415 tons of ore in January with a profit of \$6638. The loss in residue was \$1.11 per ton. Cash on hand and in banks is \$51,682, and total resources \$194,003, with no liabilities. All litigation is finished at a cost of \$2500. An old ore dump was bought for \$5220 and is being milled at a profit.

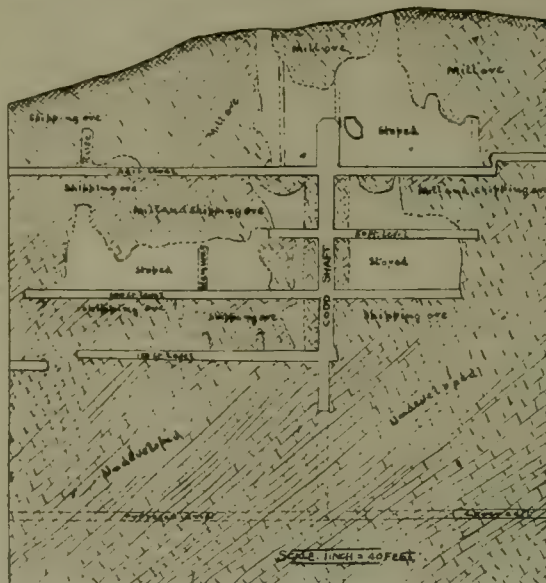
ESMERALDA COUNTY

At a meeting of the board of directors of the Goldfield Consolidated Mines Co., held at Reno on February 26, a dividend of 30c. per share was declared, payable April 30 to stockholders who are of record on March 31. This will amount to \$1,067,744, making a total of \$27,398,215 to date, equal to \$7.70 per share.

The February yield of the Goldfield Consolidated was \$344,000, from 26,774 tons of ore, with a net profit of \$179,000.

HUMBOLDT COUNTY

The Rochester Hills Mining Co. has a capital of \$1,000,000 shares of \$1 each, and operates a property producing silver and gold ores at Rochester. The annual report deals with the year 1913. A. A. Codd is president, and H. C. Zulch, mine superintendent. The former's report states that this is the Company's first year and it has been entirely satisfactory. The question of ore and supplies transport to and from the district mines to Oreana, on the Southern Pacific, was solved



VERTICAL SECTION THROUGH VEIN, LOOKING WEST.
ROCHESTER HILLS MINING COMPANY.

by constructing a narrow-gage railway 4½, and a wagon-road 9 miles long. The equipment consists of a Baldwin oil-burning steam locomotive, a 60-hp. gasoline locomotive, two flat cars, 10 ore-cars, ore-bins of 500-ton capacity, depot, and dwellings. The rails are 35 and 62 lb. per yard. This line has been of great benefit to the Rochester district. With a power-plant consisting of one 25-hp. Fairbanks-Morse oil engine, a 240-cu. ft. per minute duplex air-compressor, six machine drills, Westinghouse generator of 50-light capacity, and a 6-hp. Fairbanks-Morse hoist, as much as 250 tons of ore has been mined in a day. The mine is now 225 ft. below the adit level, and a larger equipment is to be installed. This consists of a 75-kva. generator, a 50-hp. motor and appa-

ratus, a 9 drill, 2 stage air-compressor, drill sharpener, and an electric hoist. During 1913 the sum of \$43,959 was spent on equipment generally. The mine was developed by an adit level, from which was sunk a 2-compartment shaft and roadway. The shaft is 165 ft. below the adit. Levels have been driven every 50 ft. A rich vein, known as the East, about 300 ft. east of the present vein, is to be developed at an early date.

Heiman C. Zulch reported that development covered 2316 ft. The accompanying section of the mine shows the ore which is shipped at a profit, and the mill ore, which is from 4 to 14 ft. wide, worth \$12 to \$16 per ton, and amounting to 25,000 tons. Late in January 1914 a shoot was opened on the hanging wall of the 150-ft. level, assaying \$5 to \$8 gold and \$40 to \$87 silver per ton. Financial results were as follows:

Ore shipped to smelter, short tons.....	9,167
Gross value	\$175,762
Smelter charges, equal to \$6.20 per ton.....	72,464
Transport, equal to \$4.40 per ton.....	40,684
Net return	62,613
Revenue in 1913 from ore and stock sales, etc.....	187,873
Expenditure on all work	181,855
Cash on hand	6,018

NYE COUNTY

Bullion taxes paid in the county during the September quarter of 1913 amounted to \$37,157. Of this the Belmont company at Tonopah contributed \$27,650, part of which was due from 1912, and the first and second quarters of 1913. The Clifford-Nay mine shipped 4930 lb. of ore worth \$2492 per ton during the third quarter. On April 1, the Belmont company will pay 25c. per share, equal to \$375,000. The shaft vein was opened last week on No. 13 level, showing 3 ft. of good ore. The West End shaft is to be sunk from 800 to 1000 ft. The new hoist recently raised 1550 tons with a 2-ton skip in 24 hours, costing 1.7c. per ton, about half the cost with the old engine. At 698 ft. in the Montana, the Macdonald vein is 12 to 15 ft. wide, of which 4 ft. is good mill ore. To permit of a survey being made of the disputed ground, the Jim Butler and West End companies will suspend mining in the Eureka claim of the former until March 10. Probably there will be no litigation over the matter.

SOUTH DAKOTA

LAWRENCE COUNTY

Eastern people have acquired an option on the Far West and other claims in the Carbonate district. Water caused a suspension of work years ago. The Titanic company holds leases and options on several well known claims south of the Far West, and is doing a considerable amount of prospecting. The Oro Hondo mine, situated about a mile from Lead, and adjoining the Homestake on the south, is to be reworked by John T. Milliken, of Cripple Creek, Colorado, under the management of Joseph E. Carr. The shaft is 1050 ft. deep and almost full of water. This will be baled out and the shaft sunk another 1000 feet.

POTTER COUNTY

After drilling over 2000 ft. and spending from \$25,000 to \$30,000 at Gettysburg, the Fox Oil Co. is drawing the inner casing of the well. It is said that the well is not deep enough to cut the oil strata and suitable drilling machinery was not used.

UTAH

JUAB COUNTY

The Gemini mine, according to J. H. McChrystal, superintendent, produced \$500,000 from about 20,000 tons of ore in 1913. Of this, nearly \$170,000 was from lessees' ore. The present output of the mine is 1800 tons per month. Two hundred tons of 7 to 8% copper ore is being shipped monthly from

the Iron Blossom. Development at 1900 ft. is encouraging, but work has been stopped on levels between this and 700 ft. The annual report of the Eagle & Blue Bell Mining Co. shows that ore shipments were worth \$315,324, containing 7514 oz. gold, 417,279 oz. silver, 4,639,973 lb. lead, and 157,596 lb. copper, all increases on 1912. Development covered 3872 ft., at a cost of \$9.13 per foot. Net earnings were \$147,198. From 8 to 18 in. of silver-gold-copper ore is being opened on the lowest level of the United Tintic mine.

SALT LAKE COUNTY

Larger crushers are to be installed at the Lark mill of the Ohio Copper Co. The three units of the plant have a capacity of 500 tons each per day; but with the changes to be made this will be increased to 1000 tons each. Net earnings of the Utah-Apex Mining Co. for the last quarter of 1913 were \$26,145, compared with \$48,752 in the third term. This decrease was due to most of the mine being sealed in order to try to capture a bandit who was hiding there, bad weather preventing ore and concentrate shipments and a drop in the price of lead. Development work has been excellent. By April 1 the mill will be treating 350 tons of ore per day. Twenty tons daily of lead carbonate ore is being mined by Wade and Tibby, lessees on the Columbus Consolidated portion of the Wasatch Mines Co.'s property at Alta. The railroad from the smelters to Wasatch has reduced transport charge from \$2.05 to \$1.75 per ton.

SUMMIT COUNTY

At the Snake Creek tunnel the advance is 8½ ft. per shift. The flow of water is 2000 gal. per minute, but as it is warm the men are not inconvenienced thereby. The face is at present 1200 ft. below the surface. Excellent reports come from the Silver King Consolidated, especially from the 1550-ft. level. Twenty-five men are working at 800 and 1200 ft. in the old Daly mine, and high-grade ore is being marketed. From the American Flag, \$46 to \$50 ore has been sent to Salt Lake City. This Company has bought the Grasselli zinc plant at Park City, which will be overhauled and the Holt process installed. The snowfall at Park City in January was 64.2 in., and the greatest depth in the mountains was 120 in. near Park City.

WASHINGTON

PIERCE COUNTY

Governor Lister has ordered an investigation of the strike of 400 laborers at the American Smelting & Refining Co.'s smelter at Ruston, a town adjoining Tacoma, according to advices received at Central Labor Union headquarters. The Industrial Workers of the World and Western Federation of Miners have been interfering as usual. A shipment of 250 tons of ore from Cordova, Alaska, containing 65% copper and 18 oz. silver per ton, has been received at the smelter during the past week.

CANADA

BRITISH COLUMBIA

The provincial legislature is alive to the value of radium, and has taken out of the ordinary mineral classification all ores containing this mineral. A reward of \$5000 is offered to anyone discovering such ores, the government reserving to itself 50% of the value of the discoveries.

ONTARIO

All records for silver shipments were broken on February 24, when the Nipissing sent 381 tons, containing 452,336 oz., worth \$260,681, to England. At the Temiskaming mine, at Cobalt, the shaft is down 710 ft. Below the Keewatin, in the diabase, a new series of veins is being opened. Eighteen drills are working. The mill is treating 100 tons of ore per day. During January the Hudson Bay mine produced 1972 tons of ore yielding 56,983 oz. silver, with 89% recovery. The tailing averaged 2.8 oz. per ton.

Decisions Relating to Mining

COAL LAND—PURCHASE PRICE

Where a coal land applicant filed a proper application to purchase, complied with the regulations of the Department as to publication of notice, etc., and paid the price of the land as determined by conditions then existent as to distance from a completed railroad, he is entitled to purchase at that price notwithstanding the subsequent completion, prior to allowance of entry, of a railroad within fifteen miles of the tract.

MINERALS BY ADVERSE POSSESSION AGAIN

The Supreme Court of Alabama (Black Warrior Coal Co. v. West, 54 Southern, 200), by a four to three decision, held that Milly West had no interest in the minerals in controversy.

Milly urged that her ancestor owned a piece of land upon which one Garner entered adversely and after the statutory period acquired title. Before the statute of limitation had run, Garner conveyed to the predecessor of the coal company all the minerals in the land. Garner maintained his possession. There was no actual separate possession of the minerals. She contended that Garner's deed operated a severance of agricultural from mineral rights, created two separate estates, was an abandonment of the possession of the minerals, and, as the grantee failed to take possession of the minerals, her ancestor's title to minerals was unaffected by adverse possession, which confessedly ripened as to the surface.

The prevailing opinion appears to be logical. Why three judges should dissent is not clear. May we surmise an innate aversion to title by adverse possession (characterized by a Western court as "title by larceny")?

The West case controlled four judges of the same court to deny a right which seems rather to be fortified by it (Moore v. Empire Land Co., 61 Southern, 940; opinion by Anderson J., who dissented in the West case). No opinion is expressed by the other three members of the court, two of whom also dissented in the West case.

In the Moore case a remote grantor of Kay while endeavoring to acquire title by possession, conveyed surface to the predecessor of a land company, and under that deed continuous possession had been maintained with no one in actual possession of the minerals. The court holds that when Kay conveyed the surface apart from minerals, this as a severance, was a mere legal fiction, and in absence of actual possession of minerals did not operate to sever possession of minerals from possession of surface. The court states that "In the absence of a physical severance, the possession of the surface, and the holder of the surface, if the grantor of the mineral right, or if the holder of the surface was the grantee of the surface right, then he held the possession of the mineral right for the benefit of his grantor of the surface right, but who reserved the mineral right."

This appeals to us as a correct statement of principles though the court adopts it with reluctance because announced by a majority only in the West case; nevertheless the court concludes that the land company has title to the minerals by adverse possession. Can it be that one who holds "possession of the mineral right for the benefit of his grantor of the surface right, but who reserved the mineral right" can thus acquire his grantor's reserved mineral right? Wherein is the benefit to the grantor? Can one hold under a deed at the same time that he claims adversely to it?

A possible solution of the apparent inconsistency is that some possessor held under a deed that ignored the mineral reservation and purported to convey full title; but this would require consideration of other principles, and no such condition is revealed by the report of the case.

Personal

F. H. MORLEY is at Pasadena.

H. H. WEBB is in San Francisco.

DORSEY HAGER has been in San Francisco.

EDWIN HIGGINS was in San Francisco Monday.

C. C. BROADWATER has returned from New York.

H. C. HOOVER has left for New York and London.

REEVES DAVIS, of Happy Camp, is in San Francisco.

J. D. HUBBARD is at Chico, Butte county, California.

CHARLES BUTTERS was expected in San Francisco today.

F. C. ALSDORF, of San Francisco, is in Arizona examining mines.

MALCOLM MACLAREN is returning to London from Kalgoorlie by way of India.

GELASIO CAETANI was at the Plymouth mine, Amador county, California, this week.

HARRY G. HANN is drilling alluvial ground for the Lenskoi Gold Mining Company.

W. H. WEED has been in Butte examining the property of the Butte-Duluth Mining Company.

STANLEY HARROLD, who has been visiting California, will return to Venezuela the last of the month.

P. F. HARE, manager of the Pierce Company, Ltd., dredge at Pierce, Idaho, is in London. He will examine placers in Peru.

FERDINAND McCANN has gone to the Philippines to take charge of the cyanide plant of the Keystone M. Co., at Aroroy, Masbate.

WALTER W. BRADLEY and FRED L. LOWELL, of the California State Mining Bureau, are examining mining districts in Tuolumne county.

HOWLAND BANCROFT has gone to New York, and expects to sail for Peru today. He will return to Denver at the beginning of June.

MORTON WEBBER, who has been in California, has gone to Salt Lake City and Butte, from which latter place he will return to New York.

F. McN. HAMILTON and ERROL MACBOYLE, of the California State Mining Bureau, have just returned from a tour of the Mother Lode counties.

ROBERT S. TAYLOR, and EDWARD RECTOR are in San Francisco for the Deister Concentrator Co. in connection with the Mine & Smelter Supply Co. litigation.

W. H. STAYER, assisted by O. E. PRESTEGARD, is installing a small experiment cyanide plant near the Harvard mine, Sonora, Tuolumne county, California.

The Montana section of the AMERICAN INSTITUTE OF MINING ENGINEERS held its annual meeting at Butte on February 6, over 50 members being present. The old officers were re-elected. E. P. Mathewson is chairman; Frank M. Smith, vice-chairman; and D. C. Bard, secretary. The above, with J. L. Bruce and Oscar Rohn, constitute the executive committee. After the business meeting the following papers were read and discussed: 'The Drumlummon Mine,' by C. W. Goodale; 'Economy and Efficiency of Reverberatory Smelting,' by C. D. Demond; and 'The Labor Crisis in Chile,' by Bancroft Gore.

DURING the period October 1 to November 30 there were 7251 men employed at the Lena Goldfields, Siberia, and 102,074 cu. yd. of gravel was mined. Only 10,161 cu. yd., averaging \$8.46 per yard, was washed on account of the winter season.

New York Metal Market Review

In February there was a continuance of heavy copper exports, but a falling off in foreign buying toward the end of the month, which, with a lessened domestic demand, caused a decline in prices. There were heavy sales of lead, mostly at low prices, and American metal was exported to London. In spelter there was good buying in keeping with the greater activity of the sheet mills, but it did not last long. Antimony presented little of interest. There were some fairly good movements in tin, some of which were largely due to manipulation to which there was a reaction and this metal's reputation for violent fluctuation was maintained. Aluminum varied but little in price, for the reason that foreign metal exercised a steadying influence. In nearly all metals the early days of the month saw advances, after which a steady decline set in.

COPPER

Exports of copper in January and February were maintained and in the former month reached the big total of 35,566 tons. Following heavy buying, both foreign and domestic, in the last few days of January, electrolytic stiffened and advanced to about 14.75c. cash, New York, which was quoted when February opened. Prior to the movement referred to the demand from abroad had been much the heaviest, but in early February domestic consumers took the lead. In the face of the advance came a puzzle for the trade in that the American Brass Co. reduced its prices for brass and copper products $\frac{1}{4}$ c. per pound. Various theories were advanced for this step, one being that the Company had bought enough copper for its needs at a low price and was willing to take a proportionate profit, while another was that it did not concede the justification for the advance in price and had decided to take a hand in the game and show its disapproval. A second flurry of buying was a good one, though somewhat spotty, quotations varying from 14.62 $\frac{1}{2}$ to 14.70c. cash, New York, with Europe again figuring in a majority of the sales. After the issuance on February 9, of the Copper Producers' statement for January, which was favorable in that it showed a decrease in stock of 4,142,182 lb. and that domestic deliveries had increased over 26,000,000 lb. over those of December, though still short 20,000,000 lb. of normal, there was some moderate buying of electrolytic, and the market settled at about 14.62 $\frac{1}{2}$ c. cash, New York, where it stood until February 21, when it dropped to 14.50c. cash, New York, a price made by second hands. Toward the middle of February it became known that the demand for brass and copper products had eased off again and that some of the Naugatuck valley mills had again reduced their working hours. Toward the end of the month the market was quiet, although foreign deliveries were keeping up at a good pace. Throughout most of the month the producers were holding ostensibly to their 'peg' price of 14.87 $\frac{1}{2}$ c. delivered, cash 30 days, or 14.75c. cash, New York; but, as already indicated, the metal was to be had at lower figures, and toward the end of the month there was a break in the peg price, and at least one producer had made sales on a basis of 14.62 $\frac{1}{2}$ c. cash, New York. Second hands would take 14.50c. or less. Lake was nominally quoted at 15c. throughout February, though sales of choice brands were made at 15.12 $\frac{1}{2}$ c. cash, New York, and 15.25c. cash, New York. Lake was scarce and the producers were picking their customers. Copper exports up to and including February 26 were 26,140 tons. The Waterbury average for January was 14.75c. per pound.

LEAD

At the beginning of February the American Smelting & Refining Co. advanced its price 5 points to 4.15c., New York, while the St. Louis quotation moved to 4.05c. Demand was fair when the advance was made, but it eased off shortly after, and with more definite rumors of government action against

the large interest, a declining tendency in London, and quiet in the domestic market, it became apparent that lower prices were to be expected. These expectations were realized on February 11, when the New York price was made 4c., a drop which was more than the trade looked for, despite the softness which had prevailed. At the new price business was induced, but many independent sellers withdrew from the market rather than meet the low price. Later in the month they offered to take business again, but consumers evidently had filled up and there was little doing. The St. Louis price had dropped to 3.87 $\frac{1}{2}$ c. and remained there from February 11 to near the close of the month. When the low prices were established there came about what had long been expected, the exportation of American lead to London. It was done very quietly, and while the fact was confirmed, the amount shipped could not be ascertained. It was regarded as natural that lead should go abroad in view of the narrow margin between New York and London prices. The former, of course, were shaded in what transactions there were. One reason for sending lead abroad was the accumulation of a surplus here. Still more exports are expected.

SPELTER

Starting at around 5.40c. New York, and 5.25c. St. Louis, spelter advanced and in the second week of February reached 5.45 to 5.50c. New York, the higher prices being predicated on a much better demand from the sheet mills, which accompanied the better trend in iron and steel generally. Toward the third quarter of the month the demand subsided and quotations declined to 5.35 to 5.40c. New York, with St. Louis 15 points lower. On the decline the West was pressing for business, but not much was stirring.

ANTIMONY

In late January and early February there were fair quantities of antimony taken, after which the demand eased off and there was little of interest in the metal in the remainder of the month. Quotations for Hallett's were uniform at 7 to 7.25c. Cookson's declined a few points, 7.20 to 7.25c. being quoted February 26. Chinese and Hungarian brands showed weakness also, being quoted at 5.87 $\frac{1}{2}$ to 6.12 $\frac{1}{2}$ cents.

PIG TIN

Although tin touched 41c. early in February, its general course was downward and the quotation for prompt on February 25 was 38.12 $\frac{1}{2}$ c. The month's buying was in fits and starts and at times there was fairly heavy buying. February 3, for instance, probably 300 tons was taken in deliveries that ran from spot to June, both dealers and consumers taking the metal. February 4, between 500 tons and 700 tons was sold at 41 to 41.25c., dealers taking many tons in an effort to hold the market up. Thereafter dullness ensued and it was seen that a decline was inevitable. The manipulation caused lack of confidence on the part of buyers, especially those who had bought when the higher prices prevailed. February 18 there was a slight turn from the downward trend and about 200 tons was taken at prices that ranged between 39.25 and 39.40c. Immediately thereafter dullness was in full force again and there were more sellers than buyers and the former were depressing the market to make business. The only buying in the week ended February 25 was of a hand-to-mouth character. The course of prices in London is indicated by the fact that quotations on February 11 were £185 5s. for spot and £186 7s.6d. for futures, while on February 25 there were £173 10s. for spot and £175 10s. for futures. Deliveries into consumption in January reached the excellent total of 3600 tons, as compared with 3700 tons in the same month of 1913. The total visible supply January 31, 1914, was 14,859 tons, which was 888 tons above that of January 31, 1913. On February 26 the arrivals of the month totaled 3020 tons and there was afloat on that day 2970 tons. February deliveries into consumption are estimated as between 2800 to 3000 tons.

The Metal Markets

LOCAL METAL PRICES

San Francisco is not a primary market for the common metals except quicksilver. The prices quoted below therefore represent sales of small lots and are not such as an ore producer could expect to realize. Ore contracts usually call for settlement on the basis of Eastern prices, less freight and treatment charges. The prices quoted are in cents per pound, except in the case of quicksilver, which is quoted in dollars per flask of 75 pounds.

San Francisco, March 5.

Antimony	9 — 9½c
Electrolytic copper	15½—15¾c
Pig lead	4.25—5.20c
Quicksilver (flask)	\$39.00
Tin	42½—44c
Spelter	6½—6¾c
Zinc dust, 100 kg. zinc-lined cases, 7½ to 8c. per pound.	

EASTERN METAL MARKET

(By wire from New York.)

NEW YORK, March 5.—Electrolytic copper is still weak, declining from 14.25 to 14.15c. per pound. Exports from the United States in February totaled 34,384 tons, against 26,767 tons a year ago. The Miami February output was 3,393,100 lb. Lead is steady at 4c. and spelter is easier at 5.15c. per pound. Tin is quiet at 37.87 to 38.12c. and antimony is dull. In London, copper is £64 2s.6d. for spot and £64 12s.6d. for futures, prices unchanged. Lead is £19 17s.6d., off 2s.6d. Gold bars worth \$2,000,000 have been engaged for shipment to Paris from New York, making \$16,000,000 for the present movement.

SILVER

Below are given the average New York quotations in cents per ounce, of fine silver.

Date.	Average week ending.
Feb. 26	57.50
" 27	57.50
" 28	57.62
Mch. 1 Sunday	
" wires down	57.46
" wires down	57.37
" 4	57.32
Monthly averages.	
1913.	1914.
Jan.	57.58
Feb.	57.53
Mch.	57.87
Apr.	59.26
May	60.21
June	59.03

COPPER

Quotations on copper as published in this column represent average wholesale transactions on the New York market and refer to electrolytic copper. Lake copper commands normally 1-5 to 1-4c. per lb. more. Prices are in cents per pound.

Date.	Average week ending
Feb. 26	14.25
" 27	14.25
" 28	14.25
Mch. 1 Sunday	
" 2	14.20
" 3	14.20
" 4	14.15
Monthly averages.	
1913.	1914.
Jan.	16.54
Feb.	14.93
Mch.	14.72
Apr.	15.22
May	15.42
June	14.71

Consumption of foreign copper in Germany in 1913 was 224,350 tons, according to L. Vogelstein & Co. The total in 1912 was 195,917 tons. Of the past year's imports, 94,638 tons came from the United States.

According to the Department of Commerce, imports of copper and manufactures thereof for December 1913 amounted to \$3,142,810 compared with \$4,609,063 for December 1912. For the year ended with December 1913 the total was \$44,479,568, compared with \$44,315,525 for the year ended December 1912. The exports of copper and manufactures thereof for December 1913 were \$12,666,621, compared with \$11,180,000 for December 1912. For the calendar year of 1913, exports were \$144,909,117, compared with \$126,770,167 in 1912.

QUICKSILVER

The primary market for quicksilver is San Francisco, California, being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at

which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending		Feb. 19.	1913.	
Feb. 5.		39.00		
" 12.		39.00		
Monthly averages.		Feb. 19.	1913.	
1913.	1914.	1913.	1914.	
Jan.	39.37	39.25	July	41.00
Feb.	41.00	39.00	Aug.	40.50
Mch.	40.20		Sept.	39.70
Apr.	41.00		Oct.	39.37
May	40.25		Nov.	39.40
June	41.00		Dec.	40.00

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.	Average week ending
Feb. 26	4.00
" 27	4.00
" 28	4.00
Mch. 1 Sunday	
" 2	4.00
" 3	4.00
" 4	4.00
Monthly averages.	
1913.	1914.
Jan.	4.11
Feb.	4.02
Mch.	4.32
Apr.	4.36
May	4.34
June	4.33

1913.	1914.	1913.	1914.
Jan.	4.28	July	4.35
Feb.	4.33	Aug.	4.60
Mch.	4.32	Sept.	4.70
Apr.	4.36	Oct.	4.37
May	4.34	Nov.	4.16
June	4.33	Dec.	4.02

At the beginning of March 1914 neither zinc nor lead at Joplin is selling as high as they did at the corresponding period of 1913, but the outlook for better prices is fairly good. At this time last year offerings were declining, and many mines which were able to operate at the higher prices that had prevailed were beginning to shut down. Zinc sulphide ores of 60% metallic zinc now sell for \$11 to \$14, basis, with premium grades selling up to \$47, these figures representing an advance of about \$1 per ton over prices that prevailed one month ago. Spelter at East St. Louis has been holding fairly firm at \$5.25 to \$5.35 per 100 lb. For the corresponding week of 1913, zinc sulphides brought \$45 to \$48, basis, with premium grades selling up to \$51 per ton. Calamine is in good demand at \$21 to \$23 per ton, basis of 40% metallic zinc, with premium grades bringing up to \$27. In the corresponding week of 1913 calamine brought \$24 to \$26, basis, with premium grades bringing as high as \$33. Lead ore remains unchanged at \$50 per ton, basis of 80% metallic lead, with premium grades bringing as high as \$4 in excess of this figure. Pig lead, at East St. Louis, is easier at \$3.90. In the corresponding week of 1913 lead ore brought \$53.50, basis, with pig lead quoted firm at \$4.20. The entire district is now producing about 4800 tons of zinc sulphide per week, the average of which will be about 58% metallic zinc, while much of it carries sufficient iron to warrant penalizing. The calamine output is about 400 tons per week which will average nearly 100%, while the lead ore output is about 800 tons which will average almost 80 per cent.

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date.	Average week ending
Feb. 26	5.15
" 27	5.15
" 28	5.15
Mch. 1 Sunday	
" 2	5.15
" 3	5.15
" 4	5.15
Monthly averages.	
1913.	1914.
Jan.	6.88
Feb.	6.13
Mch.	5.94
Apr.	5.52
May	5.23
June	5.00

TIN

New York prices control in the American market for tin, since the metal is almost entirely imported. San Francisco quotations average about 5c. per lb. higher. Below are given average monthly New York quotations, in cents per pound:

Monthly averages.				
	1913.	1914.		1913.
Jan.	50.45	37.85	July	40.70
Feb.	49.07	39.76	Aug.	41.75
Mch.	46.97	.....	Sept.	42.45
Apr.	49.00	.....	Oct.	40.61
May	49.10	.....	Nov.	39.77
June	45.10	.....	Dec.	37.57

The Stock Markets

SAN FRANCISCO STOCKS AND BONDS

(San Francisco Stock and Bond Exchange)

BONDS
March 4.

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Associated Oil Co.	\$ 97½	98½	Natoma Consol. Co.	—	26
Unlisted.			Pac. Port. Cement Co.	—	100
Ass. Oil Co.	—	78	Santa Cruz Cement Co.	85	90
General Petroleum Co.	44	46	Union Oil	—	88

STOCKS

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Amalgamated Oil	—	86½	General Petroleum	44	54
Associated Oil	41½	42	Noble Electric Steel	5	—
E. I. du Pont pfd	—	90	Natoma Consol.	14	—
Giant	85	87	Pac. Port. Cement	—	60
Pac. Oil Borax, pfd	70	—	Riverside Cement	60	65
Pacific Crude Oil	10c	30c	Santa Cruz Cement	50½	—
Sterling O. & D.	14	—	Stand. Port. Cement	22	—

NEVADA STOCKS

(By courtesy of San Francisco Stock Exchange.)

March 5.

Atlanta	\$.18	Montana-Tonopah	\$1.00
Belcher	.60	Nevada Hills	.35
Belmont	8.00	North Star	.38
Con. Virginia	.11	Ophir	.32
Florence	.54	Pittsburg Silver Peak	.37
Goldfield Con.	1.70	Round Mountain	.40
Goldfield Oro	.11	Sierra Nevada	.11
Hallfax	.80	Tonopah Extension	1.70
Jim Butler	.93	Tonopah Merger	.57
Jumbo Extension	.26	Tonopah of Nevada	7.00
MacNamara	.10	Union	.11
Mexican	1.10	Victor	.32
Midway	.37	West End	.89
Mizpah Extension	.44	Yellow Jacket	.41

COPPER SHARES—BOSTON

(By courtesy of J. C. Wilson, Mills Building.)

March 5.

	Bid	Ask		Bid	Ask
Allouez.....	\$ 41½	42	Mohawk.....	\$ 44	44½
Ariz. Commercial.....	5½	6	Nevada Con.....	16½	16½
Butte & Superior.....	35	35½	North Butte.....	28½	28½
Calumet & Arizona.....	67½	68	Old Dominion.....	53	53½
Calumet & Hecla.....	430	435	Osecola.....	80	81
Copper Range.....	37½	38	Quincy.....	63	64
Daly West.....	2½	2½	Shannon.....	6½	6½
East Butte.....	11½	11½	Superior & Boston.....	2½	2½
Franklin.....	6½	6½	Tamarack.....	41	41½
Granby.....	84½	84½	U. S. Smelting, com.....	41	41½
Greene Cananea.....	37	38	Utah Con.....	10½	11½
Isle-Royale.....	21	21½	Winona.....	4½	4½
Mass Copper.....	3	3½	Wolverine.....	45½	46

NEW YORK CURB QUOTATIONS

(By courtesy of E. F. Hutton & Co., Kohl Building.)

March 4.

	Bid.	Ask.		Bid.	Ask.
Braden Copper....	7½	7½	Mason Valley....	3½	3½
Braden Co.....	153	158	McKinley-Dar....	1½	1½
B. C. Copper.....	1½	1½	Mines Co. Am....	2½	2½
Con. Cop. Mines..	2½	2½	Nipissing.....	6½	6½
Davis-Daly.....	17½	2	Ohio Copper.....	¼	½
Ely Con.	4	6	San Toy.....	15c.	22c.
First National....	2½	3½	Stand. Oil of Cal.	341	343
Giroux.....	1	1½	Tri Bullion.....	¼	¼
Hollinger.....	16	18	Tuolumne.....	5½	1
Iron Blossom....	1½	1½	United Cop. com.	1½	¾
Kerr Lake.....	4½	4½	Yukon Gold.....	3	3½
La Rose.....	1½	1½			

NEW YORK STOCK EXCHANGE

(By courtesy of J. C. Wilson, Mills Building.)

March 5.

	Bid	Ask		Bid	Ask
Amalgamated.....	\$ 74	74½	Miami.....	\$ 22½	23½
Anaconda.....	35½	36	Nevada Con.....	16	16½
A. S. & R., com.....	67½	68	Quicksilver, com.....	2	2½
Calif. Pet. com.....	26½	27	Ray Con.....	20½	20½
Chino.....	41½	42	Tenn. Copper.....	35½	35½
Guggenheim Ex.....	53½	53½	U. S. Steel, pfd.....	101½	101½
Inspiration.....	16½	17	U. S. Steel, com.....	65	65½
Mexican Pet., com.....	67½	67½	Utah Copper.....	54½	55

LONDON QUOTATIONS

(By cable, through the courtesy of Cathin & Powell Co. New York)

March 5.

	£	s.	d.		£	s.	d.
Alaska Mexican	1	7	8	Kern River Oilfields	9	7	8
Alaska Trandwell	8	10	0	Mexico Mines	5	2	6
Alaska United	3	2	6	Messina	1	12	6
Arizona	2	0	0	Oroville	0	12	6
California Oilfields	6	0	0	Pacific Oilfields	0	2	6
Camp Bird	0	12	6	Itto Tinto	50	0	0
Cobalt Townsite	2	12	6	Santa Gertruda	0	16	6
El Oro	0	15	0	Tanganyika	2	2	6
Esperanza	0	18	9	Tomboy	1	2	6
Granville	0	10	0				

AUSTRALASIAN

March 5.

	£	s.	d.		£	s.	d.
British Broken Hill	2	2	6	Mount Elliott	3	15	0
Broken Hill Prop.	2	1	3	Mount Lyell	1	5	0
Golden Horse-Shoe	2	13	9	Mount Morgan	3	1	9
Great Boulder Prop.	0	13	9	Walhi	2	14	9
Ivanhoe	2	15	0	Walhi Grand Junc.	1	7	8
Kalgurli	1	17	6	Zinc Corporation, Ord. ..	1	2	6
Mount Boppy	0	12	6				

Current Prices for Ores and Minerals

(Corrected monthly by Atkins, Kroll & Co.)

The prices are approximate, subject to fluctuation, and to variation according to quantity, quality, and delivery required. They are quoted, except as noted, f.o.b. San Francisco. Buying prices marked *.

	Min.	Max.
Antimony ore, 50%, $\frac{1}{2}$ ton	*\$18.00	\$20.00
Arsenic, white, refined, $\frac{1}{2}$ lb	0.02½	0.03½
Arsenic, red, refined, $\frac{1}{2}$ lb	0.08	0.08½
Asbestos, chrysotile	100.00	350.00
Asbestos, amphibole	5.00	10.00
Asphaltum, refined, $\frac{1}{2}$ ton	11.50	20.00
Barium carbonate, precipitated, $\frac{1}{2}$ ton	40.00	45.00
Barium chloride, commercial, $\frac{1}{2}$ ton	40.00	42.50
Barium sulphate (barytes), prepared, $\frac{1}{2}$ ton	20.00	30.00
Bismuth ore, 15% $\frac{1}{2}$ ton	*\$50.00 upward	
Chrome ore, according to quality, $\frac{1}{2}$ ton	10.00	12.50
China clay, English, levigated, $\frac{1}{2}$ ton	15.00	20.00
Cobalt metal, refined, f. o. b. London, $\frac{1}{2}$ lb	2.50	
Coke, foundry, $\frac{1}{2}$ 2240 lb	15.00	20.00
Diamonds:		
Borts, according to size and quality, $\frac{1}{2}$ carat	2.00	15.00
Carbons, according to size and quality, $\frac{1}{2}$ carat	55.00	80.00
Feldspar, $\frac{1}{2}$ ton	5.00	25.00
Firebrick:		
Bauxite, $\frac{1}{2}$ M	175.00	
Magnesite, $\frac{1}{2}$ M	190.00	275.00
Silica, $\frac{1}{2}$ M	50.00	55.00
Flint pebbles for tube-mills, Danish, $\frac{1}{2}$ 2240 lb	21.00	22.50
Fluorspar, $\frac{1}{2}$ ton	10.00	15.00
Fullers earth, according to quality, $\frac{1}{2}$ ton	20.00	30.00
Gilsonite, $\frac{1}{2}$ ton	35.00	40.00
Graphite:		
Amorphous, $\frac{1}{2}$ lb	0.01½	0.02½
Crystalline, $\frac{1}{2}$ lb	0.04	0.13
Gypsum, $\frac{1}{2}$ ton	7.50	10.00
Infusorial earth, $\frac{1}{2}$ ton	10.00	15.00
Iridium	55.00	
Magnesite, crude, $\frac{1}{2}$ ton	5.00	7.50
Magnesite, dead calcined, $\frac{1}{2}$ ton	20.00	25.00
Magnesite, brick (see firebrick).		
Manganese ore, oxide, crude, $\frac{1}{2}$ ton	10.00	15.00
Manganese, prepared, according to quality, $\frac{1}{2}$ ton	30.00	70.00
Mica, according to size and quality, $\frac{1}{2}$ lb	0.05	1.00
Molybdenite, 95% MoS ₂ , $\frac{1}{2}$ ton	500.00	750.00
Monazite sand (5% thorium), $\frac{1}{2}$ ton	150.00	200.00
Nickel metal, refined, $\frac{1}{2}$ lb	0.45	0.60
Ochre, extra strength, levigated, $\frac{1}{2}$ 100 lb	2.00	2.50
Osmiridium, $\frac{1}{2}$ oz	25.00	
Platinum, native, crude, $\frac{1}{2}$ oz	30.00	45.00
Silic lining for tube-mills $\frac{1}{2}$ 2240 lb	35.50	37.50
Sulphur, crude, $\frac{1}{2}$ ton	20.00	25.00
Sulphur, powdered, $\frac{1}{2}$ ton	30.00	35.00
Sulphur, 80%, $\frac{1}{2}$ ton	16.50	18.50
Talc, prepared, according to quality, $\frac{1}{2}$ ton	20.00	50.00
Tin ore, 60%, $\frac{1}{2}$ ton	450.00	500.00
Tungsten ore, 65%, $\frac{1}{2}$ ton	425.00	450.00
Uranium ore, 10% min.	25.00 per unit	
Vanadium ore, 15% V ₂ O ₅ , $\frac{1}{2}$ ton	150.00	180.00
Wolframite (see tungsten ore).		
Zinc ore, 50% up, $\frac{1}{2}$ ton	*\$15.00	20.00

Current Prices for Chemicals

(Corrected monthly by Braun-Knecht-Helmann Co.)

Prices quoted are for ordinary quantities in packages as specified. For round lots lower prices may be expected, while in smaller quantities advanced prices are ordinarily charged. Prices named are f.o.b. San Francisco and subject to fluctuation. Other conditions govern Mexican and foreign business.

	Min.	Max.
Acid, sulphuric, com'l, 66°, drums, $\frac{1}{2}$ 100 lb.....	\$0.85	\$1.10
Acid, sulphuric, com'l, 66°, carboy, $\frac{1}{2}$ 100 lb.....	1.25	1.75
Acid, sulphuric, C. P., 9-lb. bottle, bbl., $\frac{1}{2}$ lb.....	0.13	0.18
Acid, sulphuric, C. P., bulk, carboy, $\frac{1}{2}$ lb.....	0.09 $\frac{1}{2}$	0.12
Acid, muriatic, com'l, carboy, $\frac{1}{2}$ 100 lb.....	1.85	3.00
Acid, muriatic, C. P., 8-lb. bottle, bbl., $\frac{1}{2}$ lb.....	0.15	0.20
Acid, muriatic, C. P., bulk, carboy, $\frac{1}{2}$ lb.....	0.10 $\frac{1}{2}$	0.15
Acid, nitric, com'l, carboy, $\frac{1}{2}$ 100 lb.....	6.00	6.50
Acid, nitric, C. P., 7-lb. bottle, bbl., $\frac{1}{2}$ lb.....	0.16	0.22
Acid, nitric, C. P., bulk, carboy, $\frac{1}{2}$ lb.....	0.12 $\frac{1}{2}$	0.15
Argols, ground, bbl., $\frac{1}{2}$ lb.....	0.10	0.20
Borax, cryst. and conc., bags, $\frac{1}{2}$ 100 lb.....	3.00	4.35
Borax, powdered, bbl., $\frac{1}{2}$ 100 lb.....	3.38	4.50
Borax glass, gd. 30 mesh, cases, tin lined, $\frac{1}{2}$ 100 lb.....	10.50	13.50
Bone ash, 60 to 80 mesh, bbl., $\frac{1}{2}$ 100 lb.....	5.50	6.50
Bromine, 1-lb. bottle, $\frac{1}{2}$ lb.....	0.55	0.65
Candles, adamantite, 14 oz., 40 sets, $\frac{1}{2}$ case.....	4.60	4.80
Candles, adamantite, 14 oz., 60 sets, $\frac{1}{2}$ case.....	5.25	5.45
Candles, Stearic, 14 oz., 40 sets, $\frac{1}{2}$ case.....	5.00	5.20
Candles, Stearic, 14 oz., 60 sets, $\frac{1}{2}$ case.....	5.70	5.90
Clay, domestic fire, sack, $\frac{1}{2}$ 100 lb.....	1.50	2.00
Cyanide, 98 to 100%, 100-lb. case, $\frac{1}{2}$ lb.....	0.18	0.22
Cyanide, 98 to 100%, 200-lb. case, $\frac{1}{2}$ lb.....	0.18	0.22
Cyanide, 125%, 100-lb. case, $\frac{1}{2}$ lb.....	0.22	0.25 $\frac{1}{2}$
Cyanide, 125%, 200-lb. case, $\frac{1}{2}$ lb.....	0.22	0.25
Lead acetate, brown, broken casks, $\frac{1}{2}$ 100 lb.....	9.00	10.50
Lead acetate, white, broken casks, $\frac{1}{2}$ 100 lb.....	10.50	10.75
Lead acetate, white, crystals, $\frac{1}{2}$ 100 lb.....	12.50	13.25
Lead, C. P., test., gran., $\frac{1}{2}$ 100 lb.....	13.00	15.00
Lead, C. P., sheet, $\frac{1}{2}$ 100 lb.....	15.00	18.00
Litharge, C. P., silver free, $\frac{1}{2}$ 100 lb.....	11.50	13.50
Litharge, com'l, $\frac{1}{2}$ 100 lb.....	8.00	9.50
Manganese ox., bik., dom. in bags, $\frac{1}{2}$ ton.....	20.00	25.00
Manganese ox., bik., Caucasian, in casks, $\frac{1}{2}$ ton.....	30.00	50.00
(85% MnO ₂ —15% Fe)		
Nitre, double ref'd, small cryst., bbl., $\frac{1}{2}$ 100 lb.....	7.00	8.00
Nitre, double ref'd, granular, bbl., $\frac{1}{2}$ 100 lb.....	6.50	7.50
Nitre, double ref'd, powdered, bbl., $\frac{1}{2}$ 100 lb.....	7.25	8.00
Potassium bicarbonate, cryst., $\frac{1}{2}$ 100 lb.....	12.00	15.00
Potassium carbonate, calcined, $\frac{1}{2}$ 100 lb.....	7.50	9.00
Potassium permanganate, drum, $\frac{1}{2}$ lb.....	0.10 $\frac{1}{2}$	0.13
Silica, powdered, bags, $\frac{1}{2}$ lb.....	0.03	0.06
Soda, carbonate (ash), bbl., $\frac{1}{2}$ 100 lb.....	1.50	1.75
Soda, bicarbonate, bbl., $\frac{1}{2}$ 100 lb.....	2.00	2.50
Soda, caustic, ground, 98%, bbl., $\frac{1}{2}$ 100 lb.....	3.00	3.25
Soda, caustic, solid, 98%, drums, $\frac{1}{2}$ 100 lb.....	2.50	2.75
Zinc shavings, 550 fine, bbl., $\frac{1}{2}$ 100 lb.....	12.00	13.00
Zinc sheet, No. 9—18 by 84, drum, $\frac{1}{2}$ 100 lb.....	10.20	11.00

*Extra charge for packing nitric acid for shipment to conform to regulations.

Company Reports

BARNES-KING DEVELOPMENT COMPANY

This Company operates at Kendall, Fergus county, Montana, and the profit and loss account from August 27, 1912, to December 31, 1913, shows the following: Gross earnings, \$414,594;; expenses, \$274,889; balance, \$139,705; other income, \$7910; total income, \$147,615; less extraordinary expenses, \$17,709; leaving a net profit of \$129,906.

NEVADA HILLS MINING COMPANY

This Company operates a mine and treatment plant at Fairview, Churchill county, Nevada, the area being 107.5 acres, and the report covers the past year. The report of E. A. Julian, general manager, and Fred J. Siebert, consulting engineer, contains the following information: Development covered, 6243 ft., including 903 ft. of core-drilling, the total to date being 35,660 ft. The Webber shaft is now down to 854 ft., timbered with 10 by 10-in. Oregon pine. Through

prospecting along the Nevada Hills vein and its branches, on the east and west sides of the Big fault, it appears that the limits of the vein have been defined. On the west side of this fault the Eagle vein was opened with encouraging results. On the east side this vein was cut on the 650-ft. level, and opened for 160 ft. in unprofitable ore. Thirty feet above the level good ore was cut. Drilling has cut the Eagle vein at 800 ft., where the width and gold content is better than above. Reserves of ore should supply the mill for another year. The mine produced 41,919 tons of ore averaging \$13.85 per ton, as follows: Nevada Hills vein east of Big fault, 14,538 tons, worth \$18.26 per ton; west of Big fault, 11,793 tons, worth \$12.47; and the Eagle vein, 15,588 tons of \$10.78 ore; the total value being \$580,468. The cost of mining was \$3.80 per ton of ore produced, or \$2.62 per ton of ore and waste produced. The stamp-mill and cyanide plant yielded gold worth \$510,413, with an average recovery of 88.4%, at a cost of \$2.839 per ton. The total expenditure, including development, mining, milling, marketing bullion and concentrate, general, and construction, was \$333,448, leaving a net profit of \$176,966. The Company's resources amount to \$186,802, with no liabilities, consisting of accounts and bills receivable, \$50,763; cash, \$60,618; supplies, \$43,602; concentrate and bullion in transit, \$11,819; and gold in solution, \$20,000.

MOUNT MORGAN GOLD MINING COMPANY, LTD.

The great gold and copper mine operated by this Company is situated in Queensland, Australia, and the report covers the half-year ended November 30, 1913. The general manager, B. Magnus, states that in order that the mine may be in a position to supply the necessary concentrating ore during the coming year, an undue proportion of preparatory work had to be undertaken during the term. This entailed close to 1700 ft. of driving and sinking, against 208 ft. in the previous period, and has naturally absorbed a great number of miners. In the near future an extra 500 tons of ore per day for the concentrator will be required, and the Company is trying to get the necessary number of miners required to produce this, but finds great difficulty in doing so, owing to the extreme scarcity of such labor throughout the Commonwealth and New Zealand. The average daily ore extraction during the six months was 840 tons. The material mined was as follows: copper ore, 117,108; sundry ores, 12,209; waste, 21,680; and filling sent underground, 46,646 tons. Ore reserves amount to 1,285,000 tons of high grade, 1,960,000 tons of low grade, and probably another 3,000,000 tons of concentrating ore.

At the Many Peaks pyrite mine 35,769 tons of ore was mined. The usual work was done at the Marmor limestone quarries. At the coal areas, several thousand feet of diamond-drilling has been done, proving large seams of good coal, so it has been decided to open one of the properties. The smelter handled 152,016 tons of mixed ores, yielding 4354 long tons of copper and 54,992 oz. gold. The revenue was £496,936, and profit £172,846. Adding £46,591 from the previous year, the balance was £219,437, out of which £27,883 was written off for maintenance, equipment, coal prospecting, and experimental work; £24,707 for depreciation; £100,000 for dividends, and £66,847 carried forward. The reserve, contingent, insurance fund, and undivided profit total £302,233. Experiments with concentration are still under way, and the Minerals Separation recoveries corroborate those of the Company's metallurgists. Four new boilers were erected, others are being installed, while three turbo-blowers and two air-compressors were erected. Contractors for the new smelter building are considerably behind time. A Dwight-Lloyd sintering plant is to be installed for the flue-dust. A. A. Boyd is mine superintendent, and J. W. Moule reduction works superintendent.

Recent Patents

1,072,373.—PROCESS OF PRODUCING CYANOGEN COMPOUNDS AND THE LIKE. Charles E. Acker, Ossining, N. Y., assignor to The Nitrogen Co., a corporation of New York.

Reacting on an impalpable amorphous carbide with a nitrogenous reagent, at a temperature above 500°.

1,071,847.—MAGNETICALLY OPERATED CONVEYING AND DISCHARGING APPARATUS. Wylie Gemmel Wilson, Elizabeth, N. J., assignor to W. G. Wilson Co., Montclair, N. J., a corporation of New Jersey.

An annular chambered conveyor casing having an inner circumferential wall of magnetic conductivity, an endless conveyor mounted in said annular chamber and provided with pocket forming disks and soft iron pieces; and a rotatable magnet structure mounted in the space inclosed by the inner circumferential wall of the annular chamber.

1,074,192.—SLIME DEWATERING GRAVITY DEVICE. Ira F. Monell, Boulder, Colo.

A pulp classifying and slime thickening apparatus comprising a tank having a long narrow settling chamber divided into a plurality of compartments each of which has an opening in its bottom, the upper end of said narrow chamber merging into a flaring current chamber, the opening between said current chamber and settling chamber being reduced, a plurality of baffle boards depending into said current chamber and arranged over the compartments of the settling chamber and means for restricting the capacity of said openings.

1,074,114.—CASE-HARDENING PROCESS FOR ARTICLES OF IRON, STEEL AND STEEL ALLOYS. Frederico Giolitti, Turin, Italy, assignor to Societa Anonima Italiana Gio, Ansaldo Armstrong & Co., Genoa, Italy.

A process for case-hardening objects of iron, steel, and steel alloys, comprising the following steps: packing the objects to be treated in granular carbon in a retainer, heating the container from an external source, passing a current of air through the carbon, and adjusting the rate of flow to obtain the desired concentration of carbon in the treated article; the temperature and duration of the treatment being kept constant.

1,071,870.—CENTRIFUGAL CONCENTRATOR. Martin Prior Boss, San Francisco, Cal.

A revolving separating basin comprising an outer pan having peripheral discharges, an inner pan separated from the outer pan to provide a water chamber between the two pans and a crown ring on the top of the outer pan and shelving inwardly over and beyond the rim of the inner pan, and separated from the top of said rim to provide an annular space for the outflow of the concentrate separated from the pulp to said inner pan, against the inflow of an excess of water supplied to the water chamber, said crown ring having a conical inner wall with a continuous outward slope from its lower to its upper edge.

1,071,714.—SLIME CONCENTRATOR. William F. Deister, Fort Wayne, Ind.

Combination of a table having a mineral discharge edge in its front side, and inclined downwardly from its head and upwardly from its rear side, continuous or unbroken riffles, extending from the head diagonally across the table toward the front side thereof; means for feeding pulp directly into the channel intermediate the riffles, means for the direct discharge of concentrate from the table at the termination of the riffle channels extending from the point of feed, and means for so vibrating the table that the concentrate will move along the riffles and away from the rear side of the table.

Book Reviews

QUANTITATIVE ANALYSIS. By Edward G. Mahlin. P. 511. Ill., index. McGraw-Hill Book Co., New York, 1914. For sale by the *Mining and Scientific Press*. Price, \$3.

Mr. Mahlin, associate professor of chemistry in Purdue University, in writing this text-book on chemistry has attempted "to present a theoretical and practical discussion of the subject, sufficiently simple to be comprehended by the average student but not so elementary as to destroy his self-respect." The first half of the book contains a general discussion of the objects and methods of quantitative analysis, and the remainder is devoted to methods of analysis of industrial products and raw materials. It appears to be a good, general text-book which may be especially useful to students of industrial chemistry.

A READER OF SCIENTIFIC AND TECHNICAL SPANISH. By Cornelis De Witt Willcox. P. 588. Ill., vocabulary. Sturgis & Walton Company, New York, 1913. For sale by the *Mining and Scientific Press*. Price, \$1.75.

As is indicated by its title, this book is intended for the use of students in colleges and technological schools who are engaged in the study of the Spanish language and expect to practice engineering in countries where Spanish is spoken. The book consists of nineteen chapters, each of which is devoted to a technical subject, such as: physics, chemistry, electricity, steam, compressed air, mining, bridges, railways, automobiles, aeronautics, etc. The chapters are abstracts or excerpts from Spanish publications, chiefly from 'La Física Moderna.' They are elementary in character and written in popular style, but afford an excellent opportunity for acquiring a technical vocabulary. The terms used in the chapter on mining are not those in common use in Mexico, so this part of the vocabulary would be of little assistance to mining men in that country, although the technical terms may be in use in Spain or the Philippines. The 'Reader' is a good text-book for technical students in high-schools and colleges, and also for engineers who are beginning the study of Spanish.

THE SAMPLING AND ASSAY OF THE PRECIOUS METALS. By Ernest A. Smith. P. 460. Ill., index. Charles Griffin & Co., Ltd., London, 1913. For sale by the *Mining and Scientific Press*. Price, \$4.50.

Assaying is a branch of metallurgy which has attracted large numbers of students, consequently a good number of works have been published on the subject. It may be said that the majority of them have been worth while, and the one under review can be included in that list. The author, who is connected with the Royal School of Mines, London, states that his book is primarily intended for students, having been written chiefly at the request of his old students. In the design and equipment of assay offices, modern practice is discussed including the style of building, machinery, and the latest furnaces, including coke, coal, and gas-fired, are described. How to use a balance properly is explained in a simple manner. Sampling ores and other products has been discussed at great length in technical papers, and in this volume the author has given late practice. While given at length, the operation of assaying contains nothing new; but the sampling and valuation of gold and silver bullion by dry and wet methods has been carefully done. Chapter XXII covers the assay of auriferous and argentiferous metallurgical products, chapter XXIII is on laboratory work in a cyanide mill, while the last 36 pages thoroughly deal with platinum and its allied metals.

Recent Publications

THE PROGRESS OF THE MINERAL INDUSTRY OF TASMANIA. Compiled by W. H. Wallace. P. 26. Hobart, Tasmania, 1913.

THE GOLD OF THE SHINARUMP AL PARIA. By Andrew C. Lawson. Reprint from *Economic Geology*, August, 1913. P. 14. Ill.

MINING LAWS OF THE UNITED STATES AND CALIFORNIA. California State Mining Bureau, Bulletin No. 66. San Francisco, 1914.

THE METEOROLOGICAL ASPECT OF THE SMOKE PROBLEM. By Herbert H. Kimball. Smoke investigation Bulletin No. 5. P. 51. Ill. University of Pittsburgh. Pennsylvania, 1913.

THE RAND BANKET. By C. B. Horwood. Reprint from the *Mining and Scientific Press*. P. 76. Ill. San Francisco, January, 1914. This series of articles has already received editorial comment and been fairly well discussed in the columns of this journal.

COMMISSION ON CONSERVATION IN CANADA. Report of the 4th annual meeting held at Ottawa, January 21-22, 1913. P. 238. Ill., index. Toronto, 1913. This report deals with an interesting subject, and it contains the reports on committees on minerals, lands, public health, forests, fisheries, game and fur-bearing animals, and smoke prevention.

HUDSON BAY EXPLORING EXPEDITION, 1912. By J. B. Tyrrell. Reprint from 22nd report of the Ontario Bureau of Mines, 1913. P. 51. Ill., maps. An account of an expedition to Port Nelson at the mouth of the Nelson river on Hudson bay to select certain lands in that country, and information on the character, resources, and possibilities of the district.

PRODUCTION OF IRON AND STEEL IN CANADA, 1912. By John McLeish. P. 39. Department of Mines, Ottawa, 1913. Canadian mines furnished 215,883 tons of iron ore during the year, but the blast-furnaces consumed 2,090,753 tons, and steel furnaces 43,006 tons. The pig iron output was 1,014,587 tons. All departments of the iron industry showed increases over 1911.

United States Bureau of Mines publications:

METAL-MINE ACCIDENTS IN 1912. Compiled by Albert H. Fay. Technical paper No. 61. P. 76.

ERRORS IN GAS ANALYSIS. By G. A. Burrell and F. M. Seibert. Technical paper No. 54. P. 16.

THE USE AND MISUSE OF EXPLOSIVES IN COAL MINING. By J. J. Rutledge. Miners' Circular No. 7. P. 52.

NOTES ON THE PREVENTION OF DUST AND GAS EXPLOSIONS IN COAL MINES. By George S. Rice. Technical paper 56. P. 24.

COAL-MINE FATALITIES IN THE UNITED STATES. October and November, 1913. Compiled by Albert H. Fay. P. 22 and 23, respectively.

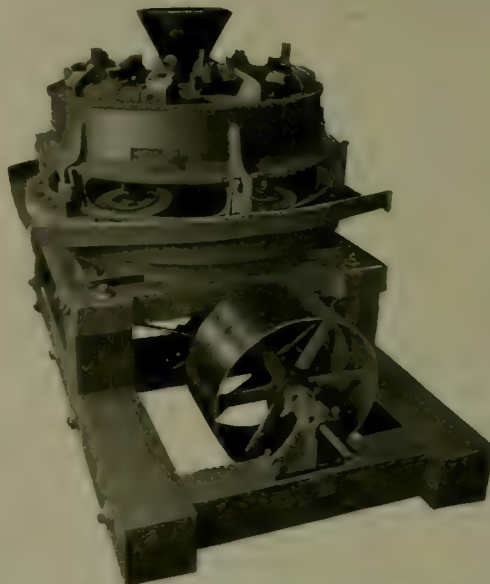
MINE-ACCIDENT PREVENTION AT LAKE SUPERIOR IRON MINES. By Dwight E. Woodbridge. Technical paper 30. P. 38. Ill. A large number of men are employed, and an enormous tonnage of ore is mined from the properties in this area, and an interesting account is given of occurrence of accidents, and what is being done for their prevention.

TESTS OF PERMISSIBLE EXPLOSIVES. By Clarence Hall and Spencer P. Howell. Bulletin 66. P. 313. Ill., index. This paper gives the results of tests of all permissible explosives tested by the Bureau of Mines experiment station at Pittsburgh, between May 15, 1909, and March 1, 1913. An explosive is considered permissible for use in coal mines when it is similar in all respects to the sample that passed the tests required by the Bureau, and when it is used in accordance with the conditions prescribed. A fee of \$150 is charged for testing any explosive.

Industrial Progress

IMPROVED HUNTINGTON CENTRIFUGAL ROLLER QUARTZ MILL.

Huntington mills are useful and efficient machines for crushing fairly hard or soft ores which have been broken to 1 to 2-in. size, and reducing this to as fine as 50 mesh. The mills are easily erected, and are especially useful for small mines producing such ores. They are good amalgamators, and recover a high percentage of gold inside without unnecessary flouring of the quicksilver. Some faults with the old type of mill are the following: (1) roller shells work loose



and fall down; (2) the screen discharge is imperfect; (3) excessive wear of the ring die directly under the feed spout; (4) short life of roller shells and ring dies; (5) uneven motion of the roller shells due to wood wedges; and (6) poor means of lubricating the roller shafts, resulting in regular shut-downs to oil up and other troubles. The improved Huntington mill, manufactured by the United Iron Works of Oakland, California, claims to eliminate these faults by (1) dispensing with wood wedges and using a roller head turned on a strong taper to fit the bored taper of roller shell; (2) the screen discharge is all around the mill housing instead of covering one-half of it; (3) a central feed is supplied which discharges ore equally in front of each roll, making even wear; (4) roller shells and ring die are double the usual thickness, and are forged and rolled chrome steel; (5) shells and die are machined all over; and (6) an oil hole extends right down roller shafts and a cross hole drilled to meet this one near the top of the roller head sleeve, and by a spring grease cup the shafts are lubricated continuously for 24 to 48 hours, and only feeds while the mill is working. Standard sizes of these mills are 3½, 5, and 6 ft. diameter, weighing 7000, 14,000, and 22,000 lb., and with capacities of 10 to 20, 20 to 40, and 50 to 100 tons per 24 hours. This firm also makes an ore feeder of the Challenge type suitable for feeding its mill.

The CALIFORNIA EXPLORATION Co. has let the contract for the New Plymouth Consolidated mill. It will include Demarest stamps, two 8 ft. by 2-in. Hardinge pebble mills, and Isbell vanners.

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EDITORIAL

WE print this week the first part of an elaborate paper upon the geology and ore deposits at Globe, written by Mr. W. L. Tovote, whose earlier papers on the Clifton-Morenci and other Arizona copper mining districts will be recalled by our readers with pleasure. The paper illustrates not only the careful geological work that is now done as part of the routine of American mining companies, but in its free publication also evidences the generous attitude of the Southwestern mining companies toward making public facts of general interest and value.

SAFETY is being made the first consideration at an increasing number of works, and at the mines and plants of the Nevada Consolidated Copper Company every effort is being made to impress upon officers and men the paramount necessity of guarding life and limb. A convenient book of rules has been prepared and printed in English, Italian, Greek, and a Slavic language, for circulation among the men. We print an extract which exemplifies the practical character of these regulations. A monthly bulletin is also published. In it each accident is recorded with full details, and, where necessary, simple sketches showing how similar accidents are to be avoided.

CABLE advices announce that in the case before the Judicial Committee of the Privy Council, involving the question of infringement of the Elmore process by that of Minerals Separation, decision has just been given in favor of Minerals Separation. The matter was discussed in our London correspondence of February 28, and earlier. While some of the points involved were adjudicated in November 1909 in action before the House of Lords, in which case Minerals Separation won, the present decision is on appeal in the interest of the Elmore process from a decision rendered July 24, 1911, in New South Wales, and involves additional matters. The court of last resort now holds that the Elmore patent is valid, but "limited to any process of separation in which oil is adequate in quantity and of sufficient tenacity to entrap or coat mineral particles in a watery pulp and to hold or carry such particles until separation is effected." It is also held that "respondents do not either directly or indirectly use the invention claimed by appellants, but a process essentially distinct, and that there is no infringement." In the absence of the full text of the decision it is im-

possible to tell exactly what weight to place upon the phrase "entrap or coat." The fact that the quantity and tenacity of the oil is mentioned seems to indicate that the court had in mind making sharp distinction between the bulk oil flotation of the Elmore process and froth agitation of the Minerals Separation.

SPELTER production in the United States in 1913 amounted to 346,676 tons, according to figures collected for the United States Geological Survey, by Mr. C. E. Siebenthal and printed this week. Comparison of this figure with the 345,575 tons estimated by Mr. Siebenthal at the first of the year and printed in our issue of January 3 and the 356,146 tons estimated by a New York contemporary January 10, would seem to indicate that the staff of the Geological Survey is in closer touch with the metal producers than might be inferred from the repeated insistence of the journal in question that the opinion of the Survey statisticians as to metal markets is of no consequence.

COMPLAINTS of the agriculturalist against the miner are old as industry. Agricola wrote that "the strongest argument of the detractors is that the fields are devastated by mining operations" and quotes many an ancient author. None the less, mining has gone on steadily, as it will doubtless continue to do. The world cannot get along without either grain or metals and undue waste in either agriculture or mining should be stopped. Without question, it will be decreased as attention is directed to the matter and to the possibilities of improved methods of work are learned. The dredge men and the valley farmers have been in controversy both in California and Victoria, and we reprint this week the substance of a report made to the Victorian Parliament upon the matter. It must be confessed that it tends strongly to confirm the claims made against the dredge men. If, however, that represents the facts it is important to have it fully and fairly stated. Our own impressions are to the effect that destruction of valuable farming land by gold dredging is relatively insignificant.

Louis Janin

Death of Louis Janin at Santa Barbara last week removes another of that group of brilliant engineers who contributed so mightily to placing mining in the western United States upon a sound technical basis. In our semi-centennial number, May 21, 1910, Almon D. Hodges, Jr., another member of this group, gave a graphic picture of San Francisco and the Comstock when the latter was at its greatest productivity. It was a period when silver was apparently to be picked up by the most inexpert, as had been true of gold before, and when the professional engineer had to climb over a mountain of prejudice if he would reach the lonely heights of the few who could demand big fees for advice on technical matters. There were not many who were soundly prepared to give such advice, and

among those few Louis Janin was by no means least. Of French descent, American born, educated at Freiberg, and drilled in mining as actually conducted in what was then the greatest scene of mining activity in the world, Louis Janin built up a reputation for skill and sound judgment that placed him in the very front of the profession. He examined and reported upon many of the properties throughout North America that have since become most famous, and while still young for such a mission he was called to Japan to assist in re-making the mining industry of that empire, even before the revolution, when the Shogun was making the first attempts to acquire for that ancient country the best of the knowledge and skill of other lands. Janin's advice was sought on all the big mining lawsuits so long as he remained in practice, and even in those later years when at the pleasant little ranch at Gaviotta or among the idlers at Santa Barbara he, as he jokingly referred to it, was "waiting to die," many a request for advice and help found its way to him from the largest interests. Louis Janin's counsel was sought because it was always honest, it was always based on real study, and it was illuminated by wide experience and much reading. His example was a most helpful one. He took the responsibilities of his profession seriously. To him mining engineering was no mere glorified manner of scrambling into wealth, but was ever a field for serious investigation and for exercise of discriminating, responsible judgment. He held his assistants to hard work. "Get the facts," was his repeated injunction, and the men who have gone out from his service to make brilliant successes in their profession, among whom Mr. H. C. Hoover and Mr. John Hays Hammond may be mentioned, have shown always the ability to get the facts which is the first requisite to any sound report on a property or a business venture.

Louis Janin was a many sided man, and neither space nor time is available here for more than this brief announcement. At another time we hope to tell connectedly the details of his most interesting life and career. For the present we express sympathy with his relatives and friends and our pleasure in belonging in a calling that breeds up men with such professional ideals.

Mining in China

Interest in China has been greatly stimulated of late by a joint arrangement between the Standard Oil Company and the Chinese government to develop the petroleum resources of western China, and by the arranging for a loan of \$20,000,000 under the auspices of the American Red Cross Society, which is to be expended in conservancy work for the prevention of floods along the course of the Huai river. This work is to be done by the J. G. White Corporation, which has an established reputation for engineering works of large magnitude. The Red Cross Society and other

philanthropic organizations have for many years been raising considerable sums for the relief of flood sufferers in China, and it is an exhibition of admirable intelligence which prompts the expenditure of money to prevent the occurrence of suffering and at the same time produce revenue, since the crop yield in the affected region can be greatly increased by proper irrigation. Aside from its aspects of humanitarianism and good business, this scheme has an even more important bearing on international relations. The great American public knows little about China and cares less, being content with the idea that it is the point of origin of 'chop suey' and laundrymen, and is largely inhabited by opium smokers and missionaries. As a matter of fact, 'chop suey' is unknown outside the American 'Chinese' restaurant, men do not do laundry work in China except for foreigners, opium smoking has been almost suppressed, and the missionary, with his schools and hospitals, has been the most effective agency in the renaissance of that ancient empire. This lack of interest is based on a lack of commercial relations, and American participation in the recent loans to China was a failure, largely because Chinese bonds could find no market here, our Government did not officially endorse the American banking group, and there was no public sentiment which would urge the Government to do so. The patronage of the far-reaching organization of the Red Cross Society should be able to reach that best possible market for bonds—the small investor who is not trading in the general market; and the widespread holding of Chinese securities should develop in time a keen interest and more exact knowledge of China in the American public.

The details of arrangements made by the Standard Oil Company are, like most of the operations of that concern, shrouded in obscurity. Out of the maze of contradictory statements which have been made may be gleaned the fact that a joint company is to be formed in which the Chinese government will receive a minority interest (said to be 40 per cent) in return for securing such lands, working rights, and rights-of-way for pipe-lines and railways as the Company may require. Geologists and drill crews have already been sent to Shensi, where the promising property at Yen Chang (110° E., 36°30' N.), formerly developed by Chinese and Japanese, has been turned over to the new Company. From this point west, northwest, and south, for great distances, is an area which is but little known, and which offers some promise at least of developing oilfields of considerable importance. In Ssu-chuan the Chinese have for centuries been using the natural gas obtained from deep brine wells for the purpose of evaporating the brine, but the amount of oil here obtained is insignificant. It must be remembered, however, that the Chinese sought for brine, not oil, and a better-directed search may have different results. In any case, the action is significant, for three reasons: it indicates the confidence of a well informed

business organization in the republican government, it is a unique instance of a partnership between an Oriental government and a foreign corporation, and it may lead up to the development of a large new supply of fuel oil and cause international readjustments that cannot now be even guessed.

Despite these important happenings, mining in China languishes as a whole. A single exception to this must be made, for coal mining prospers, especially the mines that are under foreign management. From now on the coal industry will take care of itself, for the Chinese are familiar with the profits that have been and are being made, and are equally familiar with coal-mining methods. Iron mining languishes for two reasons. Whenever money for new railways is borrowed from abroad, a 'rider' is attached to the agreement providing that the equipment must be bought in the country which furnishes the money. As a result, China has become the greatest museum of railroad equipment anywhere to be found. Because of this the Chinese steel company at Hanyang has labored under great difficulties, often being unable to secure specifications on which to bid in competition with foreign makers. The finances of the Company have been so poorly handled that its control has passed into the hands of Japanese bankers. The net result is far from encouraging to those Chinese who consider embarking in the iron and steel business. Of mining for other metals, it may be generally said that the Chinese are unwilling to grant concessions to foreign companies, having learned better by numerous unfortunate experiences, while it is impossible to raise much domestic capital for mining ventures, since there are ample opportunities for investment in enterprises with which Chinese merchants are more familiar.

The most hopeful signs of progress are the recent statements of Chang Chien, minister of commerce and industry. Since 1900, numerous attempts have been made to draw up a satisfactory set of mining regulations, without success. The most important defects have been that the areas allowed to a mining company have been too small, a heavy royalty was demanded, and the conditions under which foreign capital could be invested in mines were so disadvantageous that certainly no foreigner would invest in mines. It is now proposed to increase the area to about a square mile (ten times the former size), to collect a tax on output rather than a royalty, and to permit free dealing in mining shares, which would mean that the control of companies could be secured by foreign investors. The experience of the past two decades indicates that a mine with modern equipment, but under native control and management, has almost no hope of making much profit. If progress is continued along the lines which Chang Chien has mapped out, there is good hope that the backward mining industry of a country of great natural resources may at last be galvanized into productive activity.



OLD DOMINION, LOOKING EAST.

The Globe Mining District, Arizona

By WILLIAM L. TOVOTE

The Globe mining district, Gila county, Arizona, is one of the older mining centres of the Southwest, and has seen boom and depression for more than the last 35 years. It is more flourishing now than it has been for a long time, if ever, but an overboosting at the Miami end for real estate and other commercial purposes tends to turn this boom into a premature depression. Silver mining was the start of the mining industry here, but today copper is paramount. The mines of the district in order of production are the Miami, Old Dominion, Black Warrior, Superior & Boston, Iron Cap, and Gibson. The Arizona Commercial and a few old mines that bid fair to become successful producers are in course of reopening. A number of prospects are worked in a desultory fashion, some of them being of decided merit.

Production and Reserves

The Inspiration Consolidated, with ore reserves upward of 45,000,000 tons and a proposed production of 7500 tons per day, looms large as the probable greatest producer in the future. The Miami and Old Dominion each produce at present about 30,000,000 lb. of copper per year. The former a little more, the latter a little less, but the Old Dominion may possibly exceed the Miami, when the remodeling of concentrator and hoisting plant, now under way, is finished. Black Warrior is now shipping 125 tons of 7% ore per day under leasehold. The Superior & Boston, after prospecting for years the fault that dislocated the Great Eastern vein, has recently picked up the displaced extension and opened a body of promising ore and is getting ready to ship 150 tons per day of about 6% ore. The Iron Cap produces perhaps 600 tons per month of 8% ore besides high-grade copper-glance ore with considerable silver. The Gibson used to ship about 300 tons of

20% ore per month and is now being reopened, after a short shut-down, under new management and getting ready to build a mill and utilize the large accumulations of low-grade ore in the mine and dumps. Arizona Commercial, when ready, should produce about an equivalent of 50 tons of 6% ore per day, but the development has as yet not proved any large ore reserves. The list of probable producers might be increased if some of the prospects, especially at the Miami end, now in the developing stage, prove sufficient tonnage and commercial grades of ore. The district ranks at present third in Arizona in copper production and close to the Clifton-Morenci. With the Inspiration coming into the field and the modern improvements and expansion under way now at the Arizona Copper Co. at Clifton, both districts will contend for a while for this second place, but Globe ought to outdistance Clifton ultimately and even crowd Bisbee closely for first.

Outside of the copper, the silver production of the district should show considerable increase, as several of the older silver mines that gave birth to the camp in the early seventies are worked under leasehold or are in process of reopening, especially the great Stonewall McMillan vein, and the extremely rich ore found locally augurs well for the future, even if some of the veins are rather narrow and the ore bunchy. There are furthermore, besides numerous copper and silver prospects, some small gold veins and a few rather meritorious lead-silver, lead-copper-zinc, and zinc prospects. Vanadium minerals and carnotite also occur.

General Geology

The geological history of the district starts with marine deposits of Archean age, the Pinal schist. A gap in sedimentation between these and the Cambrian points to continental development. The Cambrian



OLD DOMINION, LOOKING NORTHEAST.

shows submerging to deep-sea and subsequent risings; it is represented by conglomerates, silts, shale, limestone, quartzites, and sandstone. The Silurian remains unrepresented in spite of the fact that in the Clifton district, not far away, unmistakable Silurian sediments are exposed; but it must be borne in mind that the upper quartzite series, generally attributed to the Cambrian, is not fossiliferous and might possibly be of Silurian age, especially since the Devonian rests conformably upon it. The Devonian is represented by about 300 ft. of fossiliferous limestone, sometimes gritty at the base, and continues without dividing horizons. The same character of sediments (limestones and calcareous shales with occasional sandy beds) continue through the Mississippian into the Pennsylvanian. Here sedimentation ceases, commencing again only with the roughly stratified creek gravels and lacustrine conglomerates of Tertiary or Quaternary age, here divided into 'Whitetail conglomerate' and 'Gila conglomerate' (Ransome) by an intervening surface flow of dacite.

There have been three main periods of volcanic activity in this district. The oldest antedates the Cambrian and is represented mainly by granitic rocks, named by F. L. Ransome, the Madera diorite, Solitude granite, and Ruin granite. The second and most important, because connected with the ore deposition, is of Mesozoic age and occurred after sedimentation had ceased and erosion had had its turn. It included the great diabase extrusion, followed by a smaller intrusion of diorite-porphry, and another outpouring of great masses of granite-porphry (Schultze granite). The third and last is evidenced by great surface flows of dacite, probably of Tertiary age. There are rocks of several smaller volcanic eruptions in addition to those of these main periods. These include diorite-porphry sills of uncertain age, and basaltic lava flows, one of Cambrian age and resting upon the Cambrian limestone, and one of Quaternary age intercalated in the Gila conglomerate.

Geological Structure

The structure of the district owes its present configuration mainly to the great diabase extrusion, and to subsequent faulting. Whatever faulting and dissection might have existed prior to the Mesozoic period of volcanic activity, has been almost entirely obliterated. The subsequent faulting and that following the dacite outpouring was so tremendous in scope and effect that Mr. Ransome coined the term 'regional brecciation' for the configuration produced by it. A great massive of pre-Cambrian granite to the north of the district, that sends out the two branches, the Apache and Pinal mountains, served as an upholding buttress, but between these granite-schist massives the country collapsed, and irregularly detached masses of sediments descend from their slopes, while a wide fringe of the same sediments less disrupted surrounds them on the outside. The Globe district embraces the Apache and Pinal mountain country, while the Ray district adjoins it on the west slope of the Pinals.

How far reaching an influence upon the structure the diabase eruption had, is best seen from the fact that it added more material to the outer crust of the rocky shell, than had been accumulated during the whole Paleozoic sedimentation above the Archean Pinal schist. The sediments amounted to about 2000 ft. and were disrupted by sills, dikes, and intrusive masses, sometimes bodily shifted and perhaps almost floating in the surrounding masses of semi-consolidated magma. Two columnar sections, Fig. 1, showing approximately the sedimentary column before and after the diabase eruption, explain this better than words.

The reaction from this volcanic cataclysm caused settling of the overburdened surface. Faults began to dissect the country and ore genesis began in fissures. These post-diabasic faults, important as seats of ore deposits, have generally a northeast-southwest course.

A second period of intense faulting followed the outpouring of the dacite. These faults have generally a



OLD DOMINION FAULT PLANE.

northwest-southeast strike and displace the older north-east-southwest fissures. As a rule they are not primarily ore bearing, but have sometimes followed planes of weaknesses produced by diabase intrusions, and might in this case comprise primary ore deposits. At times secondary ore occurs along these faults near their intersection with mineralized veins. The tracing of these relative fault movements becomes more complicated as some of the northeast-southwest faults have been reopened during the post-diabase period of faulting, as for instance the Old Dominion vein. Here the problem is perhaps even more complicated, as some facts (the unequal distribution of diabase sills in foot and hanging wall) point to an existence even antedating the diabase intrusion for that particular fault.

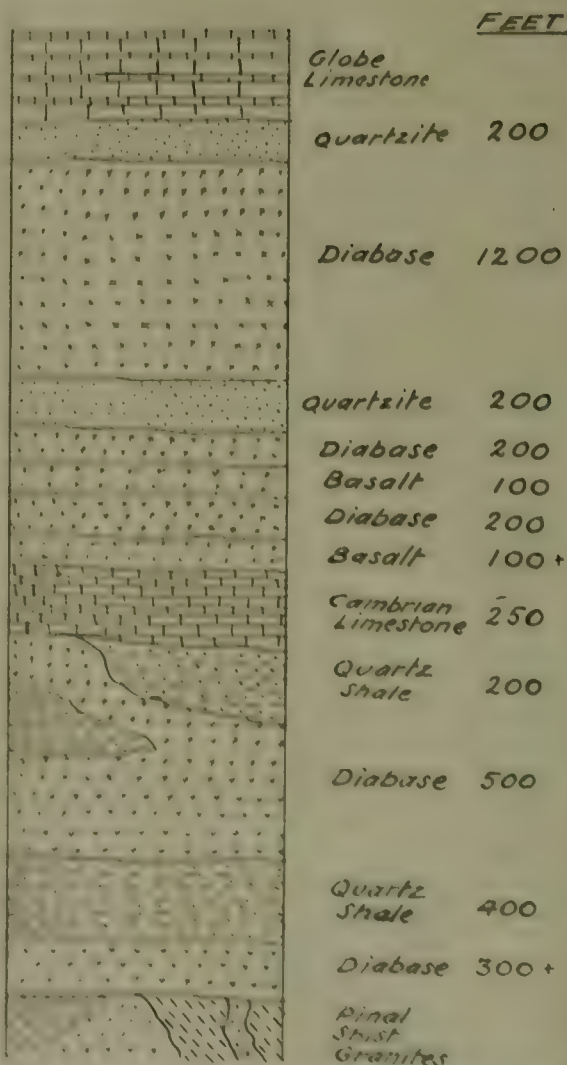
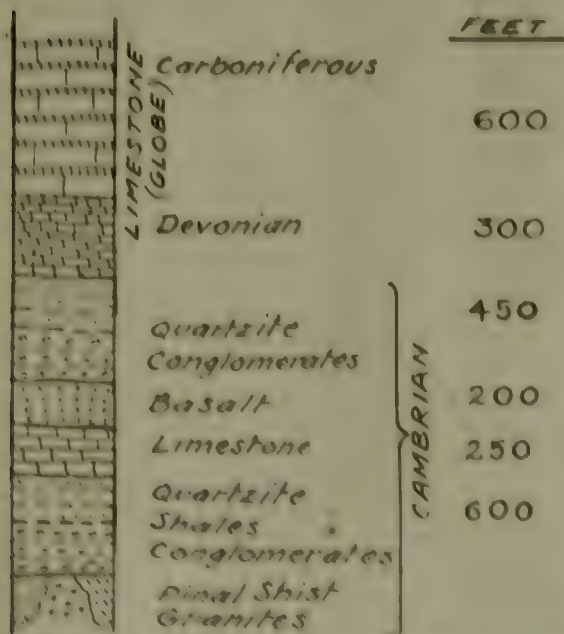


FIG. 1. SKETCH OF SEDIMENTARY COLUMN BEFORE AND AFTER DIABASE INTRUSION. THE DIABASE SILLS ARE NOT UNIFORM, BUT SUBJECT TO CHANGE IN HORIZON AND THICKNESS.



WEATHERING OF THE DACITE AT GLOBE.

Some of the faults have individual throws exceeding a thousand feet (the Old Dominion, for instance, and others might have possibly several times that amount) but it is scarcely possible to arrive at reliable estimates in a country where sediments of originally close proximity may have been shifted 1000 ft. by intruded diabase sills. The post-dacitic fault movement caused concerted step faulting amounting to perhaps 6000 ft. between the Apache and the Pinal mountains. Lower Cambrian sediments top the Apache granite massive at an altitude of about 7000 ft., the top of the Pinals at about the same elevation is granite and schist stripped of sediments, while the lowest (16th) level of the Old Dominion (elevation 2400 ft.) is still in Devonian limestone overlain less than 200 ft. above by the Cenozoic Whitetail conglomerate. On top of this rests normally a dacite surface flow overlain in turn by the oldest rock in the district, except the Pinal schist, the pre-Cambrian Madera diorite, here brought up by overthrust faulting. This marks an overthrust therefore that lifted the block of Madera diorite at least 3000 ft. From this overthrust mass of Madera diorite along Pinal creek to the main massive of the same rock, a distance of about seven miles, stretches an unbroken area of Gila conglomerate screening any further faults or vein outcrops. But, assuming the overthrust angle of between 20 and 30° as constant, this would call for a length of approximately two miles for the overthrust movement, a distance which might coincide with that to the lowest structural depression between Apache and Pinal mountains.

Types of Ore Deposits

There are three types of ore deposits represented in the district: (1) mineralized fault fissures; (2) disseminated sulphide impregnations in fracture zones; (3) irregular metasomatic bodies of secondary ore. The first type was first explored and is generally genetically the oldest. The second attracts more attention at present. The commercial value of the second lies in copper-exclusively. For the first type copper is

the commanding metal, but it includes also deposits of silver, lead, zinc, and gold. The third is sometimes so closely linked with the first as to form only a local phase due to conditions of complex fissuring and adaptability of country rock. In this case the secondary minerals are partly at least derived from primary sulphides oxidized in situ, but it forms also an independent type in the Black Warrior and the Geneva mines, where chrysocolla, derived most likely from the oxidation and erosion of the neighboring Miami-Inspiration orebody, replaces the lower horizon of the dacite, here resting on Pinal schist.

Mineralized Fault Fissures

These fissure veins have their main representative in the Old Dominion, the first mine operated in the district, and the one most thoroughly explored. It is

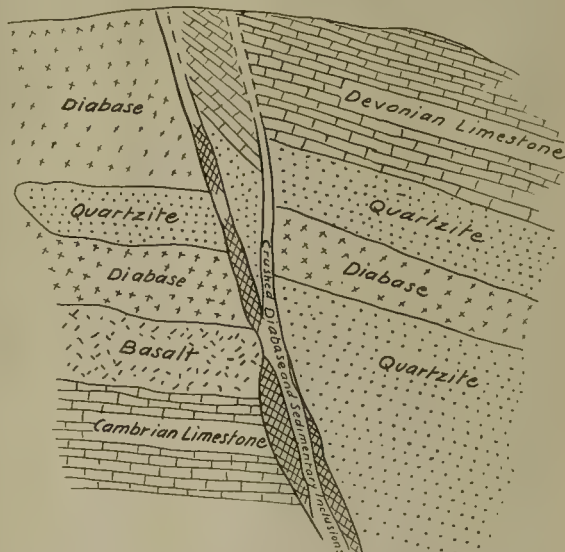


FIG. 2. IDEAL CROSS-SECTION THROUGH EAST END OF OLD DOMINION VEIN. NOTE THAT THE THICKNESS OF THE UPPER QUARTZITE HERE IS APPARENTLY ABOUT 800 FT., FAR IN EXCESS OF THE 400 TO 450 FT. GIVEN BY F. L. RANSOME.



OLD DOMINION FAULT PLANE.

northwest-southeast strike and displace the older north-east-southwest fissures. As a rule they are not primarily ore bearing, but have sometimes followed planes of weaknesses produced by diabase intrusions, and might in this case comprise primary ore deposits. At times secondary ore occurs along these faults near their intersection with mineralized veins. The tracing of these relative fault movements becomes more complicated as some of the northeast-southwest faults have been reopened during the post-dacite period of faulting, as for instance the Old Dominion vein. Here the problem is perhaps even more complicated, as some facts (the unequal distribution of diabase sills in foot and hanging for one) point to an existence even antedating the diabase intrusion for that particular fault.

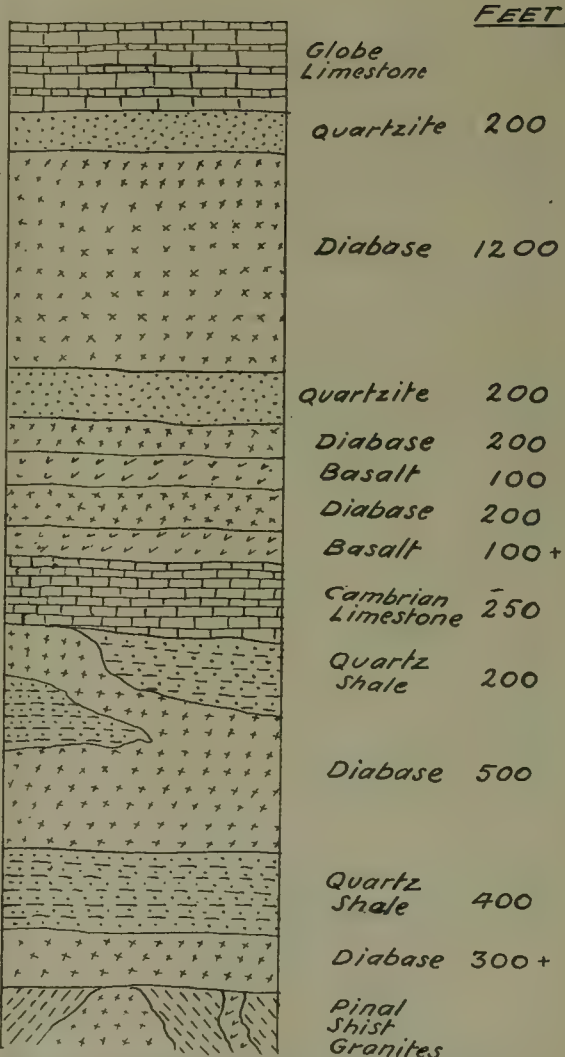
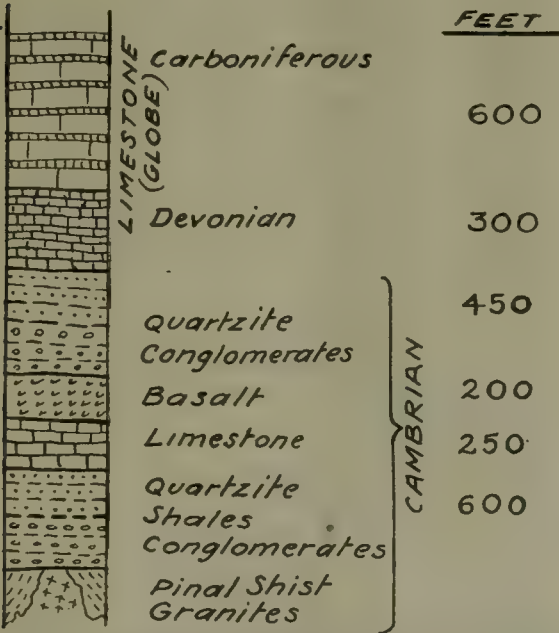


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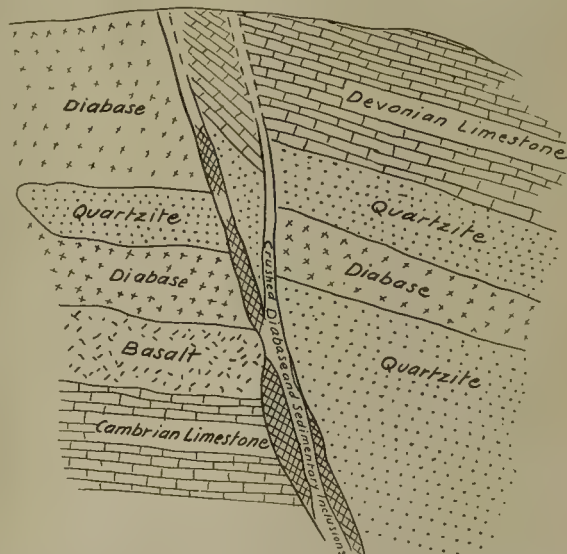


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opened by four shafts, named A, B, C, and Kingdon. The first three are in the foot-wall, the last in the hanging wall. Its lowest level is the 16th, about 1400 ft. below the collar of A, the main working shaft.

The Old Dominion vein is not a simple fault-fissure, but a complex system of roughly parallel northeast-southwest veins, which alternately join and separate. The main vein has an individual throw of over 1000 ft. in the west end of the mine, a throw that lessens considerably toward the east, where at the same time its tendency to split in several branches becomes more pronounced. It has a dip of about 65° to the south, while generally the northeast-southwest veins of the district dip rather to the north, with dips from 35 or 40° up to nearly vertical. Outside of the system of veins linked with the Old Dominion there are a number of similar systems in close proximity as well as scattered over the district, but most of them have not received more than scant attention.

The East End

Along the eastern extension of the Old Dominion system of veins and some of its branches are situated the Grey mine, Copper Hill mine, Iron Cap mine (Iron Cap and Williams shafts), the Eureka shaft of the Arizona Commercial Copper Co., and the Superior & Boston. None of these mines has developed orebodies approaching in size or richness those of the Old Dominion. There is a gradual change in character of ore from the west end of the Old Dominion toward the Grey mine that points to a difference in genesis, while the Grey mine and the mines farther east are surprisingly similar. The outcrops here are as a rule either in diabase or in some of the Cambrian quartzites, though sometimes at the contact of these two rocks.

Where diabase is the country rock the outcrops consist of discolored and weathered diabase, sometimes containing lenses of rusty quartz and stained brown or black by oxides of iron or manganese. The uppermost part of the veins, sometimes down to several hundred feet, are barren, with the exception of some minor veins that contain considerable in the form of chloride and bromide, more rarely native silver, at the grass roots; but these veins have not shown much in depth, so far as they have been tried. Their prospecting does not allow of a final conclusion, but they might possibly form a type somewhat distinct from the general copper veins notwithstanding that they blend decidedly into each other. Manganese stained outcrops are a good indication of silver.

The copper veins proper are, as mentioned before, usually barren and leached in their upper levels where diabase forms both walls. Farther down, oxidized copper minerals begin to appear as well as the oxides of manganese and iron. The gangue as a rule is altered diabase, whose feldspar is first saturated with and then replaced by copper salts. Inclusions of brecciated sediments in the vein usually cause a concentration of metals. The copper minerals are principally mala-

chite and chrysocolla, azurite being rare.

Sometimes a transition zone with native copper and cuprite appears at the bottom of the oxidized zone, but this is lacking in many cases. Where quartzite or limestone, and to a lesser degree, where a diabase-sediment contact forms the walls of the vein outcrop, copper ore begins right at the grass roots. Sometimes traces of diabase mark the vein in these sediments, but as a rule the existence of intrusive diabase dikes is rather hard to prove in the zone of surface alteration. The copper minerals are chrysocolla, malachite, cuprite, brochantite, melanochalcite, and copper pitch. Native copper, so plentiful in the Old Dominion mine, is rather scarce in these veins. The metallic minerals replace and pervade the crushed sediments, apparently causing a concentration of silica in quartz grains and first attacking the calcareous or aluminous components of the country rock, but ultimately even replacing apparently pure quartz. Veinlets of manganese oxide (wad) accompany the ore and micaceous hematite or limonite are practically universally present, intimately mixed with the ore or disseminated or in stringers through the sediments. Zones of enrichment show large accumulations of silicious iron oxide, usually limonite, with irregular bunches of copper minerals throughout this mass. Where these veins change from a quartzite to a diabase country rock in depth, a barren zone usually follows below the quartzite, sometimes for several hundred feet at a stretch, but micaceous hematite continues in most cases. Exceptionally, the case has been observed where the vein outcrop in quartzite was barren, the ore beginning in the diabase below, but this vein might possibly belong to a different period of mineralization.

In depth these differences of mineralization of the outcrops disappear and the veins are dikes of diabase between walls of sediments on both sides, diabase and sediments, or diabase on both sides. The gangue is prominently micaceous hematite with subordinate quartz, siderite, dolomite, or calcite. The ore is a mixture of pyrite, chalcopyrite, and bornite in this gangue. Chalcocitization is as a rule not much in evidence, but exceptionally bunches of almost pure chalcocite are found, accompanied as, for instance, at the Iron Cap by much silver due to an admixture of argentite. Here an imitation of structure approaching pseudomorphosis after hematite can be observed.

The Old Dominion Mine

The Old Dominion vein has been considered a fault-fissure with diabase foot and sedimentary hanging wall. This is not exactly correct, but approaches the fact, as an intrusion or sill of diabase at least 1200 ft. thick forms the foot-wall for a great part of the mine. But actually the vein can be included between diabase foot and sedimentary hanging, diabase foot and hanging, or sedimentary foot and diabase hanging wall. It contains three ore-shoots as far as explored; the central orebody—the oldest and biggest—and the east and west orebodies more recently opened. The central ore-

body has an exceptionally strong surface cropping of silicious limonite between diabase foot and Devonian limestone hanging. The other two show no surface indications.

The east orebody approaches a simple fissure vein in character. Hematite is not abundant, in fact rather scarce. The gangue is an intrusive diabase dike with inclusions of crushed sediments, principally quartzite. The diabase is not everywhere easily recognizable and quartz grains included in it sometimes suggest the admixture of an acid porphyry. But I have never been able to identify acid porphyry beyond a doubt, and usually the quartz grains, sparingly as they occur, are of rounded outline or in seams, being therefore probably either of sedimentary origin included in the fault breccia or vein quartz.

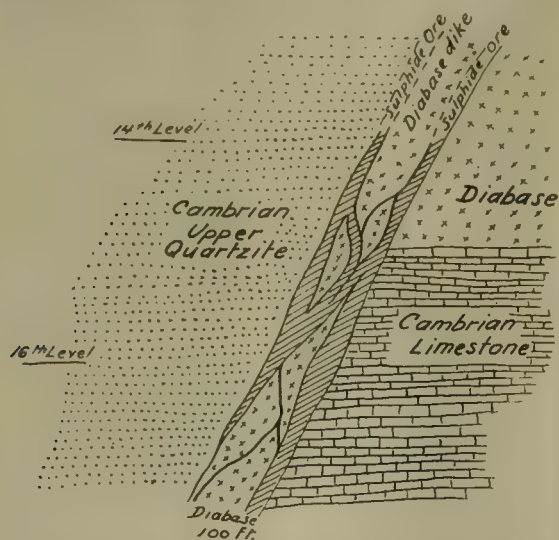


FIG. 3. IDEAL CROSS-SECTION THROUGH EAST OREBODY, IN THE LOWEST PRESENT WORKING, SHOWING THE DIABASE DIKE AS THE ONLY SEAT OF ORE.

The lowest level, the 16th, has a Cambrian limestone foot-wall and Cambrian upper quartzite hanging wall, the former not altered at all, the latter slightly recrystallized and invaded by sulphides only for a few feet from the vein, if at all. Between both lies a diabase dike up to 100 ft. thick, and this dike contains the ore. Sulphide impregnations and small veinlets extend fairly well all through it, but along certain zones marked especially by kaolinization and serpentization rich shoots of bornite, chalcopyrite, and pyrite occur. These sulphides penetrate included slabs of quartzite as well as the diabase dike.

While the oxidized part of the vein, except where limestone forms the hanging wall, parallels very closely the veins farther east, both the transition zone of native copper and cuprite as well as chalcocitization are very prominently developed. The sedimentary blocks in the vein show a lagging behind the diabase; that is, they parallel the barren diabase and ore-bearing quartzite outcrops farther east. Oxidized ore appears

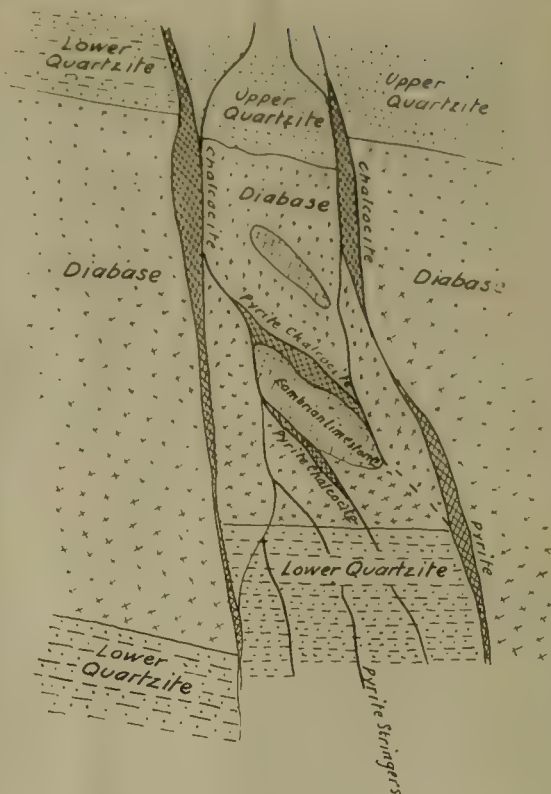


FIG. 4. IDEAL CROSS-SECTION THROUGH THE OLD DOMINION IN LOWER LEVELS OF THE CENTRAL PART OF THE MINE.

in the diabase at greater depths and then is not as rich as in the sediments, which seem to have absorbed by migration and replacement a great deal of the ore originally contained in the diabase. Chalcocite ore in diabase occurs side by side with native copper-cuprite ore and even malachite in the quartzite, and rich sulphides in the quartzite parallel pyritic ore in the diabase.

The central orebody differs from the east orebody in that bornite is not found at all here, while it is almost paramount there. Chalcopyrite is exceedingly rare. The sulphide zone starts in with secondary chalcocite and grades into pyrite. Native copper is frequently intergrown with chalcocite in the transition zone of the vein, and sheets and flakes of the metal impregnate the diabase country rock often for considerable distances. The central and west orebodies also diverge widely from the straight fissure vein type of the east orebody, inasmuch as a number of parallel veins approach the main vein from the hanging wall and the main ore-shoots frequently extend away from the foot into the hanging wall country.

Structurally the west orebody is very complicated in consequence of intricate step-faulting. These faults, while attaining throws of 400 ft. each along two main planes about 1000 ft. apart, are accompanied by numerous smaller faults and seem to represent one single movement. They converge north of the vein, probably

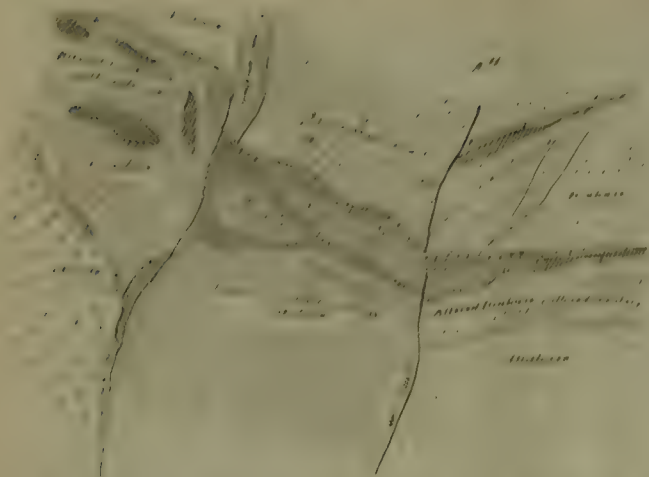


FIG. 2. MAP OF THE OLD DOMINION VEIN IN THE WEST END OF THE OLD DOMINION VEIN, SHOWING THE LOCATION OF THE VEIN.

passing there and diverge to the south. Still more intricate becomes the disposition of the vein by a reopening of the Old Dominion vein contemporaneously with the cross faulting. Along the Bath level of the Old Dominion there is from east to west the following horizon, partly due to this faulting: (1) rich primary sulphides, hornite, and chalcopryite (east orebody), (2) iron pyrite (central orebody), (3) chalcopryite pyrite (west orebody), (4) malachite and oxidized ore (downthrown part of west orebody). The west orebody is a close parallel to the uppermost part of the central orebody that caused the Old Dominion to be closed as a replacement deposit. Here as there Devonian limestone occurs in the hanging wall, which accounts for this abnormal development of the vein. This limestone has been altered over areas up to several hundred feet square, to hematite and limonite grading through increasingly silicious impurities to

rusty chert and sand and soft iron-stained leached-out calcareous clay. Diike-like masses of white or yellow kaolin occur frequently, also, sheets or dikes of loose friable micaceous hematite. Both of these are sometimes linked. Except for the occurrence of hematite the type is practically the same as the Kishew orebodies. Since dikes and sills of diabase are sometimes recognizable beyond a doubt through this zone of alteration, I consider the kaolin and hematite dikes as alterations of, or indications for, similar intrusive masses. The ore occurs as irregular masses in this altered zone and is frequently terminated rather by economic considerations than an actual lack of admetized copper. The change from altered to unaltered limestone is more frequently abrupt than gradual.

The pronounced difference in throw be-

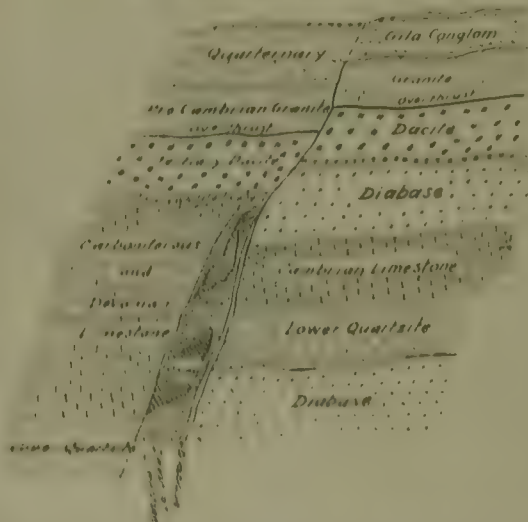


FIG. 3. IDEAL CROSS-SECTION THROUGH WEST END OF OLD DOMINION VEIN, SHOWING REOPENING OF THE FAULT AND OVERTHRUST MASS OF MADURA PORPHYRY.

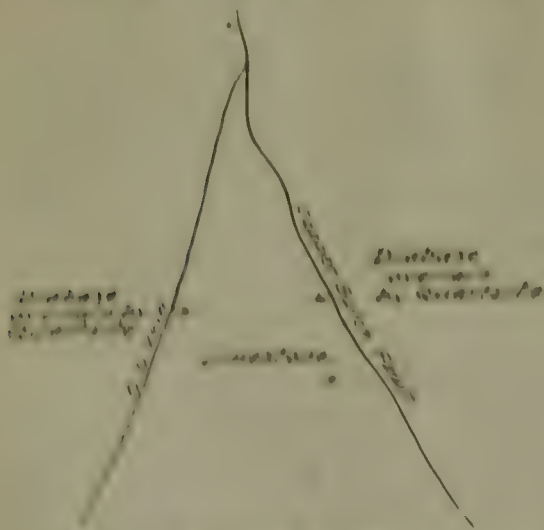


FIG. 4. MAP OF THE OLD DOMINION VEIN IN THE WEST END OF THE OLD DOMINION VEIN, SHOWING THE LOCATION OF THE VEIN.



FIG. 5. CROSS-SECTION OF THE OLD DOMINION VEIN, SHOWING THE LOCATION OF THE VEIN.

tween east and west end of the Old Dominion vein is most easily explained from the fact that a second fault joins it near the Grey mine. Between these two faults a block of ground, triangular both in horizontal and vertical section, has dropped down. Where both faults join, the throw is eliminated and the vein changes dip. It is surprising that the joining of the two faults has apparently not produced any noticeable enrichment, and that the joining fault, which is most probably of the same age as the Old Dominion, has not been found ore-bearing where intersected. But since very little work has been done on it, the established facts are not necessarily final.

Of the number of parallel veins partly connected with the Old Dominion system and explored in the same mine, I might mention the Maggie, Josh Billings, Kirkey, Buffalo, Nevada, and No. 3, all of which have produced ore. Usually those that were rich near the surface have proved disappointing in depth, and some vice versa. Some of these minor veins depart slightly in character from the main vein by lack of hematite and increasing content of pyrite and quartz, and were probably formed at a period slightly later than the Old Dominion.

The Pinal Schist Area

The No. 3 vein is probably identical with the Great Eastern vein of the Superior & Boston. A very flat dip to the north (40°) is a prominent characteristic of both. Of the same type are the veins in the Pinal schist area of the Pinal mountains, between Globe and Ray, including the Gibson, Cole & Goodwin, Bobtail, Independence, and numerous other prospects of surprisingly similar characteristics. Their similarity with the Great Eastern, twenty and more miles distant, is brought home especially where this vein has Pinal schist for wall rock.

The veins in the schist area are conspicuous by a lack of surface indications. The whole area has been apparently eroded very rapidly and this erosion outstripped oxidation. Outcrops of rusty cavernous quartz are sometimes found, but usually the veins can be traced only by outcrops of light yellowish siliceous schist-breccia contrasting with the general silky gray color of the sericite-schist. Sulphides begin practically at the grass-roots, chalcocitization is almost lacking, and pyrite, chalcopyrite, and occasional bornite are the predominant minerals. Hematite is found.

The Bobtail, a prospect at present idle, is very exceptional for this district in mineralization because of having hübnerite ($MnWO_4$) and a gray copper ore, either tennantite or more likely enargite, besides the usual sulphides, in a very quartz gangue. Sphalerite is found in most of these veins, which form a connecting link between the copper and zinc veins of the district. The Gibson is the only one of this group that has produced successfully until now.

Zinc-Lead Veins

The zinc-lead veins are bound to diabase areas and

are all in the first stages of prospecting. The gangue is quartz and the mineralization varies from straight sphalerite to galena-sphalerite-pyrite, with occasional chalcopyrite. They are usually narrow, but well mineralized, and include among their number rather promising prospects. They are prominent around Pinto creek, especially in Powers gulch, but are represented also in the neighborhood of the Old Dominion. The zincblende is of the dark black as well as the resinous variety.

Sometimes the lead prevails over the zinc in the composition of these veins, and in that case silver is liable to be an important accessory, especially in the oxidized zone. The outcrops in this case are usually less iron stained, but vanadium compounds are found frequently, mainly vanadinite, but if copper minerals are present cuprodescloizite is also.

Copper Veins in Schultze Granite

The second period of mineralization, that has its most important representative in the Miami-Inspiration orebody, has formed also vein deposits. These have up to now not attained commercial importance, and are as a rule narrow veins in the Schultze granite area containing stringers of vein quartz and chalcopyrite in a gangue of crushed and kaolinized granite-porphry. Chalcocite occurs rather pure, probably as a secondary mineral. The oxidized zone is rich in azurite in contradistinction to the above mentioned veins where azurite was conspicuous by its absence.

Gold Veins

These are small veins of usually quartz gangue. The quartz is very cavernous, probably due to leached-out pyrite, but not necessarily iron stained. Sericite is common, lead occurs sometimes.

(To Be Continued.)

In drilling for artesian water at Casiguran, Sorsogon, in the Philippine Islands, the government officials in the Bureau of Science have found gold in the rock cuttings at a depth of 250 to 300 feet. Colors were obtained by panning crushed samples, and the residue after panning assayed ₱5.30 per ton. The driller's log showed the well to be in sand for nearly its entire depth of 520 ft., excepting the rock-mentioned between 250 and 300 ft. This consists of pumice, obsidian, basalt, and a felsitic to porphyritic light-colored rock. The gold is mostly free and very fine. It seems that the well passed through the edge of a volcanic flow or fine volcanic breccia, mixed with pumiceous volcanic tuffs and alluvial sands. The rock containing the gold has been impregnated with solutions carrying silica and other minerals. Gold has never been reported from this district before, and this constitutes a genuine discovery.

West Africa is now importing its own silver coins from England, which will eventually displace the British silver coinage.

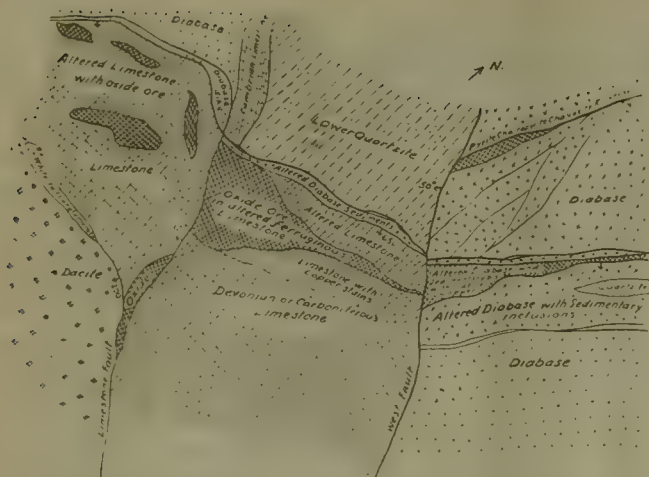


FIG. 5. IDEAL GEOLOGICAL PLAN OF FAULTED WEST SIDE OF OLD DOMINION VEIN ABOUT THE TWELFTH LEVEL.

joining there, and diverge to the south. Still more intricate becomes the disruption of the vein by a re-opening of the Old Dominion vein contemporaneously with the cross-faulting. Along the 16th level of the Old Dominion there is from east to west the following horizons, partly due to this faulting: (1) rich primary sulphides, bornite, and chalcopyrite (east orebody); (2) lean pyrite (central orebody); (3) chalcocite pyrite (west orebody); (4) malachite and oxidized ores (downthrown part of west orebody). The west orebody is a close parallel to the uppermost part of the central orebody, that caused the Old Dominion to be classed as a replacement deposit. Here as there Devonian limestone occurs in the hanging wall, which accounts for this abnormal development of the vein. This limestone has been altered over areas up to several hundred feet square, to hematite and limonite grading through increasingly silicious impurities to

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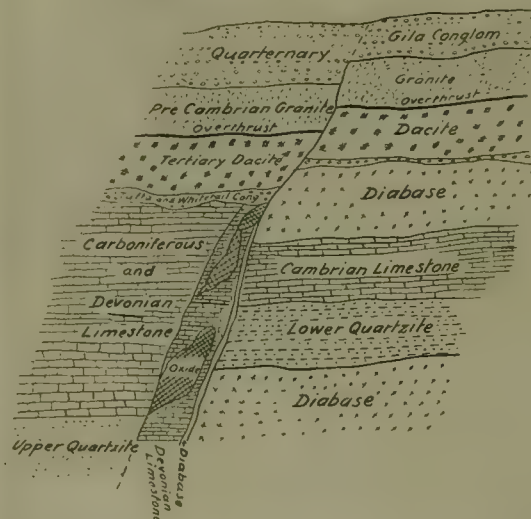


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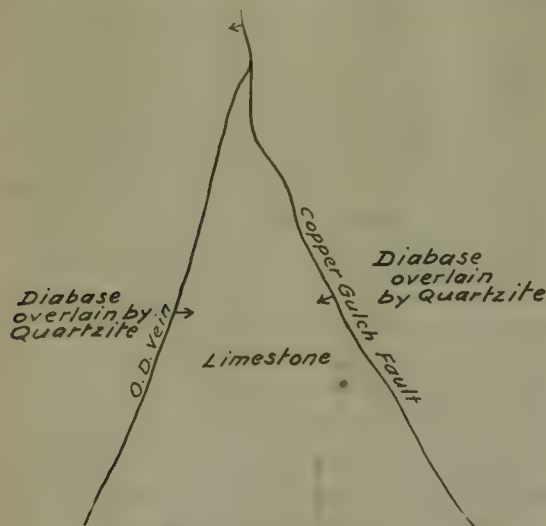


FIG. 7. PLAN OF FAULTS.

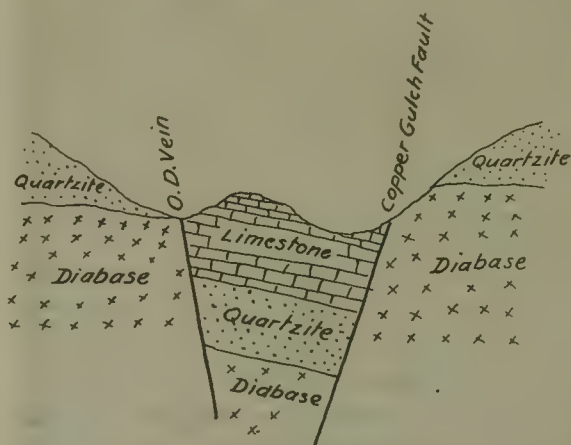


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Sometimes the lead prevails over the zinc in the composition of these veins, and in that case silver is liable to be an important accessory, especially in the oxidized zone. The outcrops in this case are usually less iron stained, but vanadium compounds are found frequently, mainly vanadinite, but if copper minerals are present cuprodesclowitzite is also.

Copper Veins in Schultze Granite

The second period of mineralization, that has its most important representative in the Miami-Inspiration orebody, has formed also vein deposits. These have up to now not attained commercial importance, and are as a rule narrow veins in the Schultze granite area containing stringers of vein quartz and chalcopyrite in a gangue of crushed and kaolinized granite-porphry. Chalcocite occurs rather pure, probably as a secondary mineral. The oxidized zone is rich in azurite in contradistinction to the above mentioned veins where azurite was conspicuous by its absence.

Gold Veins

These are small veins of usually quartz gangue. The quartz is very cavernous, probably due to leached-out pyrite, but not necessarily iron stained. Sericite is common, lead occurs sometimes.

(To Be Continued.)

In drilling for artesian water at Casiguran, Sorsogon, in the Philippine Islands, the government officials in the Bureau of Science have found gold in the rock cuttings at a depth of 250 to 300 feet. Colors were obtained by panning crushed samples, and the residue after panning assayed ₱5.30 per ton. The driller's log showed the well to be in sand for nearly its entire depth of 520 ft., excepting the rock-mentioned between 250 and 300 ft. This consists of pumice, obsidian, basalt, and a felsitic to porphyritic light-colored rock. The gold is mostly free and very fine. It seems that the well passed through the edge of a volcanic flow or fine volcanic breccia, mixed with pumiceous volcanic tuffs and alluvial sands. The rock containing the gold has been impregnated with solutions carrying silica and other minerals. Gold has never been reported from this district before, and this constitutes a genuine discovery.

West Africa is now importing its own silver coins from England, which will eventually displace the British silver coinage.

The Victorian Dredging Industry

*The long looked for report of the special board appointed by the Victorian government to inquire into matters connected with and arising out of dredging and sluicing for gold, and other metals, in that state, was presented to Parliament January 30. Its effect upon the industry is likely to be serious. On most points the report is unanimous, although, as the chairman (W. Davidson) mentions in a note to the Premier, accompanying the report, such unanimity was arrived at by a series of compromises; there is, however, a minority report, signed by three members of the board, in which the maximum of solids permissible is as high as 450 gr. per gallon, against 100 gr. in the majority report. The principal recommendations of the board are that no dredging leases should be granted for land of a value over £3 per acre, that 100 gr. of solids in suspension should be the maximum permissible, that no leases should be granted for dredging or sluicing with respect to river beds or banks, nor any leases within a chain of any river, that re-soiling should be to a depth of 2 ft., and that the Sludge Abatement Board should have plenary powers over all dredging and sluicing leases. It is also recommended that no reasonable effort should be spared to reserve good land from destruction by dredging or sluicing.

Effect of Ancient Workings

The report traces the development of the industry in Victoria, and of the government policy in relation thereto. Long prior to the development of bucket-dredging for gold mining, the effects of gold mining generally, and more especially of shallow alluvial digging and sluicing, on watercourses and agricultural lands, had called for serious consideration. In the course of its investigations the board encountered numerous instances in which present levels were several feet higher than the original surfaces of extensive alluvial flats. A notable and typical instance was that of the Sandy Creek valley. The whole of this area had, since the discovery of gold in Sandy creek, been covered with deposits, resulting indubitably from alluvial gold digging in its primitive ways, to depths ranging up to 4 ft., which, in the passing of years, had developed a soil, now chiefly utilized for the fattening of cattle. Bucket dredging is, and has been, almost entirely conducted in Victoria, under leasehold tenures, granted by the Department of Mines. Since 1900 there have been issued 176 bucket dredging leases, apparently for an aggregate area of 20,704 acres, while there are now in existence 52 such leases, of a real aggregate of 9830 acres. As the report indicates, however, it does not follow that the difference in the totals (10,874 acres) consists of land that has been dredged, as, owing to the consolidation of numbers of the original leases, many areas occur twice in the major aggregate.

In the earlier stages of the operations in river beds

and adjacent lands, there do not appear to have been any restrictions placed on the dredging owners as to the disposal of the dredged material after its passage through the machine, and, so far as the board had been able to ascertain, in no case was any effort made to restrict the amount of polluting matter that might pass into and down the district main water courses, or to restore in any degree the surfaces of dredged areas. Since the creation of the Sludge Abatement Board, it has been the practice to include in all dredging leases certain covenants, designed to secure water courses and lands against pollution or injury from dredging operations. It is only since 1906, however, that these covenants have been embodied in full in dredging leases. The duty of seeing that they are observed falls upon three official inspectors of dredging, who make periodic inspections of all dredging and sluicing operations within their respective districts, report to headquarters as to the observance of covenants, and, within limits, give directions to dredge masters as to the disposal of debris, and the control of effluent water. It cannot be said (adds the report) that the board considers the relations existing between these officers, the Department, and the Sludge Abatement Board, as being on a quite satisfactory basis.

Attention is called to the anomaly of Crown land, for which no compensation is sought, being leased for dredging at a rental of 5s. per acre per annum, while adjoining it, and included in the same mining lease, is land only lately acquired as freehold from the Crown, for which the owner receives compensation at the rate of £9 per acre, and the opinion is expressed that considerable revenue might have been derived by the state if an equitable charge had been made for the Crown lands required for dredging. Until recently, the Department of Mines paid no heed to the nature or value of the lands, whether Crown or freehold, leased by it for dredging; but early in 1909 it was decided that no land of a value of £3 per acre and upward should be so leased. This restriction is not embodied in any act of Parliament, but is being given effect to by ministerial order only.

Original Condition of Land

Referring to the Ovens and Buckland Rivers district, the report says that prior to the inception of bucket dredging, the whole of the flatter areas was covered with good alluvial soil, of varying depths, while in exceptional plots there are evidences in it of great productivity for many of the forms of agriculture. A considerable portion of the valley was worked, and very likely reworked, by the alluvial gold diggers of the fifties and sixties, to the destruction of the original timber and vegetation, the honeycombing of the land with shafts and drifts, and the part upturning of the surface. There are also evidences of hydraulic sluicing, on both the flats and the adjacent

*From the *Australian Mining Standard*, February 5, 1914.

terraces, having been extensively carried on, and although, as is visible in many places, a fairly dense afforestation followed on the abandonment of the valley by the diggers, in many instances the value of the land for agricultural purposes must have been greatly reduced before dredging began. The board admits that it found proofs, not only that efforts are being made by many dredge owners to comply with the re-soiling conditions of their leases, but also that the deposition of sludge is not always and permanently destructive. In one instance, on the Buckland, the Buffalo dredge had re-soiled an area of four acres, with good results. A portion of the four acres was sown down, which yielded $2\frac{1}{2}$ tons of hay to the acre. The cost of re-soiling, however, is regarded as being heavy, about £54 an acre. As to the pollution of the Loddon river, the board does not hold dredging solely responsible for it.

Pollution of Streams

In the Castlemaine-Loddon district the board investigated numerous complaints of water pollution by the dredges. The board found that the effluent from a dredge, the Guildford, was being discharged directly into the Loddon river. In the Ovens and Buckland valleys, at Sandy creek, and in the Loddon, below Campbell's creek, lands are now being dredged which the board is strongly of opinion should not have been leased for such purpose. There may be enumerated the leases of the Tewksbury No. 1, near Bright; the Kia Ora, on the Ovens river, at Eurobin; the Confidence, at Eurobin; the Ovens Junction, the Myrtle Queen, at Myrtleford; and the Guildford, on the Loddon; while in the Sandy creek region, where no great national damage has yet been done, it has to be noted that the leases of the Briseis company cover most of this very rich valley, down to Huon-lane. The board considers it nothing to the purpose that the owners of the lands are being compensated, possibly richly, nor does it attach much importance to the inclusion of re-soiling conditions in the leases, for the reason that the members are unanimous in the belief that no other forms of restoration avail in returning these lands to their pristine productiveness. If any system can be devised by which all dredging leases now in existence can be so curtailed in area as to eliminate from them all land of agricultural value, either present or potential, no delay should take place in putting it into execution; and this point it desires to accentuate beyond any other. It may be accepted as a fact, the board considers, that, so far as has been observed, all the lands, or very nearly so, which might be dredged without injury to the future of the state, have either been actually dredged, or are included in existing leases.

There are now lying at the Department of Mines, 61 applications, covering 11,525 acres of land, for dredging and sluicing purposes, of which it is proposed that 3880 acres shall be dredged, and the following instances are quoted as indicating the character of much of the country that is sought to be used for dredging

or sluicing: Ovens Valley. (Killawarra, 900 acres.) This land is situated near the Ovens and Murray rivers, and is of the general character of the Murray valley country, being of great productiveness. Murray Valley. (Corryong, 1200 acres.) This is notable grazing country, which will, with railway connections, if not meanwhile destroyed, become thickly populated. Murray Valley. (Surveyor's Creek, 1080 acres.) Characteristic grazing country of the Upper Murray. Loddon Valley. (Ravenswood, 450 acres.) This is a continuation of the Harecourt fruit producing country. Morra-hool Valley. (Morrison's, 2300 acres.) This is fair grazing country, with tracts of good agricultural land, within 23 miles of Ballarat.

"The board advises most decidedly against the continuance of bucket dredging on land suitable for agriculture. The board recognizes the wisdom of the Ministerial order of 1909, by which a maximum value of £3 per acre was placed on land which might be dredged. It thinks this maximum at most should be retained, and recommends that the provision be given force of law by enactment. In reference to valuable lands being included in existing leases, the board feels that, if these can be rescued from the dredge or sluicer, no reasonable effort should be spared to do so. Even if the policy of the non-issue of leases for land of £3 per acre and upward in value be permanently adopted, it is considered to be essential that the true value of any land applied for, and its potentialities, shall be ascertained, and this demands the assistance of an agricultural land expert valuer. This is recommended for observance in connection with all future applications for dredging leases.

Recommendations of Board

"The board cannot acquiesce in the contention that good land, after having been dredged, may be restored by the processes laid down by the Department of Mines. Even re-soiling does not apply where the depth of overburden is less than two feet. Yet two feet of soil in its natural state is frequently of great value, and always capable of producing crops. When dredged, it is lost absolutely. Nor can the board accept the view that where the overburden is over two feet, the results of 'advance stripping,' and depositing wet, from dredge buckets, on shingle heaps, are restoration. It is idle, in the opinion of the board, to contend that land so treated is not seriously injured permanently. By its general observance under covenant, the present condition of two feet of overburden and under might be eliminated from those relating to re-soiling, inasmuch as the material would be removed in dry condition in advance of dredging, and spread systematically over the rear shingle and silt. This system the board recommends for adoption in connection with all leases that may possibly be issued henceforth, and also with those which, after due investigation, it may be considered equitable to renew; and, further, should in any circumstances in the future, dredging leases be granted over areas possessing over two feet of overburden, at

least two feet in depth of that material shall be deposited 'dry' on properly leveled and prepared surfaces, or shingle and silt.

"Under no circumstances should permission be given for the disturbance, by dredging or sluicing, of the bed or banks of any river or principal stream and should any land be found of a less value than £3 per acre, which it may be desired to dredge, no lease boundary shall approach nearer to the bank of a stream than one chain, and that only such 'grips' for abstracting water for dredging operations from such river or creek shall be cut as shall, after inspection, be authorized by an officer of the Sludge Abatement Board."

The board advises against lessees being permitted to construct dams on streams, for flotation or other purposes; that in no case shall settling or precipitation dams be constructed across rivers or creeks, or than as represented by a line in cross-section of 4 horizontal to 1 vertical, from the bed of such river or creek, and that all such precipitating works shall be constructed above flood level, or, where that is found impracticable, the construction to be of a stable character, to designs to be approved by the Sludge Abatement Board, and carried out subject to that board's inspection, supervision, and direction. The present allowance of 800 gr. of earthy material per gallon of effluent water, whether from dredging or sluicing operations, is regarded as an excessive maximum, which, if availed of in practice to the full limit, would produce heavy discoloration and deposition in the streams which must ultimately receive it. A majority of the board, six members, proposes a reduction of this minimum to 100 gr. per gal., while a minority, numbering three, considers that the reduction should be from 800 gr. to 450 gr. Out of 278 cases in 52 instances, of dredging and sluicing, the rate of matter in suspense was under 100 gr., in 62 it was over the maximum of 800 gr. per gal. The report also recommends that all miners' right holdings for dredging and sluicing shall be brought under the control of the Department of Mines and the Sludge Abatement Board, as regards disposal of dredged or sluiced material, and effluent water, exactly as are the dredging and sluicing leased areas.

The Smuggler Union Air Lift

By WALTER L. REID

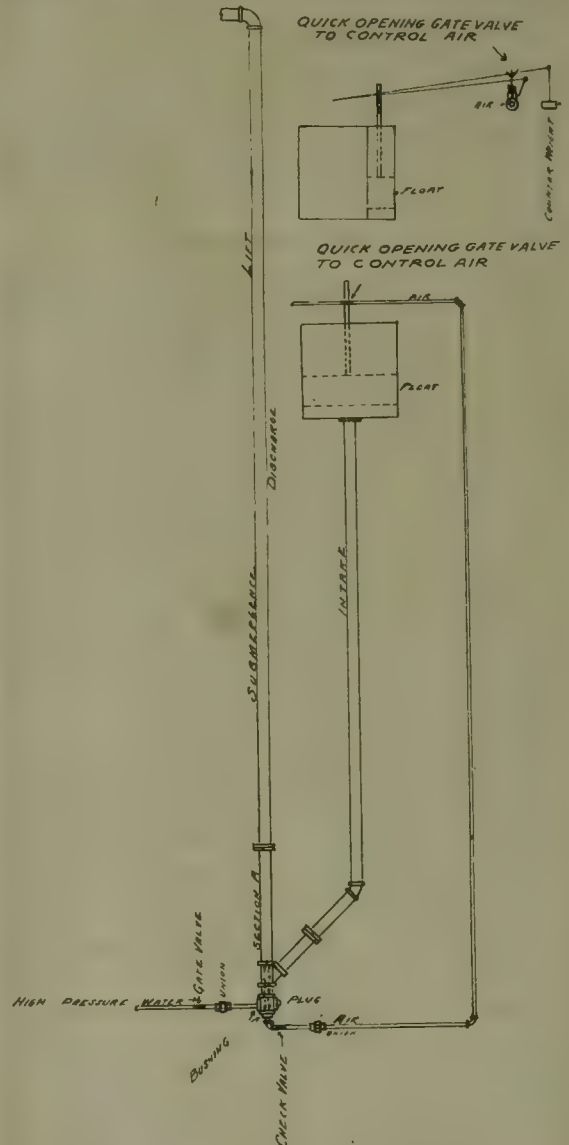
The accompanying figure illustrates the design of the air lifts which I have adopted in the Smuggler Union mills at Telluride. The advantages of this lift, which have been demonstrated by several months operation, are as follows:

1. It automatically takes the exact amount of air required at any moment. This is decidedly important, as our experience has shown that trouble may be caused from too large an air volume quite as frequently as from fluctuations in the quantity of pulp to be raised. Again, where several air lifts are being supplied by a compressor operating up to capacity, this

control serves to keep the air requirements for the several lifts more nearly uniform.

2. Owing to the check valve being placed near the outflow of the air line, there is practically no choking of the air line itself.

3. Should the lift pack full of sand and slime, while standing during a prolonged shut-down of the compressor, it can usually be started in a few minutes with no other attention than to turn on the high pressure water or solution line; this has been done after



the lift had been standing for four days filled with sand to the top of the intake box.

4. When necessary to renew any of the fittings that may wear, the section A can be quickly removed by taking out the bolts on the two flange unions.

The intake box provides an ideal place for screening the feed so that no chips or other debris are allowed to flow into the lift.

Leaching of Zinc Ore at the Afterthought Mine

By FRANK L. WILSON

The ore of the Afterthought mine, Ingot, California, contains so high a zinc content that ordinary smelting methods are not practicable. The ore is a complex 'black jack' averaging 14.3 to 15.6% zinc and 11.6% iron, the zinc at times reaching 30 to 40%. Most of the sulphide ore averages about 18.7% sulphur. This ore gave considerable trouble in smelting, because the zinc and barite caused clogging of the tap-hole and crusts over of the top of the charge. The zinc had to be in part carried away in the slag and matte, and in part was volatilized. When the plant of the Great Western Gold Co., as it was then known, was in operation during 1905, 1906, and 1907, the ore was smelted in a 150 by 42-in. blast-furnace designed by S. E. Bretherton. Mr. Bretherton devised the scheme of using hot blast and running the furnace with a low column of ore above the tuyeres and a hot top to overcome these difficulties. Results showed that 40.92% of the zinc entered the slag, 11.04% the matte, and 47.98% was volatilized. During a period of 5 months, in which the furnace was in operation 128 days, 2,046,031 lb. of zinc was volatilized, or an average of 16,000 lb. per 24 hours. No attempt was made at that time to save the zinc fume, because of financial difficulties.

The coke and supplies for the smelter and mine were hauled by wagon from Bella Vista, a distance of about 13 miles. This expense, added to the hauling of the matte produced back to Bella Vista, led to a complete shut-down of the plant in December 1907, at which time copper was at a low price. Development at the mine was continued intermittently and repair work kept up. In a report presented to the directors of the Company in 1911, there was shown to be over \$11,000,000 worth of ore developed. This ore will average at least 20 to 25% zinc, and large blocks will run as high as 30 to 45% zinc. During the interval of six years' inactivity, the exposed wood timbering at the smelter has had to be repaired. The iron flue-dust chamber has given some trouble also. From time to time the expensive machinery about the plant has had to be overhauled, for there have been continued hopes that operations would be resumed. In all, the plant has been fairly well preserved.

Afterthought ore was sent to several places and tested for zinc extraction and recovery. Of the many processes tried, the ammonia carbon-dioxide process was found to be the most proficient. David Mosher, of San Francisco, first suggested the use of ammonia and carbon dioxide in solution, as devised by Carl Schnabel. Mr. Mosher at that time was interested in the ammonia-cyanide process. I made a series of tests on zinc extraction from the Afterthought ore

with ammoniacal solutions in connection with my graduating thesis at the University of California. The results so clearly proved the value of the process that several patents were applied for, which have since been secured. As a result of these tests, it was decided to install this process on a commercial scale at the mine, and to work out the suggestions that had presented themselves in the preliminary tests on the Afterthought and other ores. A preliminary testing plant of 25 lb. capacity was erected and further checked the smaller tests.* No pressure was used, it being desired to see if the more expensive plant could be done away with. It was found, however, that with pressure the time and amount of solution is cut down to a minimum, which greatly offsets any extra expense in the initial cost of the plant. Using pressure, the ore is agitated, leached, and washed in 8 hours, and only 5 tons of solution to 1 ton of ore has to be treated for the recovery of the zinc, copper, and gases. A testing plant using pressure is now in use with a capacity of 50 lb. per 8 hours.

The ammoniacal solution is separated from the ore in a laboratory Kelly filter-press, and the solution then treated with scrap zinc or zinc dust for the removal of copper and any silver that might have passed into solution. This is again filtered, the cement copper being sold for pigment or thrown with the residue in to the matting furnace, and the clear solution is sent to a battery of stills, where the free ammonia and carbon dioxide are boiled off by the use of live steam and caught in properly constructed absorbers. The zinc precipitates as a granular and semi-flocculent white basic carbonate. This precipitate is filtered through a press and is either sold as the carbonate or calcined to oxide, which has been pronounced of excellent quality for paint body.

In July 1913 the stockholders, at a special meeting held in Indianapolis, decided to try, under the leadership of George L. Porter, to raise a bond-pool of \$250,000 to liquidate all debts, construct a 50-ton reduction plant at Ingot, and have a reserve fund for immediate operation expenses. Nearly all of this pool has been subscribed, and hopes are high for resumption of operations on a large commercial scale in the near future.

The Laloki mine, on the island of Papua or New Guinea, north of Australia, contains 145,000 tons of basic ore averaging about 4% copper and 2.25% gold above the 140-ft. level. An option held by the Great Fitzroy Mines, Ltd., has been exercised by Bewick, Moreing & Co., the general managers.

*Smelting Zinc-Copper Ores, S. E. Bretherton, *Mining and Scientific Press*, April 12, 1913.

Accidental Discoveries of Mines

By G. L. SHELDON

Many years ago two prospectors were grubstaked by a saloon-keeper in a town not far from the present Coeur d'Alene district, Idaho. They were given a burro on which to pack their food and supplies. They returned for more grub several times. Finally, being discouraged and 'out of sorts,' they quarreled and divided up the outfit. One struck out down the gulch, the other, to whom the gun and burro fell, went to hunt his burro. He found him up on the side of the mountain standing upon the outcrop of what is today one of the largest dividend-paying mines of the district.

In the early days of the Granite Mountain mine, Montana, which has paid many millions in dividends, when the shaft was about 100 ft. deep, driving was being done from the bottom of the shaft. It was customary for the miners to drill and shoot a certain number of holes for a shift's work, and they were given a sufficient number of sticks of powder for the holes drilled. The ground was pretty tough, and as the shift-boss was an easy-going man, some of the miners would throw some of their powder through the cracks of the timbers near the bottom of the shaft, thus avoiding the drilling of one or two holes. One day one of the miners, the last one going up, threw a stick of powder, with a lighted fuse attached, in behind the timbers. The explosion was so terrific that it proved that many of the miners had been caching their powder there. The explosion opened up another parallel vein which was very rich.

A one-time partner of mine, in the early '70s, traveling on foot along the main trail from Red Mountain to Ironton, Colorado, sat down under a tree at the side of the trail to rest. Having a small prospector's pick in his hand, he broke a piece off the rock nearest to him, and this proved to be galena. An hour's prospecting on the mountainside disclosed the vein, although hundreds of good practical miners had passed over the trail without noticing the float. He took out \$20,000 worth of ore, and sold the claim for \$70,000.

At the Camp Bird claim, near Ouray, Colorado, the men doing the annual assessment work late in the fall cut some material in the drift that was different from the rock which they had been driving. On account of a heavy snowfall they were obliged to leave the property in haste, and forgot to take samples of the new material with them. Eventually this rock, which had been thrown on the dump, proved to be rich ore and led to the discovery of the now well known Camp Bird mine.

Years ago at Delamar's Trade Dollar mine, in Idaho, a new foreman examining a dump made before his arrival, noticed some strange material that had been thrown over the dump and found that it was rich sil-

ver ore. Not long afterward, for some trivial cause, the foreman was discharged, and later the owner himself ostensibly discovered this ore in the mine. He was ashamed to have it known that he had been throwing the ore over the dump.

The good luck of the wife of the original discoverer of the Enterprise mine, at Rico, Colorado, led to its discovery. In sinking a wet shaft, the owner had become heavily in debt, when his wife was fortunate enough to draw a \$4000 prize in the Louisiana lottery. She had the nerve to put it into the mine, receiving an undivided one-half interest. With this they were enabled to sink farther, and eventually opened a blanket vein which led to the discovery of the same vein on adjoining properties. After taking out a million, the Enterprise was sold for one and one-quarter million dollars.

The Tomboy mine, Telluride, Colorado, in its prospect days, was taken over by a hardware merchant, the surface indications being poor, for a debt of \$1200. This led to its development into a paying mine, and it was afterward sold to an English company for more than a million dollars. It is still paying dividends.

The Republic mine, Chihuahua, Mexico, was discovered by the wife of a peon, who was washing clothes in a creek. Her attention was attracted by some pretty stones; she took them home and her husband recognized them as rich silver ore. He found the vein a few hundred feet above the place where it crossed the creek, the vein being exposed in the cliffs for 200 ft. An American, who lived near, purchased a half interest for \$1500. After doing some development work and shipping some high-grade ore, they sold the property for \$150,000. The mine is paying dividends today.

It is claimed that the rich gold camp of San José de Gracia, Sinaloa, Mexico, was discovered by the Spaniards about 100 years ago. Having heard of gold in that section, they were investigating the district. Being out of meat and seeing an Indian hut and goat corral, with goats within, they rode up to buy some goats and noticed that the corral was made of gold-bearing quartz. Upon examination the rock was found to be rich in free gold. The vein was discovered nearby and a rich mine was opened which is still producing.

The calamine deposits of Leadville, Colorado, were for many years unrecognized by the best mining men of the country. Hundreds of tons of this ore was thrown on the dumps, until finally some one happened along who recognized the ore. This discovery led to the rejuvenation of the old camp. The same is true of the Potosi mine in southeastern Nevada, the eighth patented mine in the United States, worked by the Mormons in 1860 for lead. Until recent years no one knew what composed the immense deposits of grayish, sandy material. Finally, an engineer, who happened to be passing that way, saw the deposits and noticed that they consisted of calamine, containing 34% zinc.



Winter Dredging in Idaho

By JOHN H. MILES

Gold dredging in the winter has many disadvantages, and mining men may be interested in the following remarks, concerning the operation of the 18-cu. ft. boat built by the Yuba Construction Co. for the Boston & Idaho Gold Dredging Co., and now completing its third season's work. The dredge is at Idaho City, Idaho, and when it is noted that this place is near the 44th parallel and has an altitude of nearly a mile, it will be understood that its climate is somewhat different from that of the California fields.

There is very little trouble with ice forming on the pond until the temperature reaches 10° below zero, when ice begins to form in the corners. If the cut is narrow enough so that the boat can go from one side to the other in 6 or 8 hours, there is not much difficulty, as little ice will form in that length of time. But if the pond is over 700 ft. wide, it is impossible to carry a 10-ft. step and cross the pond in less than 16 hours. This gives ice time to form about one-half inch thick. As the boat moves across the pond it forces the ice into the corners, making a solid mass three to four feet under water and two to three feet above water. It is often necessary to dynamite to loosen the ice so that the boat can dig the corners. This trouble increases as the thermometer drops, and when 20 to 24° below is reached it is necessary to stop digging and move the boat across the pond as fast as possible, keeping the pumps, bucket line, stacker, and screen running. If the trip can be made in about 40 minutes, the water is kept so agitated that ice will not form more than one-fourth inch thick during the boat's journey. All the time large cakes of ice are taken up by the bucket line and carried through the boat to the tailing pile and this helps to clear the pond, especially in the corners.

Although it sometimes gets colder than this for a few hours, the cold snaps seldom average worse than 24° below, and this usually lasts only a couple of days. The ground freezes about three feet deep and caves off in great slabs which have to be broken up by the

buckets. Some difficulty is experienced in handling these chunks in the hopper and on the conveyor belt.

The snow is a serious handicap in moving the lines, although the system used gets around this trouble very well. Two $1\frac{1}{2}$ -in. cables are stretched, one on each side of the boat and running 3000 ft. ahead, and anchored at 200-ft. intervals. This is equivalent to a continuous dead man on each side. All side lines are moved every 24 hours, and by so doing are kept at the proper angle with the boat to give the best results. With the help of four horses and two men, all side lines can be moved ahead in about two hours without losing any running time. After a fresh fall of snow the teams break new trails for line changing. One team, used for emergency night work, is kept in a portable stable which is moved along as the boat advances. The amount of snowfall has not exceeded four feet in the past three years.

Another problem is to heat the boat to a degree of comfort for the men and keep the stacker rollers and drum free from ice without using too much fuel. Wood is the only fuel available, at a cost of \$4 per cord; five cords per day are used in the coldest weather. The dredge boiler is 80 hp. and is connected to over one mile of 2-in. heating pipe. There are also four home-made electric heaters connected in series across 2200 volts. These are used alone until the thermometer reaches the zero mark. The capacity of the four heaters is 44 kw. The frames and the heavy screens which guard the heaters are thoroughly grounded; the outfit has proved a useful feature for the earlier part of the cold season. The stacker needs heat as soon as the temperature is at the freezing point. From 32° above down to 10° below, the stacker and winch room are supplied from a 2-in. auxiliary line. As the weather gets colder, steam is turned into the 4-in. main line that heats the boat in general. The steam pipes under the tables are not used, except on clean-up days, until 15° is reached. The ice that forms on the tail sluices, stacker, and ladder is broken

off every other day. Ice troubles in all have not caused more than a total of 4 days lost running time to date, though the dredge is now in its third winter.

This boat is now equipped with 18-cu. ft. buckets in place of the 15-cu. ft. buckets originally furnished. The November yardage was 385,196, averaging 683 yd. per hour; the December yardage was 403,144, or 703 yd. per hour. Yardage is measured under the same system used at Natoma, California, one-third slope being deducted for sides. The crew consists of 9 men, as follows: 3 winchmen at 56c. per hour; 3 oilers at 50c.; 1 deck-hand, night only, 10 hours, at 40c.; 1 teamster and 1 shore-man, each 10 hours, at 32½c. This is probably the only large dredge operating with

Standardization of Terms

By WILL H. COGHILL

The Chemical, Metallurgical, and Mining Society of South Africa has recently adopted and published certain terms and definitions with a view to establishing uniformity in the use of technical terms, and we might emulate our South African friends to our profit.

One fault is the continual use of certain terms that have been picked up from chemistry. These have been borrowed from the chemist and used in such a ruthless manner in metallurgy and geology that our creditor is now advocating that we be a little more consistent

and thus avoid foreclosure proceedings.

The term neutral is much used by metallurgists. The student in chemistry learns that neutral means having the properties neither of an acid nor a base. But this is only his first lesson. When he gets about half way through his 'Principles of Copper Smelting,' he learns that atmosphere can also be neutral, because a neutral atmosphere is one that is neither oxidizing nor strongly reducing.

If one is inclined to browse among the English authors, he will find,

on p. 296 of Roberts-Austin's 'Introduction to Metallurgy,' that " $2\text{RO} \cdot \text{SiO}_2$ is the neutral silicate of the metallurgists."

I am unable to glean one bit from this statement, but was taught in school that a neutral slag was a very fluid corroding slag; more fluid than if the silica content were either increased or decreased. However, when it came to furnace linings, neutral bobbed up again, this time the antithesis of the neutral slag, in the form of a chromite brick which would neither fuse nor corrode. After all, it is not so strange that it is difficult to correlate neutral, for we read in Hofman, that: "The so-called neutral ore is of different composition in different districts, even differing sometimes in the same district."

The silicate degree is confusing. In chemistry the student becomes more or less familiar with ortho, meta, di, and tri, but when he gets to metallurgy, some one must sugar-coat mono-silicate, bisilicate, and trisilicate, and administer them to the patient. When the coating dissolves, he finds that, while in chemistry $4\text{H}_2\text{O} \cdot 3\text{SiO}_2$ was trisilicic acid, in metallurgy $4\text{RO} \cdot 3\text{SiO}_2$ is a sesquisilicate, because the ratio of oxygen in the



ICE ON DIGGING LADDER.

only one oiler on a shift. The boat is equipped with inter-communicating telephones. There is an automatic stop for stacker and screen that is tripped whenever the stacker belt gets overloaded. This is necessary on account of the large frozen chunks that lodge between the side boards of the conveyor.

The tables have a combined area of 6000 sq. ft., and to wash the maximum capacity it is necessary to use three 14-in. pumps handling nearly 20,000 gal. per minute. The main drive belt is now 36-in. leather, double ply. Leather belts are used on the screen and stacker motors. All other belts are rubber. The conveyor belt is speeded up to 465 ft. per minute—about 100 ft. faster than usual practice.

It is of interest that the November and December yardage of this boat, already noted, approaches a total of a round million tons.

Seven Edwards roasting furnaces are working at the central treatment plant of the Ashanti Goldfields mines, West Africa.

Mt. Rainier, Washington, is 14,408 ft. high.

base to oxygen in the acid is 2 to 3. Needless to say, the pills fail and the instructor is obliged to have the class learn to sing. Ratio of the oxygen in the base to the oxygen in acid, sub, mono, bi, tri, to the tune of Yale Boole for weeks before it soaks in.

Acid and Basic

The student may run the gauntlet in metallurgy and geology until he gets to acid and basic, but if he sticks through that ordeal there is hope that he will fight it out to the end. Maybe the complexity of the subject lends attraction, for young men are looking for worlds to conquer and pass up the easy subjects because anyone can learn them and competition for positions in such lines would be too severe. In chemistry the student learns that the radical, OH, in the formula of a salt means a basic salt and in mineralogy he naturally correlates calamine, $Zn_2(OH)_2SiO_4$ as a basic silicate and makes a test for H_2O . He begins to feel, however, that he has lost the scent after he has searched a whole page of analyses of iron blast-furnace slags, all of which are said to be basic and finds no column, 'per cent H_2O .' It begins to seem like a true paradox when his assay report on ores that contained a large amount of acid trisilicate fails to check the records in the office, within the proverbial four-hundredth, because his slag was too basic; when magnesia (MgO) is recommended as a basic refractory material, when he takes a trip to the lead refinery where he sees great stacks of base lead bullion, so called because it contains gold, silver, copper, iron, bismuth, antimony, arsenic, etc., and last of all, but not least, when his geology instructor talks at length about the composition of basic rock and does not mention his old friend 'OH', he discovers that he has made a mistake by beginning with basic instead of acid, because acid begins with a and basic with b. Thereupon, in Kemp, he finds that acid is a descriptive term applied to those igneous rocks that contain more than 65% SiO_2 , but begins to lose courage when he notes the apology, that: "The statement that acid rocks are least fusible often puzzles a student who is familiar with blast-furnace practice and the composition of slags, in which the most silicious are regarded as the most fusible. . . ." Kemp's definition does not make much of an impression, because apologies by a superior are inexcusable in the eyes of the student. He then finds that borax is classed as an acid flux. Procuring a piece of borax and litmus paper, he moistens the borax and applies the litmus and, behold, borax is basic. A splendid bit of sarcasm it was, when a professor of biology asked a candidate for a master's degree in geology if he could distinguish between acid and basic rocks, with litmus paper.

Why Not Speak Correctly?

There may be those who will say: What is the difference whether the furnace-man calls his slag acid or silicious, basic, or nonsilicious, so long as he can run the furnace at a profit? Such an argument is of about the same weight as the time-worn statement that one

man can see as far into the ground as another. It can only be said in reply that if one wishes to use terms loosely, there is no penalty fixed by law.

It must be admitted that the terms cited do make an awful jumble for the veteran, to say nothing of the recruits. They were borrowed from the chemist when chemistry was a mere system and now that chemistry is fast developing into a science and acid and base are defined in terms of hydrogen and hydroxyl ions, they should be dropped or used just as the chemist does.

What Does Neutral Mean?

On page 23 of Hixon's 'Lead and Copper Smelting,' he speaks of a slag as " . . . near enough to a neutral slag to flow freely. . . ." Now of all things on earth that Hixon does not mean, it is neutral, for his neutral slag would rapidly corrode a basic lining and thus act as an acid slag or corrode an acid lining and thus act as a base. This is absolutely contradictory to the definition of neutral. He means a eutectic slag. Eutectic is an every-day word with metallographers. It means: "Of maximum fusibility; said of an alloy or mixture which has the lowest melting point which is possible to obtain by the given components." It is ready to dissolve more of any of its components when the temperature is elevated, and remain fluid. This is a description of the so-called neutral slag. (By the law of probabilities, it would not happen once in a million times.) Therefore, I will say eutectic instead of neutral slags. When neutral atmosphere and neutral refractory material is spoken of, inert, "not affecting other substances when brought into contact with them," is what is meant. When we say acid, we mean silicious. When we say basic we mean nonsilicious. Why not say what we mean? A silicious slag or rock is one in which the flowing temperature would be reduced by decreasing the silica content; a non-silicious slag or rock is one in which the flowing-temperature would be reduced by increasing the silica content. Flowing-temperature, not formation-temperature, is the theme with Peters in his discussion of slags, and Kemp, immediately following his definition, discusses the flow of the acid and basic magma. We then have, silicious, non-silicious, and inert refractory material. The neutral ores can be called self-fluxing and borax can be said to act as a silicious flux. Instead of saying ratio of oxygen in the base to oxygen in the acid, would it not be better to say, ratio of oxygen in the metallic oxide to oxygen in the silica?

A shortage of firewood at the Ashanti Goldfields mines, West Africa, has resulted in the installation of suction-gas engines for driving generators and an air-compressor. The plant now consists of three gas-electric generator sets, and one air-compressor set with two 700-hp. gas producers, and one 300-hp. producer. One generator set will always be used as a standby. It is expected that, early in 1914 all of the motors for the central treatment plant will be working, before the annual firewood troubles start.

Mining and Washing Brown Hematite Ores

By W. R. DODGE

The total production of crude iron ores for the year 1912 was 63,859,728 short tons. Of this amount, 3% or nearly 2,000,000 tons was brown hematite, the mining of which in Virginia, Tennessee, Georgia, and Alabama forms an important industry. The deposits are widely distributed throughout the Appalachian system from Alabama to eastern Canada, there being also important deposits in Texas, Iowa, and Colorado. The composition of the ore in its pure state is $\text{Fe}_2\text{O}_3(\text{OH})_x$ and contains: iron, 59.92%; oxygen, 25.64%; and water, 14.44 per cent.

Many hypotheses have been advanced as to the origin of these deposits, the conditions in each region varying somewhat; but the general opinion is that through the agency of surface waters, which have leached through and drained from a large area made up of porous ferruginous soils, the iron has been dissolved and kept in solution. This solution has collected in basins or cavities in the impervious soil or strata, and the dissolved iron has been precipitated from the solution either by lime or potash, according as to whether the basin or cavity was composed of limestone or slate. These rocks have in turn been decomposed and a residue of clay has been left by their alteration.

Occurrence and Testing of Ores

The ore takes the form of geodes or 'pots,' pipes, stalactitic masses, cellular aggregates, and smaller lumps and grains, from which the barren clays and oeres are removed by washing. The ore is but a fraction of the material mined. It occurs in irregular streaks throughout the clays, also often widely distributed over the surface in lumps and nodules forming a gossan. The mining must of necessity be by stripping and by open-cuts, as underground mining would present great difficulties and the cost be excessive.

An estimate of the value and extent of these deposits is usually made by drilling or by sinking test pits; the latter being preferable, as they are cheaply sunk in the soft decomposed clayey soil and render a visible examination possible. The pits are generally 3½ ft. diameter and 30 to 60 ft. deep. They are sunk at regular intervals, corresponding to the checker-board system of squares, the sides of each square being 200 ft. A pit is sunk at the intersection of the lines forming each square. The dirt removed from these pits is carefully sampled, the grains and lumps are recovered by washing the clay, and the tons per cubic yard are calculated.

Ideal conditions for mining with steam-shovels exist where the deposit lies in a low hill and close to the surface. The latter condition precludes the necessity of the expense of stripping the overburden. This

situation on a hillside enables the ground to be worked in benches or terraces, and good drainage is obtained, which is extremely important where the soil is of clay.

Steam-Shovel Mining

These banks or terraces are so arranged as to give a cutting face of 10 to 20 ft. vertically, with a base wide enough to hold comfortably the steam-shovel and the narrow-gage railroad track serving it, the width being usually 25 to 30 ft. These banks, one below the other, are cut simultaneously. All obstructions ahead of the shovels, such as trees, underbrush, and boulders, must be removed. A large tree 3 ft. diameter and 60 to 80 ft. high is felled, sawn into logs, and the stump dynamited by two men in ten hours. The brush is piled into heaps and burned. The boulders are shattered with dynamite. The steam-shovels for this work must have maximum digging capacities, yet be light of weight to allow of quick change of position over a rough grade. The Vulcan shovel is a favorite for this work. The 35-ton 1-yd. dipper size has a capacity of 500 to 700 yd. per 10 hours. Each shovel has a crew of 5 men, and consumes 2½ to 3 tons of coal per day.

Narrow-gage (36-in.) steam trains, made up of locomotive and five 3-yd. cars, transport the material mined by the shovels to the washer. The locomotives are of the saddle-tank type, ranging in weight from 10 to 18 tons, according to the load requirements. They will easily handle a 15 to 18-yd. train up a 4% grade. The average speed over a good track is 8 to 10 miles per hour. A 12-ton locomotive consumes one ton of coal per 10 hours, and has a crew consisting of an engineer and a fireman. The tram cars for carrying the ore are of the high-frame, wooden body, side-dumping type. The body is 8 ft. long, 6 ft. wide, and 18 to 20 in. deep. They hold three yards. The body is hinged along its longitudinal axis, these hinges resting on the tops of A-shaped steel trusses carried on the trucks. The body is held in balance by means of four chains, two on each side. The car is emptied by releasing the chains opposite the side it is wished to dump, whereby the body is overbalanced and the load is allowed to fall out. The side doors are supported independently of the body and do not rotate with it, thereby allowing the dirt to slide out underneath them. Three men are required to dump these cars.

Construction of Tracks

The rails for the permanent main track are usually 40 to 56 lb. per yard. Oak ties are placed at 2-ft. intervals. In the headings, along the banks that are being mined by the shovels, the tracks must be constantly shifted in order to serve the shovels as they change their positions. The rails here are lighter, 30

to 36 lb. per yard. Whole sections of this track, 100 to 150 ft. in length all intact with ties, etc., are moved at one time by the track gang of eight to twelve men. No preliminary grading is done, other than a rough evening up of the ground. The track is strung out and the low places under the ties filled in with blocks or logs. Water-pipe lines are laid by the side of the track to serve the shovels.

A hillside position is chosen for the washer in order to secure sufficient elevation. The total height required from the standard-gage railroad track beneath the shipping bins to the crude-ore bins at the top of the plant varies from 40 to 60 ft. The crude ore is received at the top of the plant in a V-shaped hopper, 5 to 6 ft. wide across the top, 2 to 3 ft. deep at its upper end, and 50 to 60 ft. long, or long enough to receive the loads of a 5-car train of dirt. This hopper has a false bottom of 65-lb. rails, placed bottom side up, with 4-in. spaces between them, thus forming a grizzly. This grizzly is set on a grade of $1\frac{1}{2}$ to 2 in. to the foot, slanting toward the washer. The function of this grizzly is to support the ore in a mass above the true bottom, two feet below it, and to enable the large lumps and boulders to be broken. Beneath this grizzly is the true bottom of the hopper, which is a cast iron lined flume set on a grade of $2\frac{1}{2}$ in. to the foot. This flume is $1\frac{1}{2}$ ft. wide and the liners are semi-circular in section, 1 in. thick and 4 ft. long. Water is admitted at the upper end of the flume and flushes away the dirt as it is fed down through the grizzly by men with long picks.

Washing and Screening

The water and ore enters a revolving trommel with 2-in. round holes. This trommel is cone-shaped and mounted on tires, which are in turn carried on friction rollers and driven by them. The trommel, besides removing the oversize, also acts as a distributor of pulp to the log-washer beneath it. The oversize, consisting of lump ore with impurities as mud and clay balls, is washed by spray pipes and discharged upon a pan-conveyor picking belt. Here the impurities are removed and the clean ore is sent to the ore-bins for shipment.

The undersize from the trommel passes through the log-washer. This consists of two wooden or steel logs, octagonal in section, $1\frac{1}{2}$ ft. diam. across flats, and 20 to 30 ft. long. The logs are mounted on gudgeons and have a pitch of 1 in. per foot. They work in a rectangular flat bottomed box 7 ft. 4 in. wide, 4 ft. deep at their lower end, and 2 ft. deep at the upper end, according to the length of the logs. The lower gudgeons are enclosed in grit-proof step bearings under water. To the upper gudgeons, which are out of water and work in journals, is fastened the driving gear. To the logs are bolted blades or paddles of hard steel, 9 to 10 in. long, $5\frac{1}{4}$ in. wide, and $1\frac{1}{4}$ in. thick, in such a manner as to form an interrupted screw conveyor. The undersides of the logs rotate toward each other.

The crude ore pulp is fed to the logs near their lower end, while clean water is admitted at the upper end. The pulp is in constant agitation, the clay and mud being disintegrated and washed out as slime at the sides of the box. The ore settles to the bottom and is worked by the action of the logs to the upper or discharge end. The speed of the logs is 12 to 15 revolutions per minute.

Treating Fine Material

The discharged material still retains impurities as slime, clay, and fine sand. It is further cleansed by being washed in a double-shell perforated screen. The outer dimensions of the screen are: length, 8 ft.; diameter, 42 in. The driving gear and the tires are attached at the extreme ends. The tires, in turn, rest on rollers. The outer shell is of No. 18 steel plate with perforations 1 16 in. by $\frac{1}{2}$ in. The inner shell is 32 in. diameter and of $\frac{1}{4}$ in. steel plate with perforations $\frac{3}{8}$ in. by $1\frac{1}{4}$ in. This inner shell is intended to receive the major part of the wear and thus protect the outer shell. There being no spider arms to this screen, spray pipes are extended into it to wash adhering mud and sand from the ore.

The product from this screen is discharged upon a pan conveyor which serves as a picking belt. The impurities, such as gravel and clay balls are here removed and the clean ore passes to the shipping bins. The pan conveyor is made up of a series of pans, each pan being of $\frac{1}{8}$ in. steel plate, 15 to 18 in. long, 23 in. wide, with sides $2\frac{1}{2}$ in. high, bent up at right angles. The rear end of each pan has a 1-in. angle iron riveted to it to prevent material from slipping back when the conveyor is inclined at a steep angle. The next pan rests on this angle iron. These pans are carried on links, two to each pan. The links are of the same length as the pans and are connected by a steel pin which extends across the full width of each pan. The head and foot of the conveyor are carried on smooth, flanged friction rollers. Between these at 4-ft. intervals are 12-in. rollers which give additional support for the links passing over them. The washed ore carried by this conveyor is discharged into the shipping bin, from which standard-gage railroad cars are loaded directly beneath.

Capacity of Plant

A standard MacLanahan-Stone washer, as above described, having four logs, will wash 1000 to 1500 yd. of dirt in 10 hours. It requires 1200 to 1500 gal. of water per minute and 75 hp. to operate. The ratio of crude ore mined by the shovels to the washed ore ranges at several of the mines from 3 to 1, to 12 to 1. A general average is 5 to 1.

The sludge or slime discharged from the washer is carried by flumes to the sludge pond, which covers a tract of 25 to 50 acres. These ponds are usually formed artificially by enclosing some low basin with embankments or levees 10 to 15 ft. high. They are built higher as the pond fills with sludge. Approxi-

mately 50% of the water in the slime settles out and is decanted off for re-use.

Pumping of the water is one of the most important items in ore washing. One plant using a duplex, double-acting, compound steam pump with 12-in. suction and 10-in. discharge, pumps 1000 gal. per minute through a $\frac{1}{2}$ -mile pipe to an elevation of 60 ft., at a cost of 4½¢. per 1000 gal. A neighboring plant with a new installation of steam turbines direct connected to rotary pumps, furnishing 3900 gal. per minute, expects a lower cost than this.

Low costs in the mining and washing of brown ores depend on good weather conditions, uniformity of the ore deposit, a plentiful supply of water, and a small amount of stripping of overburden. A well managed property under the above conditions, and where the ratio of the crude ore or 'dirt' to washed ore is not greater than 6 to 1, can produce ore containing 50% iron for 50 to 75¢. per ton.

General Rules for Safety*

1. Where gasoline is used for lighting steam-shovel and churn or well drill operations, safety cans are provided and must be used by employees for conveying and handling the limited supply allowed for each shift. The use of other than the approved safety, non-explosive cans for gasoline or other inflammable liquids is positively prohibited.

2. In the use of calcium carbide and acetylene gas machines, for lighting steam-shovel and all mine operations, the transportation and storage of the calcium carbide and the care of all equipment, generators, charging apparatus, and other details must be under the supervision of employees instructed and informed in the care and attendance of same.

3. Employees whose duties are prescribed by the above rule must always observe regular time, during daylight hours only, for attending to and charging all apparatus. Carbide charges must be sufficient to furnish gas continuously for the maximum lighting period to all burners installed, and generators must be of sufficient capacity to avoid recharging at night.

4. In the case of calcium carbide lights, all employees must observe the following cautions: (a) Never open or recharge a light in the presence of an open flame; (b) never test the generator or piping for leaks with a flame; (c) never apply flame to an outlet from which the burner has been removed; (d) never use a lighted match, lamp, candle, lantern, or open light near the machine.

5. Operators and employees of churn-drills or well-boring machines must not attempt to oil, wipe, or repair inaccessible parts while machine is running. Stop the machine before oiling parts that have to be reached by thrusting arm through wheels or between belts and pulleys.

6. Mechanics, shop employees, and repairmen are

instructed: (a) Not to strike highly tempered steel with a hammer or other metal object. Use a piece of wood or brass placed against it for hammer to strike; (b) never to shift a moving belt by hand. This rule applies to and must be observed by all employees on drills and other belt-driven machines or machinery; (c) not to wear loose or baggy clothing. Jumpers tucked inside of overalls might prevent clothing from being caught in machinery.

7. Employees are instructed, and it is hereby made part of the duty of every employee, to help protect and maintain equipment in safe condition.

8. Defective equipment, or impaired or damaged hand tools, must not be used. Employees must return worn or defective tools to their foremen, who will furnish them with tools in good condition and repair.

9. Old planks or boards with nails protruding must not be thrown aside to lay around tracks or yards. Blood poisoning and the loss of a leg may result from stepping on a rusty nail. For their own and their fellow-workmen's protection, employees are urged to take an interest in this too frequent cause of injury. When an old plank or piece of board with upturned nail is found, either bend the nail down or call it to attention of foreman, who will have it removed.

10. Employees who are careless of the safety of themselves or others will be discharged and dismissed from the service of the Company.

11. The use of intoxicants by employees while on duty is prohibited. Their use, or the frequenting of places where they are sold, is sufficient cause for dismissal. Employees are required to report any fellow-workman who is intoxicated while on duty.

12. Violation of, or the refusal to obey any of these rules, or of any special instructions not in conflict herewith and issued by proper authority, will be deemed sufficient cause for prompt dismissal.

Ore Treatment at the Camp Bird Mill

During the year ended June 30, 1913, the following results were obtained:

Ore treated, tons	30,012
Metal content:	
Gold, ounces	0.958
Silver, ounces	3.330
Lead, per cent	1.420
Copper, per cent	0.217
Value per ton	\$22.51
Total value	675,630
Net recovery	597,239

Of the total value extracted, there was obtained by amalgamation 49.28%, concentration 43.91%, and cyanidation 6.81%; of which gold constitutes 85.74%, silver 9.92, lead 2.33, and copper 2.01 per cent.

The Komata Reefs mine, New Zealand, has been shut down. During the past 16 years it produced gold and silver worth \$2,016,000. Of this, \$86,400 was from the sealing of plates, equal to an absorption of about 2.3 per cent.

*From the book of 'Rules and Regulations' of the Nevada Consolidated Copper Company.

Precipitation and Clean-Up at the Lake View Mill

By J. P. CADDY

*This plant treats sulpho-telluride ores from the Lake View & Star mines, Kalgoorlie, by wet crushing with stamps, Freeman pans, Wilfley tables, tube-mills, agitation with bromo-cyanide, and filter-pressing at the rate of 18,000 tons per month. Concentrate is roasted, ground in pans, agitated, and filter-pressed.

All cyanide solutions go to the same sumps, are pumped through two classifiers to a gold-solution tank, after passing a 3-in. Kennedy meter. From this reading and the value of the solutions, the amount of gold in the zinc-boxes can be closely estimated. There are 11 zinc-boxes containing 12 compartments each, only eight being filled with shaving. The capacity of each box is 23 cu. ft., one cubic foot of zinc weighing 12 pounds. About 75 tons of solution flows through each box daily, or 3.26 tons per cubic foot of zinc. The solution is worth \$2.88 to \$3.36 per ton, contains 0.06% KCN, with no protective alkalinity. The boxes are dressed three times and cleaned-up twice a month. New zinc is packed in the lower compartments after being dipped in a solution of lead acetate. Taking a solution entering the boxes worth \$3.06 per ton, the value after No. 2, 4, 6, and 8 compartments is 42 to 53c., 28c., 12c., and 3.6c. per ton. Zinc consumption averages 3500 lb. per month.

Clean-up apparatus consists of a washing tub 30 by 42 by 144 in., with sloping sides and bottom, fitted with 10 and 20-mesh screens; a lead-lined acid tub 6 ft. diameter and 2 ft. deep with sloping bottom to a 3-in. cock; Dehne lead-lined centre-filling filter-press of 12 frames, filled by a pressure tank; three cast iron roasting muffles, 12 by 20 by 53 in., with 1¾-in. bottoms; a tilting furnace to take a No. 9 Morgan crucible; two well furnaces to hold a No. 150 and No. 60 crucible, respectively, and two cast-iron amalgam retorts 7 by 15 by 42 in., each holding three cast iron trays, 4 by 8 by 12 in. The clean-up of the zinc-boxes is similar to the usual Kalgoorlie practice, the total time taken from starting on the boxes to getting bars ready for the bank is only 18 hours. Six men are employed. Only the short zinc under the 20-mesh screen is treated with sulphuric acid, the monthly consumption being 1100 lb. Cakes of gold slime from the press are roasted for 1½ hr., then fluxed for the tilting furnace. This furnace receives the first charge about 4½ hr. after starting the first clean-up, and the last of the gold slime is ready for roasting 10 hr. after starting. Fluxes are borax, 50%, and sand, 10 to 15%. The No. 150 crucible is sometimes used for melting the fluxed slime. The No. 60 is for making bars of 700 oz. each. Amalgam collected in the mill is also retorted and melted during the clean-up. A month's yield will be 1220 lb. of roasted slime, giving 4200 oz.

bullion, 830 fine in gold, 115 in silver, and 55 base. The amalgam yields 1,500 oz. bullion, that from the concentrate being 975 in gold, 17 silver, and 8 base.

Geological Notes on Port Arthur and Vicinity

By WARREN D. SMITH

The extreme lower end of the Liaotung peninsula is studded with numerous treeless hills, having generally rounded tops and which are of moderate height. The famous 203-Metre hill is one of the highest in the immediate vicinity of Port Arthur. The small streams draining the country are in wide, almost flat-bottomed, valleys. The lower end of the main stream emptying into the harbor of Port Arthur is drowned in its lower portion; in fact, the harbor itself is nothing more than a submerged portion of this stream and of one or two of its former tributaries. The harbor is silting up at the present time, and apparently at a rapid rate. In a word, the topography has reached maturity, and late maturity at that. The absolute lack of forests will only hasten senility. In the vicinity of Port Arthur the Japanese authorities have begun to reforest the hills with Scotch pine. It may be that the experiment will be successful and that erosion will be checked in this locality.

As far as I could see from my extremely casual survey of the country during the few short hours' leave from the ship, the dominant rock in the district seemed to be quartzite, bedded and tipped at various angles, having some lenses and veins of pure quartz. On Pompelly's map of China* the lower portion of Liaotung peninsula is colored to indicate Devonian limestone. It is possible that this limestone has been metamorphosized into a highly silicious rock and resembles quartzite. In places there may be conglomerate overlying it consisting of pebbles of this formation, for specimens of it are to be seen in the military museum in Port Arthur. Both these formations are exceedingly hard. According to the Japanese authorities, their tunnels advanced during the siege only 50 centimetres per day. The formation is intersected in all directions by fractures and joints, and therefore should be more easily excavated by persons trained in practical mining. One reason why greater headway was not made by the Japanese military engineers was undoubtedly due to the fact that they could not use powder or dynamite at the time through fear of giving the Russians an idea where they were working. Quartzite being simply metamorphosized sandstone, and hence having a high percentage of silica, would afford little or no soil, and this seems to be true here. Such country should not be expected to afford much sustenance for troops.

Port Arthur affords a striking example of the bearing of geology upon human affairs.

*Abstract from the *Monthly Journal* of the Chamber of Mines of Western Australia.

*'Geologic Researches in China, Mongolia, and Japan.' R. Pompelly, Smithsonian Contributions to Knowledge, 1866.

Discussion

Readers of the MINING AND SCIENTIFIC PRESS are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment. Insertion of any contribution is determined by its probable interest to the readers of this journal.

Underestimating the Cost of Milling Plants

The Editor:

Sir—The planning and designing of ore-treatment mills has been the subject of several articles, very much to the point, during the last year in the *Mining and Scientific Press*, especially those of Sydney Additon.* On account of the importance of this subject to the mining industry, I trust that you will consider a further discussion of it is warranted.

The failure of mills to do what is expected of them is one of the reasons why investors are shy of the mining field. Everyone who reads this can call to his mind examples of rusting mills. The man who is not technically acquainted with mining and metallurgy often considers that this is one of the inherent risks of mining. He thinks that the success of a mill is a matter of chance. If you are lucky, you get a mill which treats your ore successfully. There is enough of the speculative element in the finding of ore, without introducing any in its treatment. It is a matter of much importance to the man who makes his living by mining to remove as much as possible of this risk.

There are two kinds of failures in mills, though differing mainly in degree. The one kind is the mill which is so poorly adapted to the treatment of its particular ore, and the return from the mill is so much less than the cost of operating it, that it is shut down in a very short time. The valuable metals go down the creek instead of into concentrate or bullion. The unlucky owners decide the ore is refractory, they have spent all their available capital, and the property is shut down. This kind of a failure is of course conspicuous, and is the usual kind thought of when the subject is mentioned.

The other kind of failure is the one in which the profits from the mill are not as large as they would be if the mill were properly designed. The returns, however, are still more than the cost of production, and the mill continues to operate. Now unless some one with an investigating turn of mind is connected with this mill at some time or other, the loss of profits may never be detected. If it is detected, some of the machinery may be thrown on the junk pile, to make room for equipment better adapted, or additional apparatus may be added and alterations made to adapt the plant to the scheme of treatment. In either case the profits will generally not be as large as if it were planned correctly in the first place. There is both the loss of money in the scrapped material and the

alterations made, and also that which is more important, as it is cumulative, the loss due to a higher working cost in the poorly planned mill. A mill whose flow-sheet has been juggled around a few times generally costs more to operate than it should.

The first type of failure is gradually becoming rarer, though even now I can recall three or four of this class in the last couple of years in the Northwest. Of the other class, we have no means of knowing the number. From the experience of every metallurgist, however, it is safe to say they are still with us. As long as mills continue to be planned from machinery catalogues, and by engineers whose specialty is mining and not milling, so long will such mills continue to operate at a loss to their owners. The remedy, as Mr. Additon points out, is the design of the mill by a metallurgist, the same metallurgist who conducted the testing of the ore, which is essential to a correct design.

The testing of the ore comes first, and is the foundation on which the correct design must rest. It is also the part of the planning which is often neglected, or not done in a thorough enough manner. In the first place, an ore test must be made on actual milling machinery to give results which can be duplicated later on in the mill. It must be made on a sufficient quantity of ore, so that errors are minimized as much as possible. I believe that, too often still, small tests are relied upon for information on which to base mill design. It is a well known fact that the old bottle amalgamation test, the pan concentration test, and others, are inaccurate. When such tests are relied on for a test of a combination of processes, or to get a comparison between different combinations, the results are little short of worthless.

It is just in this matter of the comparison of different combinations of processes that the thorough test is most valuable, and also where it is less used than it should be. For instance, a mill is planned for an orebody. A property nearby with what seems to be similar ore, is treating by amalgamation, fine grinding, and agitation in cyanide solution. As a matter of precaution, therefore, a test is made of the ore by the same method. This test shows a fair margin between recovery and operating costs. It is accordingly selected as the right process, and a mill designed to fit. But in such a case as this there should have been a comparison between the following combinations: amalgamation, fine grinding, and agitation (the one chosen); amalgamation, concentration, fine grinding, and agitation; amalgamation, classifying into sand and slime, and leaching sand and agitating slime, with and without concentration. Perhaps cyaniding alone, leaving out amalgamation, should have been tried, and to make the test complete, several variations of the above should have been tested. When the results of each of these tests had been tabulated and compared, the best process could then have been wisely chosen.

There have been a number of examples recently of

*See *Mining and Scientific Press*, July 19, 1913, et seq.

mills changing their scheme of treatment. Some that have been concentrating before cyaniding have rejected their concentrators, and thrown their work on the cyanide plant. Others have dispensed with fine grinding and now agitate only the natural slime, leaching the sand. Others have abandoned amalgamation, or have added it. All of these changes are expensive, and in many cases could have been prevented had a complete comparison been made at first of the different combinations of processes which were possibilities in the treatment of the ore in question. Until the importance of a thorough testing of the possibilities of treatment of an ore is realized, and the possibilities are thoroughly compared by proper testing, so long will mills continue to operate at an unnecessarily high cost, or to send to the tailing dump metal which might otherwise have been turned into profits.

Seattle, January 27.

I. F. LAUCKS.

What Is the Matter With Prospecting?

The Editor:

Sir—I have been reading the symposium on the lack of prospecting in the last few issues of the *Press*, and I think that most of the contributors have overlooked the most important feature in the whole matter, and that is the class of labor at present employed in the mines. Fifteen years ago you could make a shift boss out of practically any man in the mine. Today go into a stope of any the mines in the larger districts and ask the first man you meet a question about the mine, and two-thirds of the time you will be greeted with a blank expression and a shake of the head. Go up to the shaft when the shift is going to work or step into the office of the labor agent and listen to the inquiries of 'Catch a job dis morn?' Then try to imagine these men as prospectors. To these men a steady job where they save a considerable portion of their wages, and look forward to a home in the old country as an ideal, is all sufficient. They do not even know whether they are working in a gold or a copper mine. It is the job they want, without any reference to where it is so long as it pays. There is no interest or fascination to their work. As this type of labor now represents about two-thirds of the men around the mines, it is easy to see the reason for the decrease of the number who were willing to 'stake a pal' or 'take a chance' themselves ten years ago. Whisper in any of our Alaskan towns that gold has been found on some of the creeks hitherto unknown, and every English-speaking miner that can get away is off on the stampede and the 'bohunk' grabs the job that is left. The new camps are settled by English-speaking people; the foreign element comes when conditions are settled and work by the day may be obtained. Thus with the decrease of the easily found placers (or lodes), the American turns his attention to other lines and the foreigner settles down to the routine work.

Juneau, Alaska, February 8.

TRAVELER.

Ore

The Editor:

Sir—No one appreciates the good fun in Mr. Gow's letter more than the not unhappy victim of it. The compliment that I most appreciate is criticism that manages to be both penetrating and polite like that of the gentleman in Sumatra. As I have said elsewhere, I am not a professor but only a professional, merely an engineer become editor and therefore claiming no right to pass judgment on technical writing except in so far as any professional is entitled to give hints to amateurs. The fact that my living is made by the exercise of the pen, and the fact that I have a keen delight in learning to write well, does, I believe, justify me in elucidating principles and in criticizing errors in technical writing. That claim does not for a moment include the assumption that my own writing is above reproach—it would be absurd to say above criticism—for I am delightfully conscious that every year I learn more words and acquire a little more command in the use of them. Most of the errors against which I protest can be found illustrated in my own writings, but more in those that are least recent, for I try to practice what I preach. Not with complete success, as Mr. Gow has discovered. Undoubtedly, 'which' in the case quoted, is definitive and should be replaced by 'that'. This distinction between defining and non-defining clauses, with the consequent choice between the relative pronouns, is one that I have taken pains to advocate, and usually to apply. Therefore, the definition ought to read: "Ore is metal-bearing rock that, at a given time and place, can be mined at a profit," not as Mr. Gow phrases it, "that can, at a given" etc., be mined. It is an error to split your verb. Permit me to assure Mr. Gow that it is not done in the best families. As regards 'today,' I spell it without a hyphen for the same reason as a great many other progressive people do so, and therefore as most of the leading newspapers of America, because the hyphen in to-day has ceased to perform any grammatical function; it is atrophied. The 'to' and the 'day' are no longer betrothed, but married; they constitute a verbal unit. It is estimated that 200,000,000 persons write to-day, to-morrow, and to-night three times daily, on average, wasting thereby, in hyphens, enough energy collectively to propel an ordinary passenger train round the world.

In regard to the redundancies and contradictions against which Mr. Gow tilts so cheerfully, I demur to the contradiction, and I accept the redundancy. In the text of the lecture, from which my critic quotes, I was more anxious to be explicit than to be academic. Repetitions and redundancies are hardly blemishes in a lecture, when an effort is being made to emphasize a particular point. If I am only redundant on such occasions, I shall not be ashamed. However, I end, as I began, with raising my lance in salute to a discerning and amiable critic.

London, February 18.

T. A. RICKARD.

Concentrates

Electric blasting is causing considerable discussion in Rand.

Temperature increase in the Rand mines from depths of 500 to 2000 ft. varies from 1° in 60 ft. to 1° in 134 feet.

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To obtain the highest practical effect from a given charge of explosives, it is generally considered important that there should be no air spaces between the explosive and the side of the face.

Miners take many risks in spite of repeated warnings. Tampering with fire in places to be tested should only be done with a wooden rod. A man in the Ivanhoe mine, Kalgoorlie, recently tampered with a steel drill fire plug which resulted in the drill being blown through his shoulder.

Lumber for dredges should be properly seasoned before use in construction. Green timber shrinks as it dries and would pull dredge gear out of line. It is also necessary where timber is liable to be wet and dry alternately, on a boat such as that near the beach line, to cover it with flat iron to prevent rotting.

Dangers in mining are many, and accidents are simple causes. A mine in Victoria, Australia, was recently unwatered, and on two men entering a raise above the 200 ft. level, an explosion occurred, although neither was hurt. Gas had evidently accumulated and been compressed by the water into the top of the raise, and the lights exploded it. Old winzes in mines gradually fill with water, which gets foul if there is no drainage. When driving raises to connect with such winzes care is needed, especially when nearing the bottom of the winzes. A drill hole should be made through the intervening ground, and the water gradually drained through it. In Western Australia, several years ago, two men lost their lives through a sudden rush of water from a winze to which they were driving in a raise.

Shafts now being sunk by the Oliver Iron Mining Co., on the Mesabi range, Minnesota, are being equipped with concrete sets. The concrete "timbers" are made of the same size and framed practically the same as their wood prototypes, with the exception that the wall and end plates are given a bevel in a

vertical plane at the end to keep the corner bearing. The end bearing is $\frac{1}{2}$ -in. rods throughout, although it would seem that expanded metal or wire mesh would be better for the joints. The standard spacing of the sets is 5 ft., and the wall and end-plates are 12 by 12 in. The joints are 4 in. thick and 4 ft. 2 in. long. The tops and bottoms of the wall and end-plates are notched at the outside so that the joints are set flush with the back of the sets. The wall plates are heavier, weighing about 3300 lbs., and are rather hard to handle in the shaft, but are said to be giving good satisfaction when installed. The Company maintains a concrete plant at Hibbing for making the sets, and ships them to the various mines. The bearing timbers are large steel I-beams, which are cased with concrete after being placed in position. The part of the shaft from the first bearing set to the collar is usually made monolithic. The sets are carried as close as possible to the bottom in sinking, but the dividers for the last four sets are of wood, which is removed and the concrete dividers placed as the work of sinking progresses. The miners claim that, although heavy, the sets go into place nicely, and it is possible to install them just about as quickly as the wood sets. The hangers used are of 2-in. round iron, with a ring in one end and a hook in the other to facilitate removal in case of necessity.

Orebodies are often below the beds of lakes, rivers, or the ocean, and their extraction is dangerous until arrangements have been made to cope with the water. Instances of this are found at Cobalt, Ontario, where Kerr lake has been drained, and Cobalt lake is being emptied to get the rich silver ores; coal mining under the sea in Japan and Australia; tin mining under the sea in Cornwall, England; iron mining under the sea in Nova Scotia; and gold and silver mining under a river at Karangahake, New Zealand. The latest instance of ore recovery is in the Mesabi iron range, Minnesota, where it is reported that the Oliver Iron Mining Co., the mining subsidiary of the United States Steel Corporation, has made an appropriation to drain Carson lake, covering an orebody in the vicinity of Hibbing. This work is said to involve the pumping of about 200,000,000 gal. of water. The contract has been let to construct a ditch to carry the water to Kelley lake. The water is to be pumped by three large centrifugal pumps, presumably motor driven, placing the machinery on a barge and extending the discharge pipe as the water recedes. Shafts are to be sunk as soon as the lake is dry, and an attempt will be made to operate the property as an underground mine, as the over-burden is too heavy for the best results with an open-pit mining method. The amount of water to be handled in the underground system may necessitate a change later to an open pit, but this can only be definitely determined after experiments have been made. The fee of the property is owned by the state, which will derive a large sum in royalties from the work.

Special Correspondence

LONDON

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The doings of the Exploration company are always followed closely in America, for it has interests in Colorado, at El Oro, Mexico, and in the Natomas Consolidated company, besides having investments in Cananea and at Chuquicamata. It was formed in 1886 by two celebrated American mining engineers, Hamilton Smith and E. G. de Crano, with the financial backing of the Rothschilds, Barings, and other bankers and brokers in London. After the death of the original promoters, a period of misrule supervened, but shortly afterwards R. T. Bayliss was appointed to the management and he restored its credit and some of its prestige. The Company has been hard hit by the disorders in Mexico, and by the depression in financial circles and on the Stock Exchange, so that the directors are not in a position to declare a dividend for 1913. Owing to the suspension of dividends by many of the companies in which shares are held, the gross income for the year was only £30,393, as compared with £80,644 the year before. After deducting administration expenses, a net profit of £10,058 was left. Owing to the fall in the market quotations of the shares held, the 'sundry investments' item in the balance-sheet has shrunk by £64,487; and now stands at £579,806. Owing to the serious position in Mexico, the subsidiary,

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The copper interests of the Exploration company have been increased by £87,000 by the purchase of convertible bonds in the Chile Copper Co., which operates the Chuquicamata mine in Chile. Chuquicamata is undoubtedly one of the world's greatest deposits of copper, for it is estimated that upward of 200,000,000 tons of ore averaging over 2% copper has already been proved. As readers of the journal are aware, the mine is controlled by the Guggenheims, and Fred Hellmann is manager. The money necessary for the equipment of the property with a plant of 10,000 tons daily capacity has recently been provided by the issue of convertible bonds, and it is expected that the plant will be in operation some time during 1915. This plant should produce 120,000,000 lb. of electrolytic copper per year, at a cost not exceeding 6c. per pound delivered at European ports. With copper at 14c. per pound the yearly profit would be £2,000,000. Mr. Bayliss has always had great faith in copper investments, and as opportunity offers no doubt the Exploration company will expand its investments in this direction.

NEW YORK

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New financing for the Braden is like the relief of Ladysmith in the Boer war. On even dates it is affirmed and on the odd denied. Now that the ore reserve has been so greatly increased, the next thing will be to increase the capacity of the mill and smelter. This requires money. Probably what will

Concentrates

Most of these are in reply to questions received by mail. Our readers are invited to ask questions and give information dealing with the practice of mining, milling, and smelting.

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NEW YORK

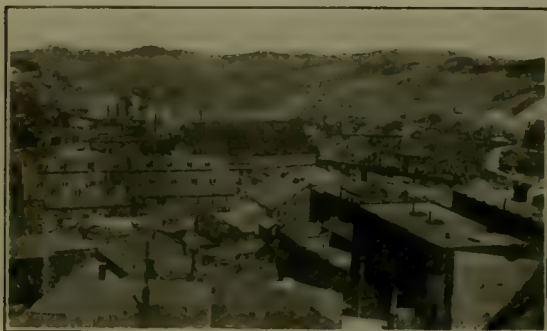
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The Shannon Copper Co. has had a fortunate windfall. The Arizona Copper Co., which has a side-line agreement with the Shannon, was recently exploring in a part of its ground which adjoins the Alaska claim of the Shannon and developed a vein 30 ft. wide, averaging 8% copper, but in the Shannon ground. As the Shannon holdings extend for a thousand feet along the vein thus discovered, the find is likely to prove of a good deal of importance, though it is about a mile from the present main workings of the Shannon. The Company has just changed its fiscal year so as to correspond with the calendar year, and the report just given out therefore covers the period from August 1912 to January 1, 1914. In that period Shannon has produced 18,800,000 lb. copper at a net profit of \$480,000. The Company has \$200,000 in cash assets and is buying in the bonds of the Shannon-Arizona railroad, which connects the mine with the mill and smelter. The Shannon has passed through many difficulties, but has been excellently managed and apparently has a brighter future.

New financing for the Braden is like the relief of Ladysmith in the Boer war. On even dates it is affirmed and on the odd denied. Now that the ore reserve has been so greatly increased, the next thing will be to increase the capacity of the mill and smelter. This requires money. Probably what will

be done will be to issue the \$1,000,000 remaining of the second mortgage convertible bonds which have been authorized, selling them to the Guggenheim Exploration Co., which already has over \$11,000,000 in cash and demand loans, and has recently increased its dividend rate to 14% per year. Pope Yeatman is expected to reach New York next month and the latest information regarding the position of the mine will then be available.

The Homestake has just made its report for last year, which makes possible some interesting comparisons with the preceding year. During 1913 the income of the Company showed a decrease of about \$500,000, but the dividends were increased from \$1,319,400 up to \$2,146,225, thereby converting the surplus of nearly a million dollars, which was on hand last year, into a deficit of \$27,719. The capital stock has been increased nearly \$4,000,000 during the year and it is reassuring therefore to find that T. J. Grier, the superintendent, reports the property in fine physical condition, with over 2,000,000 tons



SOME OF THE HOMESTAKE MILLS.

of ore broken in the stopes, and the prospects for a long and profitable life of the mine bright in the extreme.

Yukon Gold shares have been picking up, probably as a result of the good showing made in the report for 1913. With a gross output of \$4,789,402 it showed operating profits of \$2,537,447. The eight Dawson dredges made profits of \$1,827,800, while the hydraulic work at Dawson showed a loss, since most of the season was spent on washing top gravel. The dredge working in the Iditarod made a profit of \$597,800 and should do better next year. The two dredges in California brought in profits of \$72,600 but one of them has only been at work a short while. Some comparisons of cost will be of interest. The hydraulic work at Dawson cost 9.7c., dredging at Dawson 29.53c., and at Iditarod 64.33c. per cu. yd. This high cost is largely due to the collateral and overhead costs, thus at Iditarod a series of dams had to be built before and behind the dredge, large boulders gave trouble, as did heavy sand from workings above, and a stratum of clay which was encountered. The grade was steep, 6 to 10%, and the scarcity of water all combined to make the necessary dredging cost nearly fifteen times what it is in the more favorable California areas. It is necessary for the Company to write off large amounts as depreciation each year and it still owes the Guggenheim Exploration Co. \$2,100,000.

Tonopah Extension has proved a disappointment to those who expected big things of it a year ago when it was making a net operating profit of over \$25,000 per month. The earnings have shrunk until they are barely one-half of what they were and last December operations showed a loss of \$8000 for the month. Goldfield Consolidated, on the other hand, refuses to die, and its recent declaration of a dividend of 30c. per share, payable April 30, was more or less of a surprise to everybody. The controversy between the West End and the Jim Butler is still a topic of interest, but nobody seems to have any clear idea of what the outcome is likely to be.

JOPLIN, MISSOURI

ANOTHER OLD PRODUCING TRACT IS DRAINED.—QUAPAW, OKLAHOMA. DISTRICT RESUMES PRODUCTIVENESS.—ACTIVITIES THROUGHOUT THE MISSOURI-KANSAS-OKLAHOMA DISTRICT.

The drainage of old tracts that once were well known producers forms some of the more important mining development throughout the district at the present time. In addition to the drainage of the Lone Elm region, as noted in this journal on February 14, similar activities have been launched on the Cox land in the Turkey Creek bottoms, in the extreme northern part of the city of Joplin. A tract of land, once dotted with mills and smaller mining plants, later to be abandoned for many years, has now been drained to a depth of 80 ft. by the Oak Orchard Mining Co., and work is well under way on the construction of a new concentrating plant of 150 tons daily capacity. It will be used as a custom mill, over which the heavy tonnage of ore from numerous small prospects will be cleaned. Associated with this Company are A. R. Snyder, county coroner; George Quinby, former state mine inspector; Rev. W. M. Cleaveland, pastor of the First Presbyterian church of Joplin; and A. J. Johnson, H. J. Vancil, Nathan Rosenberg, and E. W. Hoffman, all business men of Joplin. At a depth of 70 ft., Miller & Warren are working a 20-ft. face of zinc ore which is showing a mill recovery of nearly 10%. Walker & Co. have a 27-ft. face of soft ore at the same depth; Lee & Westerman, also at 70 ft., have a 14-ft. face of 15% ore; Scott & Co. are operating at 50 ft. and have ore. Until the new custom mill is completed, the operators will continue to haul their ore to another custom plant, more than a mile distant.

An isolated mining camp, Quapaw, Oklahoma, of which little has been heard during the past year, is again taking a place in the list of producing camps of the district, two mines, the Ethel Miller and the Newlands, being the only productive properties just now. Operations at these, each of which is equipped with a small concentrating plant, were started recently. The output of this area will probably be increased when work starts at the Mission mine, now under the management of Wheeler & Hardy, who also have extensive mining interests at Joplin. The Mission mill, remodeled more than a year ago and then left idle, has a capacity of 400 tons per shift, and is the largest plant in the Quapaw field. It was the first mine of importance in the northeastern Oklahoma district, and has been operated by possibly a dozen different companies. At this mine work is conducted at a depth of 140 ft., the deepest at Quapaw, all other development being above 100 ft. In drilling operations, little deep work has ever been undertaken, but the plan of the company, that now has the Mission, is to put down a number of holes to a depth of over 300 feet.

Several new concentrating plants are under course of construction at various points throughout the district, but the greater part of mining activity consists of the removal of old mills to new mines, where they are reconstructed and remodeled. Considerable new equipment is necessarily required, and local machine firms report business to be somewhat better than for some time. In the West Joplin camp, the Geronimo mill, formerly operated by J. M. Short, has been purchased by the Underwriters Land Co., one of the large companies of the district, and work has been resumed at the property. Another new mill in the West Joplin field is that of the Otis Mining Co., the capacity being 350 tons per day. A new shaft is being driven, work being conducted from above and below, the underground activities being carried upward from an old drift of an adjoining mine, the Hero, which had cut over on to the Otis lease in former years. At Spring City, the Quaker Maid mill will soon be ready for operation. On the St. Louis-Joplin Lead & Zinc Co.'s land at Chitwood, the Kentucky Lead & Zinc Co. is

constructing a new mill of 150-ton capacity. Ore has been blocked out at a depth of 142 to 164 ft. Within a short time a contract is to be let for the construction of a new plant on the A B C Mining Co.'s lease of the St. Louis-Joplin land, where, about a year ago, the former mill of the A B C company was destroyed by fire. This mine was one of the most prolific producers of high-grade zinc ore in the district at that time.

S. A. Nichols and associates, of Joplin, have leased the Everett Zinc & Lead Co.'s property at St. Joe, Arkansas, from the Graves Mining Co. of Doe Run, Missouri, and they plan to construct a 100-ton concentrating plant. The Arkansas property is situated in Searcy county, from which some zinc and lead ore shipments have been reported.

DEADWOOD, SOUTH DAKOTA

THE HOMESTAKE COMPANY'S VETERANS' ASSOCIATION AND RECREATION HALL.—NEW MOGUL MILL.—WORK AT THE DAKOTA CONTINENTAL.—OIL WELL AT ARDMORE.—THE BEAR LODGE DISTRICT.

Now that there is so much discussion about 'subsidiaries,' 'interlocking directorates,' 'combinations,' etc., it might be interesting to note that the Homestake Mining Co. might some day be assailed for fathering subsidiaries. But so long as these are not combinations 'in restraint of trade,' they will continue to operate. One of the subsidiaries of this Company is known as the Homestake Veterans' Association, and to prove that it is a doubtful concern, it would be well to glance at the list of officers. They are all 'interlockers' of the best variety, and include the superintendent and assistant superintendent as well as several heads of departments. But the association need have no fear of the Interstate Commerce Commission, Congress, the Bureau of Corporations, or other governmental authority, for its mission is to promote loyalty, good will, and a closer fellowship among the employees. To be eligible to membership, a man must have been in the employ of the Company for 21 years. The roll of the association shows that there are now 120 members in good standing, and the waiting list includes about 2000 more, who are anxious to join, but are barred by short lengths of service. That the association is popular is testified by the rapid growth in membership. Men join the moment they are eligible. The officers are: president, Richard Blackstone, assistant superintendent; vice-president, W. J. McMackin; secretary, Robert Fraser; treasurer, John A. Spargo; trustees, T. J. Grier, superintendent, and William Ryan. Some idea of the immense amount of labor that has been expended on Recreation hall, the clubhouse the Homestake Mining Co. is erecting for its employees, is noticeable to the visitor to the building, now that what may properly be termed the finishing touches are being added. Interior plaster and calclining is white, and is practically completed throughout. Now that a large part of the rafters and supports in the theatre have been removed, the theatre is assuming a finished appearance. The balcony of the theatre will be one of the features, for each and every seat will be as good if not better than most of the main floor seats. The ceilings are high and permit of good and airy spaces above the balcony, and the acoustics promise to be of the best. In the basement all the plastering has been finished, and in the bathing room the cement floors have all been laid and the enamel rim of the pool is completed. The pool is 75 ft. long, 25 ft. wide, and has a maximum depth of 10 ft. and a minimum of 4 ft. Shower baths will be in the corners of the swimming room, and dressing rooms and lockers in adjoining rooms.

The new mill of the Mogul Mining Co., at Terry, was started at part capacity on February 1, and since has been

given a thorough test in all departments. It is encouraging to note that the De la Vergne oil-engine, the first to be installed at any Black Hills mine, is working well, and, it is claimed, with great economy as well. E. R. Graham is superintendent, L. D. Dougan in charge of the mill, Charles A. Chase general manager, and J. V. N. Dorr consulting engineer.

Sinking has been resumed by the Dakota Continental Copper Co. at Hill City, after considerable difficulty and expense in removing water. The shaft was 823 ft. deep and was unwatered to the 700-ft. station with one 4 and one 6-in. air-lift. At this station a Rumsey triplex, electrically driven, 400 gal. per minute pump was installed, and with its aid the shaft drained. It is proposed to sink the shaft to the 1000-ft. level, cut a station and sump, remove the pump to this station, and start prospecting. From diamond-drilling previously done, it is figured that 300 ft. of lateral work will cut a body of 're-deposited' copper ore. Ingersoll-Rand jack-hammer drills are being used in the shaft. W. J. Booth, of Hill City, is in charge of operations.

A trial shipment of 20 tons of \$16 gold ore from the Heidelberg property has been sent to the Golden Reward mill at Deadwood. This is the property which was selected for development by a committee appointed by the Deadwood Business Club after a number of promising prospects were examined, and the results so far would indicate that a wise selection had been made. Citizens of Deadwood are making regular monthly subscriptions to the development fund, and work is being pushed with a small crew. In addition to the shipping grade ore, a large quantity is being piled on the dump that would pay well to mill in a plant on the property, and just as soon as development warrants such a step, it is probable that the property will be offered for sale, and the profits used to develop other properties.

The well of the Ardmore Oil Co., at Ardmore, has recently been cased with 10-in. casing to the 1200-ft. point, and now that the size of the hole has been reduced, better progress is anticipated. It is expected that the Dakota sandstone, the oil-bearing rock of the district, will be reached at about 1600 ft. The well is a little over 1300 ft. deep.

A. E. Hall, superintendent of the Anaconda Gold Mining Co., is authority for the statement that important work will be started on this property. Funds are now being raised for development, and it is planned to do some extensive work on the north end of the mine, where some excellent surface showings have been discovered. It is probable that a new shaft will be sunk there. Otherwise lateral work from the old shaft will be attempted. The property is one of the best in the Roubaix district, and has been partly developed, but never equipped with a mill.

The Warren Peak Mines Co. has just received patent to its property in the Bear Lodge district. This is the first property in this district to be deeded by the Government. The tract includes 392 acres. The most important ore so far discovered in shallow workings is a streak an inch or so wide, carrying sylvanite, and often yielding assays up to hundreds of dollars per ton. It has been stated in the past that the Company hesitated to prosecute extensive development until patent was secured. Considerable activity is apparent in the Bear Lodge district, nearly a dozen properties now undergoing active development, and the next few months promise to witness important exploitations. It is a little early to prophesy, but from surface indications it seems that this should develop into a good mining camp.

The annual report of the Wasp No. 2 Mining Co., operating at Flatiron, shows that 127,680 tons of ore was treated, yielding \$219,335. Operating costs were \$167,392, and net profit \$24,543. Dividends amounted to \$55,000 equal to 11% on the capital. Operating time was 8.3 months. Detailed costs will be given in another issue of this journal.

JOHANNESBURG, TRANSVAAL

ANOTHER STRIKE, ITS CAUSES AND RESULTS.—VALUE OF ORE AT DEPTH AND WAGES.—CINDERELLA CONSOLIDATED SHUT DOWN.
—AIR-BLASTS AND CAUSES.—GOLD PRODUCTION.

Another strike broke out in the Transvaal at the beginning of the year, and threatened to have more disastrous results in the mining industry than the previous strike in July, when all the miners came out on strike for several days. The railway men of the state went out on strike against the dismissal of several employees, and paralyzed the railway service in the Transvaal and part of Natal and the Orange River State. In Cape Colony, the railways continued to work as usual. Unless the strike was settled within a week the whole of the gold mines would probably have been shut down for want of coal. About six of the strike leaders were arrested, and along the 'reef', from Randfontein to Springs, a distance of about 50 miles, the mines and railway were guarded by over 10,000 troops. The Transvaal government did not, as was unfortunately the case in the last strike, attempt to interfere with the men holding public meetings. The strike leaders still out of prison threatened to declare a general strike unless the imprisoned leaders were liberated. At the last mass-meeting held, it was decided to submit the question of a general strike to a ballot of the men, but so long as the railways were paralyzed by the strike, a general strike would not add much to the inconvenience, as before the result of the ballot could be acted upon many of the gold mines would be crippled for want of coal. As mentioned before, the outlook for the gold mines was bad, and should work from any cause have been suspended it would have had a disastrous effect upon the native labor supply, which since the last strike has been in a precarious condition. There has been considerable discontent among the skilled men employed in the railway workshops for some time, which made to some extent an uneasy feeling in other branches of the railway service. It was, however, in the workshops that most dissatisfaction prevailed, and sooner or later it was evident that a strike must follow. The railway men depended on the gold miners for support in their dispute, but the latter only gave a half-hearted support. Some mines were thrown idle, but the miners' organization was so defective, and a general strike unpopular, that they continued to work. In South Africa the conditions are such that a general strike is extremely difficult to bring about. Most of the work is done by unskilled and uncivilized natives, who have no idea of combining to promote their own interests, and with a few Europeans to act as supervisors work can proceed almost the same as usual on the mines. The natives are not allowed to form societies, if they could, to protect their common interests, and all they desire is to earn sufficient money to enable them, in comparative plenty, to return to their *kraals*. At the present time, January 22, the strikers are asking to be allowed to return to their duties unconditionally, and to all outside appearances the strike is virtually over. It remains, however, to be seen whether force employed to the extent it has been used on the Rand against the workers will completely crush out the strike movement. Among those arrested during the week for attempting to persuade railway workers not to return to work, was F. Cresswell, member of the legislature, and nearly every union leader of note has been placed under lock and key. Outwardly the strike appears to be over, but while a lesson, and that a severe one, has been taught to the men, there are not wanting those who consider that, owing to the overwhelming force displayed to end the strike, it is not improbable that the workmen will reorganize and watch their opportunity to again cause trouble.

[The arrest, deportation from South Africa, and the recent

arrival in England of the strike leaders, with the public opinion on this action, has been published in the daily papers from time to time.—EDITOR.]

The abortive attempts at a general strike, and the determined manner in which they were met by the Government, have caused the question to be raised as to whether the miners will be able to maintain the present high rate of wages for long. The fact that the 'reef' on the Rand, in the majority of instances, has become poorer at increased depth cannot be denied, and there are several instances where the value of the yield and the cost of working are too close to yield any dividends for shareholders. The indications for the future point in the direction of these mines increasing in number as greater depths are attained, as no matter what may be said to the contrary, working costs are bound to increase with depth, and if such increased costs are accompanied by a lower yield, the tendency for profits to attenuate is materially hastened. The need, therefore, for lower working costs must increase as time goes on, and as a last resource wages will have to come down in the inevitable pending struggle to work the deeper mines at a lower cost. The cost of living on the Rand has been materially reduced of late, far more than wages; but while the phthisis scourge may always tend to keep up wages, as mining becomes less profitable with depth it is evident that costs must come down and that wages will have to some extent contribute toward the relief.

The circumstances surrounding the closing down of the Jupiter mine, the deepest gold mine on the Rand, referred to in this journal of December 6, 1913, have not been ameliorated by a similar step being adopted at the Cinderella Consolidated mine, near Boksburg, on the East Rand. Like the Jupiter, the Cinderella Consolidated was working at a depth of from 4000 to 5000 ft., but unfortunately it was a single-shaft property, for although an outlet was obtained with the East Rand Proprietary mines, it did not in any way better the underground conditions, although it removed the restrictions imposed by the mining regulations on mines working with a single shaft in the Transvaal. The Cinderella Consolidated has had a somewhat checkered career, as while the ore sent to the mill was well up to the average of that milled on the Rand, the working costs were so high that for some time past milling operations resulted in a loss. Change of managers did not improve matters. The monthly losses continued, so it was decided to close down the mill and not waste the ore reserves of the mine by attempting to run the mine before the second shaft, in course of sinking, had been completed, and connected with the underground workings. After ceasing milling operations it was found that it was impossible to obtain the additional working capital necessary to place the mine in good condition, including the completion of the necessary underground connection, and it was reluctantly decided, as in the case of the Jupiter, to close down the Cinderella Consolidated entirely and await the arrival of better times. Underground difficulties have always been a prominent feature of this mine, apart from that of procuring ample ventilation, through the mine having for a long time only a single shaft. In the shallower part of the mine, about 4500 ft. from the surface, air-blasts frequently made their presence felt, good stopes being frequently lost for some time owing to this cause, and the working costs and difficulties considerably increased. These air-blasts appear to have had their origin principally through dikes and broken ground preventing underground subsidence taking place in a uniform manner. The leaving of pillars to steady the subsidence only added materially to the difficulty, and so strong were the air-blasts that several lives were lost through their occurrence. Probably had the whole of the 'reef' been extracted, and systematic sand filling been resorted to, these difficulties would have been reduced to a

minimum. It requires a bold mining policy to handle Rand mining properties at a depth of 4000 ft. from the surface, and in no instance has sufficient pluck been yet displayed to adopt such a wholesale mining policy as is fast becoming necessary on the deep mines of the Rand. So far, closing down the mine has been considered preferable.

The Transvaal Chamber of Mines has declared the December output of gold for the whole of the Transvaal as 672,815 fine ounces, valued at £2,857,938, being a decrease of 671 oz. compared with the preceding and shorter month of November. This declaration was disappointing, because it was at least expected to reach in value £3,000,000 and restore the gold output of the Transvaal to something approaching its normal condition. This unsatisfactory output for December shows how chronic and disastrous the scarcity of native labor has become and how difficult it will be in the present epidemic of strikes to maintain the progressive nature of the Transvaal gold output, one of its chief characteristics for the last 27 years. The total gold output for 1913 was 8,794,824 oz., valued at £37,358,040, being a decline for the year of 329,475 oz., valued at £1,399,520, when compared with the output for 1912.

Prospects for the current year are even worse. There is also the fact to be considered that the Jupiter, Cinderella Consolidated, and Treasury mines have been closed down during the year, and there does not seem any prospect of new producers taking their places. It must not be forgotten that every year sees one or more of the richer gold mines on the outcrop of the Central Rand exhausted and merged into its less profitable deeper neighbor, so that the conclusion is that the gold output of the Rand will soon reach, if it has not already reached, its maximum proportions.

DULUTH, MINNESOTA

WEATHER CONDITIONS.—INCREASING THE GRADE OF ORES.—EXPERIMENT STATION OF THE SCHOOL OF MINES.—PICKANDS-MATHER OPERATIONS.

The present cold weather has been continuous, and with the aid of a good fall of snow has made it possible for the logging contractors to get their usual quota of mining timber to the railroads, and shipments to the mines promise to be made on schedule time in spite of the late start. The cold spell has caused a great many stripping operations to cease, and the men are now employed in making repairs to the rolling stock and shovel equipment.

The subject of ore beneficiation is receiving constantly increased attention just now, and many companies are conducting experiments to determine the possibility of making a shipping grade out of their low-grade ores. These ores are a source of trouble to many mines now operating, as they are so situated as to handicap operations seriously. In the steam-shovel mines, in many cases, it is necessary to load large tonnages and haul them to lean ore dumps to get at the shipping ore, and the underground mines have to make lean ore dumps necessitating a classification of the ores sometimes into three or more products. This complicates the stockpile arrangements during the stocking season, and during the shipping season necessitates the operation of the haulage system on the stockpile in addition to loading directly from the shaft pocket into the ore cars. So, any process which can be devised to make a shipping grade of these ores will be a great benefit to mining operations, although it might not be expedient to treat the ores alone. Several mines have been obliged to suspend operations because the proportion of lean is too great to permit of profitable working. In some cases the leases are so loosely worded that there is dispute between the fee owners and operators as to the minimum grade to be handled, so the operators have closed down until an understanding can be reached and in several in-

stances the leases have been thrown up. The question of concentration involves many factors, and each case must be treated by individual investigation. The character of the ore, the percentage and locality of the phosphorus, silica, and other contents of the ore are matters which will determine the advisability of treatment, as well as the proportion of lean ore to shipping ore. Some ores will be made into high-grade bessemer ore by concentration, others will be made into high-grade non-bessemer from an apparently bessemer lean ore, while still others are not affected in grade to any appreciable extent by any process yet tried.

In this connection the Experiment Station of the Minnesota School of Mines is doing a valuable work for the state, and has just issued a bulletin, 'Preliminary Concentration Tests on Mesabi Ores,' by William R. Appleby and Edmund Newton. The bulletin describes the apparatus used in making the tests, gives working drawings, and gives the results in tabular and graphical form of a number of tests recently made for various companies and individuals. Some formulae are also given showing the relation of various results. The purpose of the station is outlined in the bulletin. It was established in the fall of 1911. Its purpose is to promote the development of the mining and mineral resources of the state to assay specimens of ores, clays, and minerals; to make such assays free of charge for private parties, subject to such regulations as the board of regents might deem necessary to make mining and metallurgical experiments in the treatment of such substances and in the utilization of mining and metallurgical by-products; to investigate the methods of mining and the use of explosives; to undertake such other mining and metallurgical problems as might seem desirable; to make all ore estimates for the tax commission and do such other work along the lines above mentioned as might be requested by other state departments. This is the second bulletin issued by the station, the first written by C. E. van Barneveld on 'Mining Methods of the Minnesota Iron Ranges' was issued last year.

The marketing of Mesabi ores involves complex calculations, and nearly all operators maintain a grading department working in conjunction with the laboratory. By combining ores of different grade from the same and different mines it is possible to ship much of the low-grade ore, and realize the higher price on it, or make a sale on ore that would otherwise be unsalable.

The Pickands-Mather company is carrying on an interesting piece of work at the Bangor mine, near Biwabik. It had a set of five boilers, of which it was necessary to keep four in constant operation to handle the water flow of 4000 gal. per minute. The boilers are being re-bricked and Toledo Model stokers installed. An extra boiler was put in at the end, making a battery of six, as it was necessary to have two boilers cold while the work of bricking-in was going on. This work has been carried on successfully without any hindrance to operations. When the brick work has been finished, and the stokers are placed, an economizer will also be installed. The stokers use slack coal, a much cheaper fuel, and it is said that the rate of steaming has also been increased by their use. This is the first installation of mechanical stokers on the range and it is likely that others will follow.

The Pickands-Mather Co. has given up its lease on the Virginia mine between Eveleth and Virginia, and has moved its shovel equipment to headquarters at the Elba mine, near Gilbert. The royalty paid on the ore was the highest ever paid on the Mesabi range, \$1.35 per ton. The reason assumed for giving up the lease is the large percentage of low-grade material necessary to be handled in removing the ore, and differences with the fee owners in interpreting the lease. The Company has stripped the property, and already removed over 300,000 tons of unsalable low-grade ore in the course of operations.

General Mining News

ALASKA

CHISANA

A well illustrated description of the Chisana goldfield has recently been published in *Bulletin 24* of the Canadian Mining Institute, Montreal, by D. D. Cairnes, of the Geological Survey of Canada. He made a trip to the new district in August of last year. The article covers the location, routes in detail, traveling expenses, previous investigations of the district, the proper name as above, topography, general geology, discovery, gold recovered, the gravels and their extent, value of the gold (\$16.10 per ounce), and the future.

ARIZONA

COCHISE COUNTY

The Shattuck-Arizona Copper Co. operates in the Warren district, and the report covers the period from August 1, 1912, to December 31, 1913. During this term the revenue from copper, gold, silver, and lead ores, etc., was \$2,562,668. Development, mining, marketing, and smelting of ores, etc., cost \$1,411,788. The net profit was \$1,150,879, out of which dividends were paid amounting to \$525,000. The net surplus at the end of 1913 was \$598,150. During the past calendar year results were as follows:

Copper ore shipped, dry tons	89,317
Copper recovered, pounds	13,219,756
Lead ore shipped, dry tons	4,874
Lead recovered, pounds	1,483,956

The ores are delivered to the Calumet & Arizona smelter, and the metals produced, are sold by Adolph Lewisohn & Sons of New York.

The general manager, Mr. Shattuck, reported that ore production has been regulated by the ability of the Calumet & Arizona new smelter to handle the Company's ores. New orebodies are being opened in the mine, which is looking excellent. Prospecting around the Shattuck fault has given

GILA COUNTY

During January, the Iron Cap mine, at Copper Hill, near Globe, produced 705 tons of ore yielding 117,309 lb. of copper, with a profit of \$7951.

PINAL COUNTY

There is considerable activity in the new goldfield at Gold Creek, near Ray, and prospecting covers a length of 2½ miles. Claims are being sold, there are arguments about overlapping claims, surveyors are marking correct lines, and blasting is heard on all sides. The country is diorite and schist. It is said that the Ray Consolidated may take an interest in the district.

CALIFORNIA

During February the San Francisco mint received 157,890 fine ounces of gold and 24,105 oz. of silver, worth \$3,277,382.69, for coinage, from all parts of California and other states. The domestic coinage was \$153,000 and \$134,000 for the Philippine Islands. The coin and bullion on hand at the end of the month was worth \$236,010,362.22, and \$136,926.50.

AMADOR COUNTY

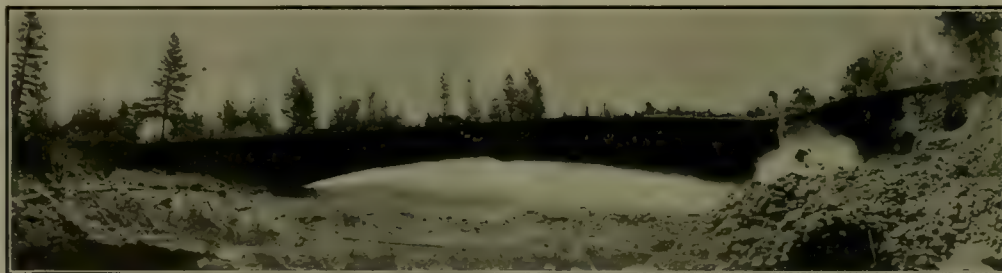
The flow of water in the Kennedy mine is about 16,000 gal. per day on the No. 36 level, this being the first water of any consequence below the 1800-ft. level. James F. Parks, superintendent of the Plymouth mine, has filed with the county recorder 14 blue-prints of the new mill, which is to be finished in 120 days from February 15, at a cost of \$27,568.

BUTTE COUNTY

The Hunter dredge, operated at Oroville by the Oro Water, Light & Power Co., is digging out a channel and making a levee or retaining wall to protect the Oroville-Marysville road, about five miles below the former town. The wall is 30 ft. high in places. This work has been under way for three weeks and will be finished in a week or so. C. G. Leeson is dredge manager for the corporation.

ELDORADO COUNTY

A 5-stamp mill has been erected by Philip Gamelo at his mine at Nashville. A large tonnage of low-grade ore has been developed at the Shaw mine, owned by San Francisco



HYDRAULICKING AT THE OLD ECHO MINE, MURPHYS, CALIFORNIA.

promising results. Two small shoots of good ore were opened on the 200-ft. level. A variety of ore, including \$30 gold ore, silver-lead ore, and copper-lead ore, has been opened on the 300-ft. level. The copper-lead ore requires careful sorting. Extensive shoots of copper ore have been opened at 400 ft. The new orebody at 500 ft. is mostly an iron ore containing 6% copper. No. 6 level produced about 50% of the ore shipped from the mine, and reserves have been maintained. A large shoot of lead carbonate ore was opened on this level, and it should yield 100,000 tons assaying \$2 gold, 2 oz. silver, and 18% lead. No. 7 level is promising, as also are No. 8 and 9 levels. Arthur Houle is superintendent of the mine. Unless arrangements are made to treat the rich lead ores produced, a lead smelter may be erected at the property.

people, headed by H. DeC. Richards. Three 10-ft. Lane mills will be installed to crush 150 tons per day.

NEVADA COUNTY

It had been reported that hydraulic mining at You Bet was being carried on in violation of the debris law, but Mr. Cheney, in charge of these matters in California, states that this is not so. It was also said that restraining dams built under government supervision on the Jerry Goodwin claims had been washed out, and the debris carried into the Bear river, and hydraulicking continued just the same.

PLACER COUNTY

A representative of the Guggenheim mining interests has made an application to the supervisors of this county for a

permit to construct a narrow-gage railroad from the Dairry Farm copper mine to Lincoln. This mine was developed at the time the San Bruno smelter was planned, and after lying idle for some years was reopened last year under lease to Newman and Beals.

PULMAS COUNTY

Rich ore is said to have been cut in the San Jose mine, a mile below Seneca. This mine is owned by Hugh Kelly. Good ore has been opened in the claims owned by Wilson and Benner on Winters creek. It is opened by an adit 150 ft. long.

SHASTA COUNTY

The new 10-stamp Straube mill at the West End mine, at Whiskeytown, is working. Previous to this all ore went to the Gambrinus mill.

SISKIYOU COUNTY

(Special Correspondence).—The Mt. Vernon mine has been taken under lease for three years by L. C. Dobbins and associates of Montana. The mine has been worked extensively in past years and is well equipped. Sinking is progressing at the Osgood mine, owned by F. H. Osgood of Seattle. The vein is widening and ore from \$20 to \$30 is being mined. A 5-stamp mill was recently placed in commission. W. Beall is superintendent. The mill at the Mono mine, near Humburg, will be started early in March. J. Joley and O. H. Poor have taken out about 100 tons of good ore. Considerable work is under way at the Big Cliff, under the management of H. B. Wintering. It is reported that a small mill will be erected during the coming summer. Work was recently resumed at the King Solomon, which is controlled by Eastern people. W. H. Young is superintendent. The Klamath River Mining Co. is operating its placer holdings above Weitchpec with 10 men. C. H. Barton is superintendent. Another attempt is being made to recover gold and platinum from the debris carried into the Klamath river by the hydraulic and placer mines. A company of Idaho people has erected a small plant near Martin's ferry, consisting of a pump, screens, canvas concentrator, and a secret contrivance.

Yreka, February 28.

TRINITY COUNTY

(Special Correspondence).—At the Golden Chest mine, in the East Fork district, 11 ft. of formation has been opened in the lower cross-cut, about 40 in. of which looks well. A drift will now be driven north on the vein to cut the main ore-shoot below the upper workings. This property has been practically closed down for several years, but has a good milling record. The further development of the orebodies should place it on the list of producers. The ore contains free gold, accompanied at times with high-grade galena which, with various tellurides, is characteristic of the district. T. J. Rochford, one of the owners, is in charge. Mr. Stofer, of Dedrick, has recently taken a lease on the property with the privilege of purchasing. He will begin active development on April 1.

Helena, February 28.

COLORADO

CLEAR CREEK COUNTY

(Special Correspondence).—A streak of very rich sylvanite 4 in. wide has been cut on No. 12 level of the Gem mine, situated on Seaton mountain. The shoot is showing in a raise for 35 feet. E. Mosher is operating under lease. Coe & Co., operating on No. 12 level east, have opened a shoot of smelting ore 5 ft. wide, and shipments made return \$30 per ton. A carload of bornite ore sent out last week from the Sun and Moon mine brought a settlement of \$5000. This property is being operated by J. P. Olsen, and a force of 20 men is at present being employed. Work will be resumed in a few days at the French Flag mine in Gilson gulch. Operations had to be suspended following the storm of last December, it being

impossible to take in fuel. Chas. H. Ripley will return from Boston in a few days to take charge of development Idaho Springs, February 18.

OURAY COUNTY

Shipments of ore and concentrate from Ouray in February totaled 1040 tons from seven properties. The Wanakah Mining Co. has secured a lease of the Brown Mountain smelter. According to the Company's manager, John T. Roberts, Jr., there is 60 days' ore on hand; but silicious ores will be accepted up to a certain tonnage. During the last quarter of 1913, the Camp Bird company had the following results:

Development, feet	1,265
Stoping, cubic feet	77,820
Broken ore in stopes, tons	14,663
Ore treated, tons	8,683
Bullion receipts	\$111,917
Concentrate receipts	82,001
Expenditure	104,453
Net profit	89,465

Development on No. 6 and 7 levels proved little of special mention.

SAN MIGUEL COUNTY

During January the Tomboy mine produced \$33,000 in bullion, \$44,000 from 1000 tons of concentrate from 11,000 tons of ore, and a profit of \$3300 from the tramway. The profit was \$30,000. Owing to snowslides, described in this journal of February 7, power and tramway operations were interrupted for two days.

TELLER COUNTY (CRIPPLE CREEK)

Details of the estimated output for February are as follows:

Plant.	Tons.	Av. value.	Gross val.
Colorado Springs:			
Golden Cycle	25,300	\$20.00	\$506,000
Portland	9,500	18.00	171,000
Denver and Pueblo smelters....	3,920	55.00	215,600
Cripple Creek:			
Portland	14,000	2.80	39,200
Stratton's	10,923	2.63	28,727
Colburn Ajax	4,000	5.00	20,000
Wild Horse	1,000	3.00	3,000
Kavanaugh-Jo Dandy	1,700	1.40	2,380
Isabella	650	3.00	1,950
Rex	300	2.40	720
Total	71,293		\$988,577

Owing to the short month and bad roads the output was lower than usual. The El Paso mine produced 2550 tons, lessees contributing 550 tons. At 1750 ft. in the No. 2 shaft of the Portland, water has caused a temporary stoppage of sinking operations. A station is to be cut at this depth.

The United Gold Mines Co. controls several subsidiary mining companies, and leases its mines at Cripple Creek. The report covers the year ended December 31, 1913. No ore was produced on company account, and the output by lessees, amounting to 20,259 tons worth \$11.36 per ton, was made up as follows:

Mines and locality.	Tonnage.	Av. value.
W. P. H., Ironclad hill.....	5,622	\$24.47
Damon, Ironclad hill.....	314	10.02
Montrose company, Ironclad hill.....	329	12.90
May B., Squaw mountain.....	214	18.38
Deadwood, Bull hill.....	1,007	9.14
Wild Horse, Bull hill.....	1,509	24.63
Requa company, Bull hill.....	350	6.40
B. H. & S. M. Co., Bull hill.....	7	5.35

The Wild Horse mill was operated under lease and treated 11,593 tons, yielding \$39,206. Charges on the ore mined were \$85,652 and \$111,111 was paid to lessees, and the royalties were \$33,539. Net profit for the Company was \$14,823.

IDAHO

LEMMI COUNTY

On March 2 the second carload of ore from the Allie mine, at Gilmore, arrived at the United States Smelting company's plant at Salt Lake City. Assays indicate that the 50 tons may be worth \$17,500. E. C. Ross, president of the Allie Mining Co., figures on a carload each month, and an exceptionally rich shipment is being prepared. The vein is 4½ ft. wide, with high gold content, while 18 in. of it is worth \$1375 per ton. On April 1, the Gilmore Mining Co., adjoining the Allie, will sink its shaft a further 200 ft., making 700 ft. on the vein. The Gilmore produced about 1000 tons of \$18 ore in February.

SHOSHONE COUNTY

Ore and concentrate shipped from 14 properties in the Coeur d'Alene in February totaled 36,714 tons. Moving pictures are to be taken of complete mining operations in the Bunker Hill & Sullivan mine. Nash Wayland, one of the electricians of the Company, is in charge of the lighting for this purpose, having installed an 8000-wp. lamp to light the stopes and other workings. The Stewart Mining Co.'s gross earnings in February were \$157,000 and net profit \$112,000, as compared with \$64,600 and \$25,300 a year ago.

The Snowstorm Mining Co. has bought a controlling interest in the Missoula Copper Co. at a cost of about \$300,000. The two mines are 1½ miles distant from one another. Charles E. Mallette, of Spokane, and Leo Greenough of the Snowstorm put the deal through.

MICHIGAN

HOUGHTON COUNTY

Considerable interest is being taken in the future treatment of 11,000,000 tons of tailing of the Tamarack company. This is said to average about 12½ lb. of copper per ton, and by grinding, about 9 lb. will be recovered. The mine is still shut down. From the Quincy 'rock' shipments are nearly 3500 tons per day. The Company will install the 'Baby Leyner' 90-lb. one-man drill in place of the old machines. There are 60 at work now and 40 more will arrive soon. The Hancock is producing 150 tons of rock, Superior 600 tons, and the Copper Range three mines from 3800 to 4000 tons per day.

MISSOURI

JASPER COUNTY

Production of zinc and lead ores from the district during the first nine weeks of 1914 was as follows:

Ores	Tons.	Av. per ton.
Blende	44,082	\$39.15
Calamine	2,754	20.98
Lead	7,628	49.57

MONTANA

MADISON COUNTY

(Special Correspondence.)—In connection with the news in this journal of February 7, of the option being taken on 20,000 acres of land near Twin Bridges, this option is to the El Oro Dredging Co. of Oroville, California. The area is about 3 by 12 miles. Land worth under \$25 for agricultural purposes is under option for \$100 per acre. Hence much joy among farmers of the district.

Twin Bridges, March 1.

SILVERBOW COUNTY

The overhead tramway from the Belmont shaft to the new steel ore-bins is ready for operation.

(Special Correspondence.)—The Anaconda Copper Mining Co. is more actively prospecting new ground now than at any time in its history. In the old silver district, west of Butte, it is unwatering the Nettie shaft, and preparing to sink deeper. East of Butte it has been sinking the Tropic shaft

and is to sink the Ella shaft on the recently acquired property of the Reins Copper Co. It is satisfying from an economic standpoint to reflect that money which formerly had to be spent in expensive wasteful mine litigation can now be put into new development. The new slime concentrating plant and the proposed leaching plant for the Anaconda smelter will mean increased population for Anaconda in the near future. Everything points to a gradual concentration of the Company's metallurgical activities at this place. The tonnage to go to Anaconda is to be materially increased, and the additional railway equipment to handle the increased tonnage on the Butte, Anaconda & Pacific railway has been ordered.

W. H. Weed's report on the Butte-Duluth, acquired by the American Metal Co., shows that 5,000,000 tons of ore has been proved by drill holes. He estimates the cost of mining and leaching 1000 tons per day at \$2 per ton.

Butte, March 1.

NEVADA

HUMBOLDT COUNTY

The first annual report of the Rochester Mines Co. shows that 14,726 tons of ore was shipped, worth \$368,770. Costs totaled \$25.04, of which lessees got \$9.79 per ton. The net profit was \$19,192. Development covered the following: trenches and open-cuts, 8160; cross-cuts, 1792; drifts, 2441; shafts, 634; raises, 730; and winzes, 165 ft. The president, J. F. Nenzel, urges the amalgamation with adjoining properties and the erection of a mill. There seems to be considerable local dissatisfaction with the control of this property.

The Seven Troughs Coalition Mining Co.'s mill is treating high-grade ore from the new shoot below No. 10 level. A canvas table has been installed to save the fine mineral which escapes from the concentrators. At 140 ft. in No. 4 winze there is 18 in. of \$594 ore. From 40 to 50 men will be employed by the end of this month.

LYON COUNTY

The Mason Valley smelter received 3556 tons of ore during the week ended March 4. Three cars of blister copper were shipped.

NYE COUNTY

The new gold and silver camp in the southeastern part of the county, discovered by Pat McAuliffe, has been named Blackthorn. It is 25 miles east of Goldfield and 3 miles west of Antelope, where is the nearest water. Prospectors are meeting with encouraging results.

The mines at Tonopah produced 10,162 tons of ore worth \$251,135 during the week ended March 7.

WHITE PINE COUNTY

An old stack, formerly used for the roasting furnaces at the McGill smelter, got into bad order until it was only 191 ft. high. It weighed about 9000 tons. On March 1, 14 holes were drilled into the base of the stack and 500 lb. of 40% dynamite exploded by electric current, and the structure demolished in good style. J. D. Watson and C. Anderson were in charge of the job. Two more McDougall roasting furnaces have been built, each of 80-ton capacity per day of concentrate. This department can treat 1440 tons per day. The last pay for 1500 men at McGill, 550 at Copper Flat, and 250 at the Veteran amounted to \$150,000, \$60,000, and \$30,000 respectively.

NEW MEXICO

SOCORRO COUNTY

(Special Correspondence.)—The Oaks Co.'s adit 'A' has entered milling ore. Other parts of the property are giving good results. At 900 ft. in the Socorro, 7 ft. of ore is being mined, and 180 tons milled daily. This shoot has been persistent for 1400 ft. below the apex of the vein on the incline. The Maud's shaft is 700 ft. deep. No. 3 level in the Deadwood has cut the south orebody. The mill is working full time. The Pacific shaft is 70 ft. below No. 3 level, where the vein

is 7 ft. wide assaying \$14 per ton. Some rich ore is being mined from a 10 ft. slope below the 250-ft. level. About 35 tons is shipped per day to the custom mill.

Mogollon, February 23.

OREGON

BAKER COUNTY

A suit was recently brought by a number of farmers on Rock creek, who alleged that 'refuse and chemicals' discharged into the stream from the Highland mine made the water unfit for drinking purposes; also when the water was used for irrigation purposes a cement-like coating was left on the sides and bottoms of ditches, which eventually killed all vegetation. A temporary restraining order was granted several weeks ago, and the farmers are now trying to have the order made permanent. The Baker Commercial Club had almost arbitrated satisfactorily, when a difference arose, and the case went to the circuit court, Judge Anderson presiding. He has now made a permanent restraining order against the Highland company, which will not be allowed to pollute Rock and Maxwell creeks. This can be done without much inconvenience, according to the court.

TEXAS

BRAZORIA COUNTY

(Special Correspondence.)—A new electric power-plant is to be erected at the Freeport Sulphur Co.'s mines at Bryan Heights, and will also supply the town of Freeport. A new superheated water plant is also to be installed at the mines. The electric plant will consist of a 200-kw. Westinghouse steam turbine direct connected to a generator. Power will be used for pumping water from the canal, fuel oil from storage tanks on the ship canal to the mines, the machine shop, and all purposes in Freeport. The station will be installed by the Westinghouse, Church Kerr & Co. of New York, in connection with the other new \$125,000 equipment now being put in at the mines by the sulphur company. The new sulphur conveyor and loading devices installed by the Company at the Seaboard & Gulf Steamship pier on the Freeport ship channel, which has a capacity of 3600 tons per day for loading vessels with sulphur, is now completed, and ready for operation. It is expected that the first shipload of sulphur to be loaded and shipped from this port, will leave here on one of the Seaboard & Gulf Steamship Co.'s boats within a few weeks. A new loading equipment for handling this product at the mines has also recently been installed and is now in operation. It consists of a Brown hoist, with a loading capacity of 30 carloads of sulphur per day. With a railroad at the mines, and loading equipment at both the mines and at tidewater now built and in operation, the shipment of considerable tonnage of sulphur from Texas' only sulphur mines is expected for 1914. The present daily output is 200 tons of sulphur.

Freeport, February 21.

UTAH

JACOB COUNTY

The Eagle & Blue Bell company will pay 5c. per share on April 1, amounting to \$44,657. Since the beginning of 1913, the total dividends are \$223,286.

SUMMIT COUNTY

The state of Utah is building a new capitol at Salt Lake City, and for a colonnade there will be 52 monoliths 31½ ft. high, 47 in. diameter, weighing 30 tons each. It was decided to use Utah granite, and a contract was let to the Consolidated Stone Co. for 165,000 cu. ft., costing \$610,000. This Company has a quarry at Wasatch in the Little Cottonwood cañon. The monoliths were to be 11 pieces each, but this quarry can supply them in single pieces. A recent blast brought down 300,000 cu. ft. of granite, more than twice the amount required for the capitol's outside walls and monoliths. One piece was 46 by 54 by 98 ft. in dimension. A spur line is

being laid to the quarry, also a 50-ton crane and planing machine are to be installed. It is estimated that a finished monolith can be produced each week.

The annual report of the Silver King Consolidated Mining Co. shows that dividends in 1913 totaled \$308,791. Cash assets stand at \$384,859. Practically all litigation is ended. In sinking the shaft 500 ft. to the 1800-ft. level, the cost was \$46,700. Development during the 3½ months ended February 25, 1914, covered 2280 feet. From 1537 ft. of work near the shaft 1326 tons of \$41.34 ore was mined, also 2100 tons of 10 oz. silver, 5% lead, and some gold and copper ore.

As mentioned in this Journal of last week, the Grasselli zinc plant near Park City has changed ownership, and under the management of George H. Scribner, the mill will be overhauled to receive custom ores from the district. Local capital is to finance the concern.

The Snake Creek tunnel was driven 275 ft. in February, and is now in 7000 feet. The flow of water is about 5500 gal. per minute. At present, with two shifts, 12 to 14 ft. per day is the advance, the face being fairly dry and requiring no timbering.

UTAH COUNTY

Assays of ore from the Santaquin King recently gave from 4.7 to 20.6 oz. silver and 40.5 to 70.9% lead. A block of ore containing 8000 tons of \$30 to \$35 ore is being prepared for mining.

WASHINGTON

Mining companies operating in the Coeur d'Alene of Idaho, and in British Columbia, and contiguous to Spokane, will pay the following dividends in March: Granby, \$225,000; Federal, \$180,000; Stewart, \$154,795; Hercules, \$100,000; Consolidated, \$116,088; Bunker Hill, \$81,750; Standard, \$50,000; International Coke, \$30,000; and Hecla, \$20,000; a total of \$957,638.

KITITAS COUNTY

(Special Correspondence.)—Ore has been opened in the old Bigney placer claim, at Liberty, which was recently acquired by William Johnson. It was supposed to have been worked out, but during the past two weeks three men have averaged about \$50 per day. The gold is mostly coarse, one nugget being worth \$43. The Bigney claim was famous as a producer about 12 years ago, when it produced over \$200,000. The recent discovery was made on the south channel, and will mean a general revival of work along Williams creek, where there are some good claims. Martin Meagher, owner of the Fraction claim adjoining the Bigney, has arrived here. He has some men prospecting the ground south of the old workings. Jack Stuart is sinking an incline in his claim, but bedrock has not been reached yet. He reports fair prospects in the blue gravel. There is considerable good placer ground here which has been scarcely worked at all, on account of lack of drainage. The Williams Creek claim-owners have been successful because they cut a drain through seven claims. These produced about \$600,000. Claim-owners on Lyons creek, which empties into Williams creek, are figuring on joining the Williams drain about half way, and so drain their properties, which, if done, will likely open some valuable ground. Prospecting on Lyons creek has been encouraging, and nuggets worth \$30 have been found. In prospecting the Beckman placer, owned by Mrs. A. Robinson, a good deal of fine and some coarse gold has been found. E. M. Wells has installed a gas-engine, pump, and hoist on his placer claim. Mr. McCauley, of Ellensburg, has bought a half interest in the Taft quartz claim from Amos Jordan. Liberty, February 15.

Placer mining near Liberty is at times yielding nuggets worth from \$32 to \$62. Livingston Bros., M. Enecks, Nelson and Stevens, and Powers and Sugars are all busy at their claims. The latter are now sluicing. Johnson recovered \$126 from 7 yd. of pay.

Personal

P. R. BRADLEY will leave for Juneau this week.

EDMUND JESSEN was at Coulterville last week.

HOWARD D. SMITH was at Santa Barbara Monday.

SAMNER S. SMITH has left Juneau for Chisana and Fairbanks.

C. T. HUTCHINSON has been visiting the oilfields of California.

D. M. FIELD is with the Rio Arriba Co., at Tusas, New Mexico.

H. W. REED has returned to Salt Lake City from Long Beach, California.

GUY A. R. LEWINGTON has gone into the oil business, and will not return to Dawson.

ARTHUR L. WALKER has returned to New York from the South, having recovered his health.

JAMES IRVING has just returned to Los Angeles from a week's trip through Mohave county, Arizona.

L. F. S. HOLLAND is examining mines in Arizona and expects to return to Los Angeles about March 21.

F. H. HATCH is in the Kirkland Lake district, Ontario, where he is inspecting the Tough-Oakes mine.

A. W. STICKNEY, of Cambridge, Massachusetts, has gone to Kyshtimsky Zavod, Perm Government, Russia.

H. L. HUSTON has removed his office from the Mills to the Alaska Commercial building in San Francisco.

R. B. LAMB sailed on the *Lusitania* on March 11, for London, England, where he will remain for two months.

L. N. PARKS has been transferred from Jenny Lind to Yreka, where he is superintending the work of the Butte Dredging Company.

E. C. MORSE has resigned from the San Poil Consolidated Co., at Republic, Washington, and is at his home at Portland, Oregon.

J. S. ICKIS, field geologist for S. Pearson's Sons, Ltd., of London, is making a trip of observation through the Midway oilfields of California.

T. SKEWES SAUNDERS, superintendent of the Teziutlan Copper Co., Puebla, Mexico, has gone to England, as the property is shut down until the revolution ends.

A. W. GATES has retired as general manager for the Utah Ore Sampling Co., and intends to go into business at Salt Lake City; he is succeeded by F. M. Mansen, of Goldfield, Nevada, formerly associated with the Western Ore Purchasing Company.

Obituary

JAMES B. COOPER, superintendent of the smelting department of the Calumet & Hecla, died at Hubbell, Michigan, February 6. He had been in the service of the Company for many years and had been an important factor in building up the reputation of Lake copper for purity and uniformity of grade. Born within the limits of what is now Detroit, in 1859, he obtained his education in the public schools and the University of Rochester. His professional career included service in the old smelter at Hancock, Michigan, the Parrott plant at Bridgeport, Connecticut, and the Calumet & Hecla plants at Hubbell and Buffalo. His father, James R. Cooper, was a smelter before him and he grew up with a fondness for the art which led him to throw his whole energy into its development, and with notable success.

Society Meetings

MARCH

Name.	Date.
Canadian Mining Institute	Montreal.... 4-6
American Institute of Electrical Engineers.....	12
Institution of Mining and Metallurgy....	London.... 19
Old Freibergers.....	Hofbrau, New York.... 25

APRIL

American Chemical Society	8-11
American Institute of Electrical Engineers	10
American Electro-Chemical Society	16-18
Institution of Mining and Metallurgy....	London.... 16

MAY

Mining and Metallurgical Society...San Francisco....	4
National Fire Protection Association	5-7
American Iron and Steel Institute	22
Institution of Mining and Metallurgy....	London.... 21

JUNE

American Institute of Electrical Engineers	22 or 26
American Society for Testing Materials	23-27
Society for the Promotion of Engineering Education	29 to July 2
American Society of Mechanical Engineers.....	end of June
Franklin Institute	Philadelphia.... end of June

AUGUST

American Institute of Mining Engineers.....	
.....	Salt Lake City.... 10-14

SEPTEMBER

American Institute of Electrical Engineers.....	not fixed
American Chemical Society	9-12

OCTOBER

American Institute of Electrical Engineers.....	9
American Iron and Steel Institute	23-24

NOVEMBER

American Institute of Electrical Engineers	13
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DECEMBER

American Society of Mechanical Engineers	7-8
Society of Gas Lighting (annual meeting).....	10
Society of Naval Architects	11-12
American Institute of Electrical Engineers	11
American Museum of Safety	11-20
Geological Society of America	30-31

Schools and Colleges

THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY reports that Henry Tschetschott, professor at the St. Petersburg Mining Institute, is registered at the 'Tech' for special work. The Russian government requires teachers with a broad view for its schools, and is sending students to foreign colleges, in case of mining.

THE COLORADO SCHOOL OF MINES, at Golden, will open a course on coal mining, for the benefit of coal mine employees, on April 1, ending on May 27. It will cover mathematics, mechanics and drawing, chemistry, geology, and mining. There will be no fees for instruction, only text books and material consumed will be charged, the total expense being about \$5. Wm. G. Haldane is acting president.

The Metal Markets

LOCAL METAL PRICES

San Francisco, March 12

Antimony	9 — 9½c
Electrolytic copper	15½—15¾c
Pig lead	4.25—5.20c
Quicksilver (flask)	\$38.50
Tin	42½—44 c
Spelter	6¼—6¾c
Zinc dust, 100 kg. zinc-lined cases, 7½ to 8c. per pound.	

EASTERN METAL MARKET

(By wire from New York.)

NEW YORK, March 12.—The metal market is dull. Copper is still dropping and is weak at 14 cents. Greene Cananea February yield was 2,282,000 pounds. The British Columbia Copper Co. shows a deficit of \$442,600 for 1913, after paying dividends. Lead shows practically no change for five weeks and is quiet; so is spelter, which is a trifle lower than last week. Prices at St. Louis are 3.90 and 5.15c, respectively. London prices are copper, £63 15s. to £64 5s.; lead, £20; spelter, £21 10s.; and tin, £173 10s. to £175 7s. 6d. Tin in New York is 37.85 to 38.62½c. Bar silver in London and New York is 26¼d. and 58¾c respectively. Gold in London was up to 77s.9¾d. per ounce standard last week, the highest for 3½ years.

SILVER

Below are given the average New York quotations in cents per ounce, of fine silver.

Date.	Average week ending.
Mch. 5.....	58.50
" 6.....	58.25
" 7.....	58.25
" 8 Sunday.....	58.12
" 9.....	58.12
" 10.....	58.12
" 11.....	58.12
Monthly averages.	
Jan. 1913.	1914.
Jan. 63.01	57.58
Feb. 61.25	57.53
Mch. 57.87	.....
Apr. 59.26	.....
May 60.21	.....
June 59.03	.....
Average week ending.	
Jan. 28.....	57.60
Feb. 4.....	57.46
" 11.....	57.54
" 18.....	57.37
" 25.....	57.53
Mch. 4.....	57.72
" 11.....	58.23
Average week ending.	
Jan. 28.....	58.70
Feb. 4.....	59.32
" 11.....	60.53
" 18.....	60.88
" 25.....	58.76
Mch. 4.....	57.73
" 11.....	.....

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.	Average week ending
Mch. 5.....	4.00
" 6.....	4.00
" 7.....	4.00
" 8 Sunday.....	4.00
" 9.....	4.00
" 10.....	4.00
" 11.....	4.00
Monthly averages.	
Jan. 1913.	1914.
Jan. 4.28	4.11
Feb. 4.33	4.02
Mch. 4.32	.....
Apr. 4.36	.....
May 4.34	.....
June 4.33	.....
Average week ending.	
Jan. 28.....	4.10
Feb. 4.....	4.15
" 11.....	4.00
" 18.....	4.00
" 25.....	4.00
Mch. 4.....	4.00
" 11.....	4.00
Average week ending.	
Jan. 28.....	4.35
Feb. 4.....	4.60
" 11.....	4.70
" 18.....	4.37
" 25.....	4.16
Mch. 4.....	4.02
" 11.....	.....

COPPER

Quotations on copper as published in this column represent average wholesale transactions on the New York market and refer to electrolytic copper. Lake copper commands normally 1-5 to 1-4c. per lb. more. Prices are in cents per pound.

Date.	Average week ending
Mch. 5.....	14.10
" 6.....	14.10
" 7.....	14.05
" 8 Sunday.....	14.00
" 9.....	14.00
" 10.....	14.00
" 11.....	14.00
Monthly averages.	
Jan. 1913.	1914.
Jan. 16.54	14.21
Feb. 14.93	14.46
Mch. 14.72	.....
Apr. 15.22	.....
May 15.42	.....
June 14.71	.....
Average week ending.	
Jan. 28.....	14.35
Feb. 4.....	14.59
" 11.....	14.64
" 18.....	14.55
" 25.....	14.34
Mch. 4.....	14.22
" 11.....	14.04
Average week ending.	
Jan. 28.....	14.21
Feb. 4.....	15.42
" 11.....	16.23
" 18.....	16.31
" 25.....	15.08
Mch. 4.....	14.25
" 11.....	.....

Buying in the New York market was light last week and the metal sagged nearly half a cent per pound. Exports during the last two days of February were unusually large and will bring the total for the month to over 77,000,000 lb. The

visible copper supply in England, France and afloat there to March 1 was 18,559 tons, an increase of 1329 tons in the past fortnight. Visible supplies at Rotterdam, Hamburg, and Bremen on March 1 were 8424 tons, a decrease of 198 tons since February 16; supplies at Rotterdam decreased 100 tons, at Hamburg decreased 31 tons, at Bremen 7 tons. Consumers here evidently expect prices to go lower, while the agencies are still hopeful of a better market soon.

QUICKSILVER

The primary market for quicksilver is San Francisco, California, being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending	Feb. 26.....	1913.	1914.
Feb. 12.....	39.00	39.00	39.00
" 19.....	39.00	38.58	38.58
Monthly averages.			
Jan. 1913.	1914.	July 1913.	1914.
Jan. 39.37	39.25	July 41.00	.....
Feb. 41.00	39.00	Aug. 40.50	.....
Mch. 40.25	.....	Sept. 39.70	.....
Apr. 41.00	.....	Oct. 39.37	.....
May 40.25	.....	Nov. 39.40	.....
June 41.00	.....	Dec. 40.00	.....

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date.	Average week ending
Mch. 5.....	5.13
" 6.....	5.13
" 7.....	5.13
" 8 Sunday.....	5.13
" 9.....	5.13
" 10.....	5.13
" 11.....	5.13
Monthly averages.	
Jan. 1913.	1914.
Jan. 6.88	5.14
Feb. 6.13	5.22
Mch. 5.94	.....
Apr. 5.52	.....
May 5.23	.....
June 5.00	.....
Average week ending.	
Jan. 28.....	5.20
Feb. 4.....	5.25
" 11.....	5.25
" 18.....	5.25
" 25.....	5.20
Mch. 4.....	5.15
" 11.....	5.13
Average week ending.	
Jan. 28.....	5.11
Feb. 4.....	5.51
" 11.....	5.55
" 18.....	5.55
" 25.....	5.22
Mch. 4.....	5.09
" 11.....	5.07

TIN

New York prices control in the American market for tin, since the metal is almost entirely imported. San Francisco quotations average about 5c. per lb. higher. Below are given average monthly New York quotations, in cents per pound:

Monthly averages.					
1913.		1914.		1913.	
Jan.	50.45	37.85	July	40.70	1914
Feb.	49.07	39.76	Aug.	41.75	
Mch.	46.95	...	Sept.	42.45	
Apr.	49.00	...	Oct.	40.61	
May	49.10	...	Nov.	39.77	
June	45.10	...	Dec.	37.57	

COPPER PRODUCERS' ASSOCIATION REPORT

The Copper Producers' Association statement, March 9, shows a decrease in production and stocks on hand. The details are as follows:

Pounds.	Increase.	Decrease.
Stocks of marketable copper of all kinds on hand at all points in the United States, February 10, 1914.	87,296,685	.....
Production of marketable copper in the United States from all domestic and foreign sources during February	122,561,000	.....
Deliveries for consumption, February	47,586,657	.....
Deliveries for export, February	83,999,183	.....
Stock of marketable copper of all kinds on hand and at all points in the U. S., March 2	78,371,852	.....
Recent changes in surplus have been as follows, in pounds:		
February 1913	896,134	.....
March	18,032,928	.....
April	28,720,162	.....
May	8,074,883	.....
June	14,569,619	.....
July	690,330	.....
August	15,280,908	.....
September	8,531,043	.....
October	2,773,288	.....
November	15,363,047	.....
December	43,509,438	.....
January 1914	4,142,182	.....
February	8,924,933	.....

The Stock Markets

SAN FRANCISCO STOCKS AND BONDS

(San Francisco Stock and Bond Exchange.)

BONDS

March 11.

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Associated Oil Co.	97 1/2	98	Natomas Consol. Co.	—	26
Unlisted.			Pac. Port. Cement Co.	100	—
Ass. Oil Co.	77 1/2	83 1/2	Santa Cruz Cement Co.	85	90
General Petroleum Co.	42	45	Union Oil	—	88

STOCKS

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Amalgamated Oil	—	86 1/2	General Petroleum	4 1/2	—
Associated Oil	41 1/2	41 1/2	Noble Electric Steel	5	—
E. I. du Pont pfd.	—	90	Natomas Consol.	50c	—
Giant	83	86	Pac. Port. Cement	—	82 1/2
Pac. Port. Borax, pfd.	70	—	Riverside Cement	60	65
Pacific Crude Oil	—	30c	Santa Cruz Cement	50	58
Sterling O. & D.	1 1/2	—	Stand. Port. Cement	30	—

NEVADA STOCKS

(By courtesy of San Francisco Stock Exchange.)

March 12.

Atlanta	23	Montana-Tonopah	99
Belcher	60	Nevada Hills	36
Belmont	7.75	North Star	38
Con. Virginia	22	Ophir	58
Florence	85	Pittsburg Silver Peak	33
Goldfield Con.	1.77	Round Mountain	38
Goldfield Oro	13	Sierra Nevada	118
Halifax	80	Tonopah Extension	1.67
Jim Butler	1.07	Tonopah Merger	57
Jumbo Extension	29	Tonopah of Nevada	7.00
MacNamara	98	Union	16
Mexican	1.10	Victor	31
Midway	37	West End	90
Mirzapah Extension	47	Yellow Jacket	55

CALIFORNIA STOCKS

(Latest Quotations.)

Bid.	Ask.	Bid.	Ask.
Argonaut	\$2.75	Central Eureka	\$0.65
Brunswick Con.	\$1.05	South Eureka	2.00
Bunker Hill	1.90		

COPPER SHARES—BOSTON

(By courtesy of J. C. Wilson, Mills Building.)

March 12.

Bid	Ask	Bid	Ask
Alouez	40 1/2	Mohawk	44
Ariz. Commercial	54	Nevada Con.	15 1/2
Butte & Superior	344	North Butte	27
Calumet & Arizona	66 1/2	Old Dominion	49 1/2
Calumet & Hecla	420	Osceola	78
Copper Range	38	Quincy	62
Daly West	2 1/2	Shannon	64
East Butte	11 1/2	Superior & Boston	2 1/2
Franklin	6 1/2	Tamarack	30 1/2
Granby	84 1/2	U. S. Smelting, com.	40
Greene Cananea	35	Utah Con.	10 1/2
Isle-Royale	20 1/2	Winona	4 1/2
Mass Copper	2 1/2	Wolverine	46

NEW YORK CURB QUOTATIONS

(By courtesy of E. F. Hutton & Co., Kohl Building.)

March 11.

Bid.	Ask.	Bid.	Ask.
Braden Copper	8	Mason Valley	3
Braden Co.	160	McKinley-Dar.	1 1/2
B. C. Copper	1 1/2	Mines Co. Am.	2 1/2
Con. Cop. Mines	2 1/2	Nipissing	6 1/2
Davis-Daly	1 1/2	Ohio Copper	1 1/2
Ely Con.	4	San Toy	15c
First National	2 1/2	Stand. Oil of Cal.	3 1/2
Giroux	1	Tri Bullion	3 1/2
Hollinger	16	Tuolumne	1 1/2
Iron Blossom	1 1/2	United Cop. com.	1 1/2
Kerr Lake	4 1/2	Yukon Gold	3
La Rose	1 1/2		

NEW YORK STOCK EXCHANGE

(By courtesy of J. C. Wilson, Mills Building.)

March 12.

Bid	Ask	Bid	Ask
Amalgamated	73 1/2	Miami	22 1/2
Anaconda	35 1/2	Nevada Con.	16
A. S. & R. com.	67	Quicksilver, com.	1 1/2
Calif. Pet. com.	20 1/2	Ray Con.	20 1/2
Chino	40 1/2	Tenn. Copper	34 1/2
Guggenheim Ex.	64 1/2	U. S. Steel, pfd.	109 1/2
Inspiration	17	U. S. Steel, com.	63 1/2
Mexican Pet. com.	67 1/2	Utah Copper	53 1/2

LONDON QUOTATIONS

(By cable, through the courtesy of Catlin & Powell Co.,

New York.)

March 12.

£	s.	d.	£	s.	d.
Alaska Mexican	1	7	6	Kern River Oilfields	0
Alaska Treadwell	8	5	0	Mexico Mines	5
Alaska United	3	2	8	Messina	1
Arizona	2	0	0	Oroville	0
California Oilfields	8	6	3	Pacific Oilfields	0
Camp Bird	0	12	6	Rio Tinto	69
Cobalt Townsite	2	10	0	Santa Gertrudis	0
El Oro	0	15	0	Tanganyika	2
Esperanza	0	18	9	Tomboy	1
Granville	0	10	0		3

AUSTRALASIAN

March 12.

£	s.	d.	£	s.	d.
British Broken Hill	2	2	6	Mount Elliott	3
Broken Hill Prop.	2	0	0	Mount Lyell	1
Golden Horse-Shoe	2	12	6	Mount Morgan	3
Great Boulder Prop.	0	15	0	Waihi	2
Ivanhoe	2	13	9	Waihi Grand Junc.	1
Kalgurli	1	17	6	Zinc Corporation, Ord.	1
Mount Boppy	0	12	6		2

Production of Spelter in the United States

The final figures of the United States Geological Survey for the year 1913, collected by C. E. Siebenthal, are as below, all quantities being stated in tons of 2000 lb.

PRODUCTION OF PRIMARY SPELTER¹ IN THE UNITED STATES,

APPORTIONED ACCORDING TO SOURCE OF ORE

United States:	1912.	1913.
Arizona	4,092	3,152
Arkansas	604	478
California	1,672	2,535
Colorado	60,841	58,113
Idaho	6,800	10,190
Illinois	3,952	1,345
Kansas	5,668	9,956
Kentucky	394	172
Missouri	149,557	129,018
Montana	14,196	35,756
Nevada	6,132	5,828
New Jersey	16,941	24,247
New Mexico	6,882	3,765
Oklahoma	2,041	6,397
Tennessee	1,935	2,635
Texas	245	303
Utah	7,756	9,503
Virginia	62	116
Wisconsin	34,137	33,743

Total domestic	323,907	337,252
Foreign:		
Canada	4,199	1,424
Mexico	10,700	6,205
Europe		1,175
Siberia		620
Total foreign	14,999	9,424
Grand total	338,906	346,676

APPORTIONED ACCORDING TO LOCALITY IN WHICH SMELTED

Illinois	88,397	106,654
Kansas	101,104	74,406
Oklahoma	76,925	83,214
Other states	72,380	82,702
Total	338,806	346,676

Primary spelter is made directly from ore, but secondary spelter is recovered from such sources as drosses, skimmings, and old metals.

The statistics, representing final figures, show production of primary spelter in the United States amounting to 346,676 tons, an increase of 7870 tons, or 2.3%, over the corresponding figures for 1912. At the same time the American consumption increased 13.2%, while the world's production only grew 3.1%. The preliminary estimates furnished by the Survey and printed in the *Mining and Scientific Press* for January 3, were within one-third of one per cent of these final figures.

PRODUCTION OF SECONDARY ZINC IN THE UNITED STATES

	1912.	1913.
Secondary spelter, redistilled	26,064	26,491
Secondary spelter, remelted	26,187	23,000
Recovered zinc in alloys, excluding old brass remelted	3,912	23,600

Subject to final revision.

WORLD'S PRODUCTION OF SPELTER

Locality in which smelted:	1912.	1913.
Australia	2,531	4,105
Austria and Italy	21,609	23,856
Belgium	220,678	217,941
France and Spain.....	79,543	78,293
Germany	298,794	311,914
Great Britain	63,086	65,201
Holland	26,380	26,313
Norway	8,959	19,040
Poland	9,659	9,520
United States	338,806	346,676

Total	1,070,045	1,103,359
United States' percentage of world's production	31.7	31.4

Subject to final revision.

CONSUMPTION OF PRIMARY SPELTER IN THE UNITED STATES

Supply:	1912.	1913.
Stock, Jan. 1—		
In bonded warehouses	32	48
At smelters	9,049	4,474
Production—		
From domestic ore.....	323,907	337,252
From foreign ore.....	14,899	9,424
Imports	11,115	6,100

Total available	359,002	357,298
Withdrawn:		
Exports, foreign, from warehouse...	6,286	6,027
Exports, foreign, under drawback...	1,188	7,459
Exports, domestic	6,634	7,783
Stock, Dec. 31—		
In bonded warehouses.....	48	.....
At smelters	4,474	40,659
Total withdrawn	18,383	61,928

Apparent consumption	340,372	295,370
----------------------------	---------	---------

Imports and exports of spelter are given under the heading 'Consumption.' The imports of spelter in 1909-1913 are as given in the December Summary of the Bureau of Foreign and Domestic Commerce except that for 1909-1912 inclusive

the quantities given therein have been diminished by the quantity of zinc dust imported since August 6, 1909, for the reason that the imports of spelter and zinc dust were not separated in the Summary. The imports of spelter are also exclusive of sheet zinc. The stock in bonded warehouses does not include zinc ore in bond or the spelter made therefrom, such spelter being included in stock at smelters.

IMPORTS OF ZINC ORE, 1904-1913

	Canada— Zinc Ore. content.	Mexico— Zinc Ore. content.	Total— Zinc Ore. content.
1904 .....	.....	2,264	2,264
1905	1,063	18,074	22,137
1906	423	59,991	55,414
1907	1,112	102,005	103,117
1908	7,406	46,351	53,757
1909	10,024	104,826	114,850
1910	4,749	1,922 67,818	23,517 72,626
1911	2,359	947 36,847	14,986 39,116
1912	8,015	3,661 35,925	14,206 43,940
1913	8,357	3,280 18,018	6,377 31,416

* Includes also 3232 tons of ore from Europe, containing 2440 tons of zinc, and 1792 tons from Siberia, containing 1397 tons of zinc.

Exports of domestic zinc ore in 1912 amounted to 23,349 tons and to 17,713 in 1913. Imports for the two years were as follows: 1912—Canada, ore 8015, zinc content 3661; Mexico, ore 35,925, zinc content 14,206; total, 43,940 tons ore, 17,567 tons zinc content. 1913—Canada, 3357 ore, 3280 zinc content; Mexico, 18,018 ore, 6377 zinc content; totals, 31,416 and 13,497.

Metal Output of the Daly-Judge Mine

This property is at Park City, Utah, and in 1913, 4954 tons of ore was sold, and 48,943 tons concentrated, with the following results:

	Crude ore.	Concentrate.	Zinc middling.
Tonnage of products...	4954	11,909	3719
Silver per ton, ounces...	38.29	29.10	20.04
Gold per ton, ounces...	0.036	0.032	0.017
Lead, per cent	21.72	27.85	4.61
Copper, per cent	1.86	1.08	.....
Zinc, per cent	14.28	13.85	38.22
Iron, per cent	8.12	18.48	7.92
Revenue, per ton	\$32.08	\$29.91	\$19.57

Output.	1913.	To date.
Silver, ounces	611,378	4,457,506
Gold, ounces	619	10,434
Lead, pounds	9,128,078	95,971,888
Zinc, pounds	7,678,589	69,323,069
Copper, pounds	407,242	2,127,652
Revenue	\$588,940	\$4,932,618

DIVIDENDS paid by the 'porphyry' copper mines to date are as follows:

Chino	\$ 2,564,000
Miami	2,979,999
Nevada Consolidated	15,477,000
Ray	2,175,600
Utah Copper	22,217,000

SEVEN DREDGES are attacking the Cucaracha slide in the Culebra cut, Panama. The slide appears to be in slight motion right across to its farthest break, 1832 ft. from the canal centre line. About 1,500,000 cu. yd. or more will have to be removed before the slide ceases to menace the channel.

THE pig iron production of Belgium in 1913 amounted to 2,466,700 metric tons, as compared with 2,298,010 metric tons in 1912.

Recent Patents

1,074,234.—**ALLOY OF ZINC.** Thomas Abraham Bayliss, Warwick, England, assignor of one-half to Byron George Clark, London, England.

A malleable alloy composed of zinc, aluminum, and lead, in proportions between the limits of zinc 99.1%-99.9%; aluminum 0.001%-0.5%; and lead 0.01%-0.9%.

1,074,282.—**APPARATUS FOR THE TREATMENT OF ORES.** George Mitchell, Los Angeles, Cal.

In a combined smelting and converting furnace, the combination of an elongated furnace chamber having a smelting hearth therein and an opening in its bottom adjacent the hearth, a removable converter section and means carried by the truck for lifting and lowering and tilting said converter section.

1,074,410.—**AMALGAMATOR.** Lloyd Oscar Crocker, Beatrice, Neb.

An amalgamator comprising a rim provided with an annular compartment having a cross section bounded by an involute curve, a revoluble table carrying said rim and extending into said compartment, said revoluble table being in the form of a plane substantially tangential to a portion of greatest curvature of said wall, means for turning said rim and said table, and mechanism for discharging ore and water upon said table.

1,074,274.—**APPARATUS FOR EXTRACTING METALS FROM ORES.** Henry S. MacKay, Riverside, Cal., assignor to MacKay Copper Process Co., Riverside, Cal., a corporation of Arizona.

In an apparatus for the extraction of metal from ore the combination of two electrolyzing vats having anode and cathode compartments for containing the electrodes and fluids, the anode and cathode compartments of one vat being connected with the same compartments of the other vat, means for mixing the fluids produced in the anode compartments of the said vats, a leaching means to bring the ore and the said mixed fluids into contact, a third precipitating vat adapted to receive the solution from the said leaching means.

1,074,400.—**PROCESS FOR TREATING PEAT, SLIME, AND LIKE SUBSTANCES.** Gustav Wolters, Weltmar, near Bochum, Germany.

A process of treating peat, slime, and like vegetable substances of a high degree of humidity, consisting in forcing the substance into a chamber, comprising a plurality of communicating compartments, passing the substances successively from one compartment to another through said chamber, supplying heat to the off-take end of said chamber, and causing the vapors generated in the chamber from the substance to pass successively from one compartment to the other through the substance toward the intake end of the chamber, the pressure and temperature in the successive compartments increasing toward the off-take end of the chamber.

1,074,218.—**FUSE DEVICE.** Albert E. Simmons, Sacramento, Cal.

A fuse device of the character described, comprising a substantially vertically arranged outer casing, formed of insulating material, metallic conductor elements connected with the upper and lower ends of the outer casing, a fuse wire disposed within the outer casing, means electrically connecting the fuse wire with the upper metallic conductor element, a gravity operated rod connected with the lower end of the fuse wire, means electrically connecting the gravity operated rod with the lower metallic conductor element, and a cap disposed exteriorly of and adjacent the lower end of the outer casing and detachably connected with the gravity operated rod to drop with the same when it is released.

Industrial Progress

THE NATIONAL TUBE CO. is now ready to distribute the booklet on 'N. T. C. Regrinding Valves' announced some months since.

THE A. S. CAMERON STEAM PUMP WORKS announces the opening of a branch office and warehouse in the city of Philadelphia, Commercial Trust Building, under the management of Phil Weiss.

THE ELECTRIC WEIGHING CO. has issued a brief description of the special applications of electric conveyor scales (Messiter patents) to automatic tonnage control and automatic mixing.

THE HARDINGE CONICAL MILL CO. announces that its London office, which has now been opened just one year, received in its twelfth month orders for nine 'Hardinge Conical Mills,' for shipment into Russia alone.

THE WESTERN ELECTRIC CO. reports sales for 1913 amounting to \$78,000,000, equivalent to an increase of 8% over the business in 1912. As telephones and telephone supplies go to all classes of people this is a good index to the general business of the country.

HEALDS ENGINEERING SCHOOL has added to its working equipment a complete working model for fine grinding and cyanidation of gold and silver ores. Among other apparatus included may be mentioned a Butters filter, Pachuca agitators, and vacuum and pressure pumps as needed.

GEORGE A. GALLINGER, of Pittsburgh, has been placed in charge of the Pneumatic Tool Department of the Ingersoll-Rand Co. with the title of Manager of Pneumatic Tool Sales. His headquarters will be at 11 Broadway, New York City. After an experience of 12 years in developing a general line of pneumatic tools the Ingersoll-Rand Co. felt warranted in establishing this special department. Mr. Gallinger's time and service are at the disposal of those contemplating the use of pneumatic tools.

HARRON, RICKARD & McCONE announce that at the meeting of the stockholders held February 8, the following officers of the corporation were elected: H. L. Terwilliger, president; H. G. Mitchell, first vice president; George O. Orr, secretary; E. H. Law, assistant secretary. The new president Mr. Terwilliger has been a member of the firm for several years and is advanced from the position of first vice president to that left vacant by the death of Mr. Harron. The business will be conducted along the same lines as before.

A NON-SKIMMING CRUCIBLE



The illustration herewith will show a new crucible which has been evolved by Henry Weisbrodt, an employee of the Joseph Dixon Crucible Co., to be used by melters of precious metals. It has been designed to do away with skimming, and also the possible chance of charcoal or molten fluxes getting into the ingot or casting. This crucible has a bridge at the top, which, on pouring the metal, holds back the charcoal and foreign matter, and so delivers clean metal. This new design does not in any way reduce the holding capacity of the crucible, and the metal can be stirred satisfactorily as in a regular crucible.

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EDITORIAL

TROUBLE is brewing for the smeltersmen in Utah since the radical element has captured the Farmers' Association, and filing of additional damage suits is threatened.

A NEW argument advanced by an enthusiastic land boomer is that fruit-growers in a certain area are absolutely protected from scale by the fumes from a neighboring smelter. This illustrates the importance of the point of view.

THE Colorado Supreme Court has handed down a decision to the effect that assessors in determining the gross output of a mine shall deduct transportation and treatment charges. In Colorado, for purposes of taxation, mines are valued at 50 per cent of the gross output, plus all the net. In addition the value of site and equipment are taken into account.

FIGURES collected by the Customs Service show that in 1913 more people came out of Alaska than went into the territory, the departures being 25,798 and the arrivals 24,672. This is likely to be the last year that the current runs outward, since the building of the railroads, already authorized by Congress, and the opening of the reserved lands seems certain to lead to rapid and substantial development.

A CORRECTION is called for in regard to the description of the battery frame adopted at the Tightner mine and described in our columns March 7. This was inadvertently stated to be made of cast steel in place of cast iron. The latter material was purposely chosen, since weight and stiffness were desired rather than strength. There are no great strains on the posts, though vibration is naturally important. Weight and rigidity are therefore more important than toughness.

IN accordance with our plan of publishing reviews of the year's work in various countries at the time that reliable data are available, we print this week a summary of mining in Peru in 1913, written by Mr. Lester W. Strauss, a practising engineer living at Lima and thoroughly acquainted with the matters of which he writes, by first-hand information. Mr. Strauss is just now visiting various mining districts in Chile, and we shall present later notes and comments upon mining in that country as seen by him.

SETTLEMENT out of court has been effected in the suit of the Merrill Metallurgical Company against the Ajax Mining Company for infringement of patent rights in connection with the use of zinc dust for precipitation. Mr. E. A. Colburn has published a letter stating that, having examined the patents involved, he is now satisfied as to the infringement and has therefore made settlement. The mill will operate hereafter under license from the Merrill company and will adopt some slight changes advised by the latter.

CALIFORNIA mine operators, manufacturers, transportation men, and employers of labor in many branches of trade, as well as representatives of laboring men, met the Industrial Accident Commission in a 'Safety First' conference at the Palace hotel on March 13. It was brought out that there were 823 deaths and 36,462 industrial accidents in the state in 1913, and that a considerable portion were preventable. The safety department now being organized by the Commission is charged with the duty of pointing out ways to decrease the number of accidents, and it was evident from the serious tone of those present at the conference that it will meet with wide and ready coöperation.

DECISION has been rendered in the United States Court of Appeals for the Third District, in the case of *Tonopah Mining Company versus Joseph A. Vincent* on appeal, involving the question of infringement of the Brown patents by the Tonopah company. The court held that, without passing upon the validity of the patent, it was sufficient to hold that the defendants do not infringe. The case was accordingly reversed and remanded to the lower court with instructions to dismiss the bill for non-infringement. Lack of space prevents printing the full text of the decision at this time, but in general it was held that use of concentrating as an intermediate process was in any event not an infringement of patents covering cyanidation followed by concentration.

WISCONSIN, which has led in so many political and educational reforms, is not unwilling to follow where the example is good. Some years ago the University of Illinois, impressed with the excellent results of the Agricultural Experiment Stations, organized an Engineering Experiment Station, which has been a large factor in the subsequent improvement in mining and manufacturing processes, and the general engineering work in that state. Similar stations have since been established elsewhere, and now the University of Wisconsin announces that all the work of testing and research along engineering lines conducted at the University will be consolidated under an Engineering Experiment Station staff. We are glad to see this emphasis placed on such work, as we believe thoroughly that it is as much the function of the University to teach the state as to teach the

citizens-to-be of the state, and that the best service of science and technology should be always available to the state government.

SENTENCES of six years in the federal penitentiary at Atlanta, Georgia, have been announced against Messrs. A. L. Wisner and John J. Meyers, found guilty of using the mails to defraud in connection with the sale of worthless mining and oil company stocks. It is an anomaly that in this country punishment is less commonly for fraud than for some such incidental matter as using the mails for fraudulent schemes. Welcome as the results are, it is a serious question whether the law does not become a joke when it is necessary to send dynamiters to prison for having conspired to transport dynamite on an interstate passenger train, because it is impossible to jail them for blowing up buildings and killing or attempting to kill men and women. To a layman it would look as if the prevalent custom of leaving law-making mainly to young lawyers who go to the legislature as a polite and ethical form of advertising, has its drawbacks.

Zinc Ore in the Electric Furnace

This is a subject on which there has been much experimental work and even more discussion, and it is but fair to say that the attitude of mind of most of the metallurgical fraternity is distinctly skeptical of immediate or even remote success. Recently Mr. W. McA. Johnson has claimed to have succeeded in putting zinc smelting in the electric furnace upon a practicable basis, and as a consequence keen interest has been taken in the results being secured in his experimental plant at Hartford, Connecticut. In January about 17 tons of zinc ore from Colorado was there smelted and the records have been given wide publicity. They are interesting enough to justify closer analysis, however, since they are by far the most significant data on electric zinc smelting which have yet been made public. The best results, covering a period of seven days, correspond to a recovery of 88.4 per cent of the zinc present, with a power consumption of approximately 2.7 kilowatt-hours per pound of spelter produced. The power consumption, however, should be credited with the base bullion and the copper in the matte produced, and on this basis the power consumption was about 2.2 kilowatt-hours per pound of metal. It should be noted in this connection that the blue powder and skimmings produced are charged back into the same furnace without any record of their weight affecting the data, so that the figures for power consumption are actual, not fictitious figures which take no account of the re-treatment of by-products. The amount of cold seconds thus rehandled is about 20 per cent of the spelter produced. Electrode consumption is given as two to three pounds per ton of ore smelted.

The greatest care is required in the preparatory pre-heating in which the necessary reduction is effected

preceding the simple fusion in the electric furnace. This does not involve any novelties of practice, however, and should not cost over \$2 or \$3 per ton in commercial work. On the basis of cost, therefore, smelting in this way seems entirely practicable. Innumerable difficulties cannot possibly be foreseen until trial is made under actual working conditions, and it is therefore possible that this new method will not prove as successful as its advocates think, but the results so far attained are highly encouraging and of great interest.

Mining Law Revision

Bills have been introduced in both the Senate and the House at Washington providing for opening to entry the withdrawn lands supposed to contain coal, petroleum, potash, and phosphate. The area affected amounts to 323,000,000 acres in addition to lands in the National Forests and Alaska. A special act covering the Alaska coal lands is already under consideration. The bills introduced are considered to be Administration measures, and follow the lines proposed by Mr. Franklin K. Lane in his annual report, which we have already discussed. In general they provide for a leasing system, the ground to be allotted in blocks materially larger than under the old fee basis, and in the case of oil with exclusive prospecting permits and other advantages to those who undertake development of new territory. We are glad to see some definite steps taken toward opening the reserved lands, and the general lines of the policy proposed have our hearty approval. The new law will not apply to mineral lands in general, and it will still be necessary to get a general revision of the mining law. Clearly, lands which show such evidence of the presence of coal, oil, potash, phosphate, or other minerals as to warrant their withdrawal, stand in a different category from the public domain in general and in which the presence or absence of mineral cannot be positively known in advance of prospecting.

There is perhaps reason for framing a separate law to govern such lands, but the more important matter is the general revision of the mining law proposed in Senate bill 4373. Piecemeal revision has led to most of the difficulties of the past, as when the placer law was extended to cover oil lands regardless of the difference in the character of the deposits. A thorough and systematic revision of the mining law is needed, and, as we have pointed out, the new code should be prepared by men familiar both with the existing law and present practice in the field. It is, we think, entirely feasible to establish a leasing system such as outlined, and to apply it to withdrawn lands and non-metallic minerals, and still leave the old law largely intact, to cover the public domain in general. The old law, however, needs change in many important particulars, as has been pointed out by committees from the American Mining Congress, the Mining and Metallurgical Society, and the American Institute of

Mining Engineers. The needful step now is the constitution of a suitable code commission to hold hearings and report to Congress next year. This commission should include mining men as well as lawyers, and we urge those interested to impress this fact on their representatives at Washington.

Presentation of the M. and M. Medal

The presentation of the gold medal of the Mining and Metallurgical Society of America to Mr. and Mrs. H. C. Hoover was made at a dinner, March 9, at the Biltmore hotel, New York. Nearly one hundred members of the Society and Institute were present. Mr. J. F. Kemp, the president of the Society, was the toastmaster. Following the dinner, Mr. Kemp, in one of his characteristic happy speeches, emphasized that the presentation of the medal was to Mrs. Hoover as much as to Mr. Hoover, and that therefore the toast to the ladies should, for that evening, take precedence of all others. Mr. Sidney J. Jennings, responding to the toast, carried along the same vein of thought in a very graceful speech. Mr. T. B. Stearns was then called on and in an interesting talk emphasized the linking of the West and the East, in which Mr. and Mrs. Hoover are typical of the cosmopolitanism of the mining profession. Mr. Kemp then presented the medal, congratulating the Society, as well as the recipients, on the fact that the first medal of the Society was given for work of the highest scholarship, coming from a profession that is too much regarded as one of the most materialistic. Mr. Hoover, in responding, carried on the same line of thought, pointing out that miners have played a larger part in the development of civilization than is commonly awarded them, the mines of Greece having been largely responsible for the flowering of Greek civilization, and the self-governing mining communities of central Europe, Cornwall, and Derbyshire having been powerful influences in the development of representative government. After the dinner an opportunity was afforded to those present to see the medal, which has on its obverse a woman's figure, lighted by a miner's candlestick, engaged in breaking down a wall of rock which typifies ignorance and superstition. A most attractive feature of the dinner was the souvenir program, made up of illustrations so selected from 'De Re Metallica' as to illustrate the labors of Mr. and Mrs. Hoover in translating the book. From the first, marked 'Ye Hooverses jumppe ye antiquas of ye anciente manne Agricola,' to the last where 'Ye Hooverses menne refine ye golde and ye silver, ye Hoovere, himself, weigheth ye bullion, ye Hoovere will later putte ye bullion in ye bank for ye othere Hoovere to spende,' the selection was most happy. The program was compiled by Mr. E. G. Spilsbury, chairman of the dinner committee, to whom, with his assistants, Messrs. L. D. Huntton and D. M. Riordan, a large share of the credit for a most successful and enjoyable evening are due.

Mining in Peru in 1913

By LESTER W. STRAUSS

The most important features in the mineral industry in Peru last year were the increase in oil production, and, to a lesser degree, of gold from the vein mines. No new business of magnitude was taken up, although increasing interest was displayed in the mineral possibilities, particularly as regards gold.

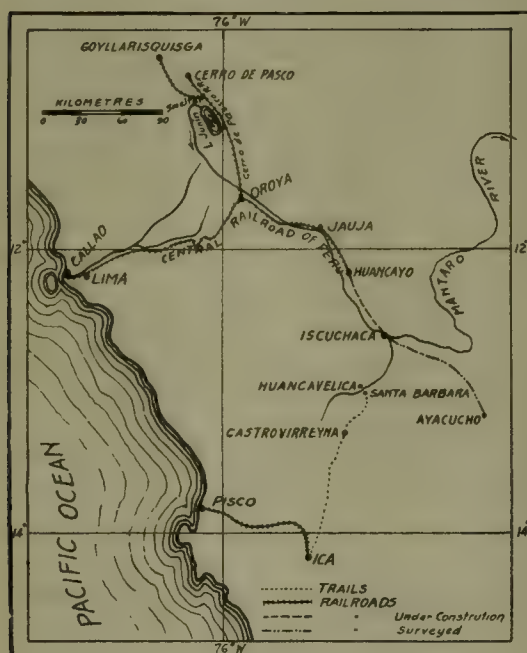
Copper Mines and Smelters

According to the statistics of Aron Hirsch & Sohn, the production was 27,500 tons (metric), as compared with 27,400 tons in 1912. (In 1903, 9500 tons was produced.) The year 1914 will mark the beginning of in-

fitted with three Stirling boilers to utilize the waste gases; the economy effected has shown a credit of about £1000 per month. The three Dwight-Lloyd sinterers have given splendid results and four additional machines will be put into commission; the average individual capacity on ores containing 22% sulphur is 80 tons per 24 hr., while with ores containing 40% sulphur the capacity decreases to 45 tons. The omission of lime in the ore fed, has tended toward slightly lower operating costs. The shortage of locally made coke decreased the smelting capacity, although in one month 35,000 tons of ore was treated. With the increased output from the Quishuarcancha coal mine, now averaging 250 tons per day since the railroad branch has been opened for traffic, the utilization of the waste gases from the reverberatories, and the introduction of electric power transmitted from the recently completed 12,000 hp. hydro-electric plant at Oroya (119 kilometres to the south), there will probably be no coal famine for the washing and coking plant at the smelter.

New Power Plant

The electric plant is said to have cost over \$1,000,000 erected. It is expected to reduce power costs, not only at the smelter and mines, but also for the Morococha Mining Co. (a subsidiary company of the Cerro de Pasco Mining Co.) at Morococha (25 kilometres westward from Oroya). The latter company contributed over 6000 tons monthly to the smelter, although the mines controlled are only at the developing stage at present. Surveys were made for a railroad line that



MAP OF CENTRAL PERU.

creased copper production, the result of the improvements in smelting capacity made by the Cerro de Pasco Mining Co. and the Backus & Johnston Co., which concerns are responsible for 44,830,107 lb. and 10,341,120 lb. of copper, respectively, produced in 1913. The latter company shipped 8,071,000 lb. matte and 2,270,120 lb. ore. Several small smelting plants and mines contributed the remaining 5,428,793 pounds.

The Cerro de Pasco Mining Co. did not operate under full capacity, only three of the four blast-furnaces (which are now between 70 and 80 in. wide at the tuyeres) and three of the five reverberatories being in commission. Two Smith-Pierce basic lined converters are now in service; a third is to be installed soon. One of the reverberatory furnaces has been



CERRO DE PASCO SMELTER AT LA FUNDICION.

would tap the Cerro de Pasco railroad and avoid the present circuitous haul over the Central Railroad of Peru to Oroya, but no further steps were taken; it appears that the ruling grade was not favorable for the economies that were anticipated.

In addition to the Morococha tonnage, and that produced by its own mines, the Cerro de Pasco Mining



AREQUIPA, CHIEF CITY OF SOUTHERN PERU.

Co. purchased considerable custom ore: the Docena mine in Cerro de Pasco contributed about 200 tons per day; other outside properties did not ship as heavily.

After spending four years in reorganization and reconstruction, involving marked steps in the improvement of its treatment plant as well as mining operations, the Backus & Johnston Co. is meeting with profitable results. The foresight, energy, and ability of the late J. Howard Johnston (who was the president and largest shareholder of the Company at the time of his sudden death in May) are directly responsible for the rescue of the business from apparent bankruptcy. The £100,000 loan made early in the year, to cancel the obligation of a large creditor, is now being retired, the first £2000 bonds recalled having been paid on December 31. The smelter is essentially a silver-copper plant and produced 1,950,000 oz. of silver in 1913. The silver ores from the Casapalca mines, as well as the custom ores obtained in the region, are dependent in a measure upon the Morococha mines which supply the necessary iron, as well as copper and silver.

The new hydro-electric plant of 2000 hp. effective (6 kilometres below Casapalca, at Bellavista) has been in service since November. In consequence the converting plant, consisting of two stands of 96 by 150-in. barrel converters (capacity 30 tons of copper per 24 hours each) and Nordberg blowing engine, has been tried out with satisfactory results. The year 1914 will mark the production of blister copper; a shipment from the trial run has been exported. The new 160 by 52-in. blast-furnace was also blown in; the old one, after four years of hard service, having been put out of commission for necessary repairs and changes, will be blown in soon. The monthly smelting capacity will probably be about 12,000 tons of raw and sintered products. The sintering plant now consists of 29 pots and the success of these has made the smelting difficulties decidedly less worrisome. The concentrating mill

will be enlarged to handle 250 tons per day. The entire electric plant is not yet in use, but meanwhile all arrangements are being made to extend the line to the Company's Morococha properties and to replace the more expensive steam-power plants. Oil has been replacing coal as the fuel during the transition stage.

The Compañía Minera del Carmen and Compañía Minera de Huarochiri, operating in the Casapalca district, ship considerable argentiferous ores to the Backus & Johnston smelter. The former company is driving a long cross-cut, using electric drills, that is expected to cut the Carmen vein within 2200 metres. This will serve to explore the veins of the district at the lowest level attempted as yet. The latter company ships its high-grade ruby-silver ores to Europe, the lower grade being sent to the Casapalca smelter.

Morococha Mines

The Morococha district is attaining considerable importance as a producer, and will be a large factor in contributing to the copper, and to a lesser degree, to the silver production of Peru. The vigorous campaign of development planned by the two principal producers, the Backus & Johnston Co. and the Morococha Mining Co., has barely begun, yet the combined monthly output of the two companies under present conditions is over 12,000 tons, including the ore from



SMELTER AT CASAPALCA.



CALLAO HARBOR, PORT OF ENTRY FOR LIMA.

the numerous properties leased by the former company. Most of the custom ore shipped is sent to Casapalca. A small, privately controlled furnace is operating in the district, having sintering pots as an important feature, and ships about 50 to 60 tons of copper matte monthly to the Cerro de Pasco smelter; the source of ore is from small producers. The plant is undoubtedly the highest operating smelter in the world, being 15,000 ft. above sea-level.

E. E. Fernandini's smelter at Huaracaca, near the Cerro de Pasco plant, treats about 3000 tons of argentiferous ores with a low copper content (less than 2%), sufficient however to make matte that assays 1300 oz. silver and 50% copper. The silver ores come from the Colquijirca mine (close to the Cerro de Pasco smelter), which has been recently equipped with electric haulage and a 20-drill air-compressor. The copper ore is from the Cerro de Pasco mines of E. E. Fernandini. The production for the year was over 1,700,000 oz. silver and 1,100,000 lb. copper as matte.

Of the smaller producing copper mines the Sociedad Minera Quiruvilca, Ltd., in the Department of Libertad, is the most important shipper, averaging about 100 to 150 tons of 35% copper ore (with slight gold and silver content) per month, which goes to the United States. In the Department of Cajamarca, the Compañía Minera Sayapullo, Ltd., which is negotiating for the sale of its properties, has been smelting spasmodically in its 30-ton water-jacket furnace at the rate of ten tons of ore per day (anthracite coal is the fuel). The resulting matte (averaging 36% copper, 170 oz. silver, and 2 oz. gold) is shipped to Europe. The Company has thus been enabled to pay some old debts as well as the interest on its bonds.

Southward, in the Department of Ancash, the Empresa Minera San Juan, Ltd., of Tarica, is obtaining better results with its 15-ton smelter; the matte exported averages about 35% copper and 300 oz. silver, with a little gold. Anthracite coal is employed in smelting. In the same department, the Magistral properties, belonging to Garaborri y Compañía, have been optioned to local people who intend to develop the property. Anthracite coal has been used in past operations in the 30-ton brick furnace; the matte production has been small. At Vinchos, near Cerro de Pasco, the Yanamina Mining Co. has recently blown in a 30-ton furnace which will smelt copper and silver-lead ores; the matte will be shipped to Cerro de Pasco.

Of the properties that have been developed, the Ferrobamba mines were inactive the past year; the region was recently reported on by a commission from the Cuerpo de Ingenieros, which states that the average grade of mineral is under 4% copper. The French syndicate that purchased the properties, now known as the Sociedad Cuivre de Huaron, near Huallay (35 miles from Cerro de Pasco), has met with favorable results in development; over 100,000 tons of ore, said to average 12% copper, is in sight, but no shipments of ore are to be made as the erection of a smelting plant is under consideration. Coking coal is obtainable close by. Considerable exploration was done on the Cobriza copper claims, in the Province of Tayacaja, but no work has been carried on since May. The Empresa Minera de Huallanca, controlling silver-copper mines at Huallanca (125 miles northwest of Cerro de Pasco), has been optioned to a French syndicate.

Lack of adequate transport, and its high cost, handicaps the development of the copper possibilities of Peru. Under certain conditions local smelting could be made a profitable business.

Gold Ores and Mines

Much outside interest has been taken in the development of the gold industry, although this continues to be unimportant if no regard is taken of the gold derived from copper and, to a less degree, from lead ores. Activities in vein mining are increasing, although no large properties are in operation, while the placers are, as yet, smaller producers.

The largest producing property is that of the New Chuquitambo Gold Mines, Ltd., six miles below Cerro de Pasco. The production for the year ending November 1913, was 114.34 kg. (nearly 3700 oz.) of bullion (over 900 fine), which represents a recovery of 65% to 70% effected by amalgamation from the treatment of 80 to 100 tons of ore per day in the 40-stamp mill; 140 men are employed in the mine and mill. The cyanide plant, erected to treat the tailing that is being stacked up after leaving the amalgamation plates, no concentration being attempted, has been abandoned due to the small amount of copper present.

The Cotabambas Auraria, at Cochasyhuas, in the Department of Apurimac, has increased its production since the cyanide plant for coarse sand has been in operation. The December output was expected to be about £3000 of bullion. The present 10-stamp mill,



ATICO, PROPOSED HARBOR FOR THE FERROBAMBO MINE.

one Huntington mill, and two Ferrarris tables, treating 16 tons of sorted ore per day, is to be increased with 40 additional stamps and a cyanide plant of adequate capacity, so that 100 tons can be milled per 24 hours. An aerial tramway will probably be erected, and a vigorous development campaign on the veins will be commenced.

Another probable increasing producer is the Sociedad Aurifera Andaray Poseo, in the Department of Arequipa. The present plant consists of two Lane mills. Only one is in operation and is said to handle 20 tons per day, the recovery by amalgamation (stated to be 50%) varying from £500 to £800 per month. The new cyanide plant, ordered as the result of tests which showed a 90% extraction, is expected to arrive in January and will treat from 40 to 60 tons per day.

In the Department of Puno, the Santo Domingo mine, of the Inca Mining Co., with a past record of £700,000 production, has been optioned to an Argentine syndicate for £120,000. Some development work is being carried on and the tailing dump of previous operations, said to contain over 50,000 tons, is being treated on a small scale. The Montebello property, distant six miles, has been optioned by the same people. Both properties may form the basis for the flotation of a new company. The Benditani property, adjoining the Santo Domingo mine, will be developed by the Sociedad Minera Benditani, Ltd.

Near Nazca, in the Department of Ica, a one-foot vein, averaging over 7 oz. gold and 5% copper, when sorted, is being developed; the property lacks water for milling. In the Potaz district, Department of Ancash, the Potaz-Parcoy Syndicate, Ltd. (now known as the Peruvian Consolidated Gold Trust, Ltd.), has been developing the several veins controlled; 100 men have been at work. In the Buldibuyo district, 15 miles away, some development is being carried on; a 3.5 ft. Hardinge ball mill has been erected to treat the oxide ores.

The production from the alluvial deposits is still small, disregarding that resulting from the native washings. The only company that has operated continuously and profitably is the Compañia Aurifera Argentina-Peruana, at Viscachani, Department of Puno. In the same province, the Aporoma Goldfields, Ltd., has not been as successful as was anticipated. On account of the lack of water, operations were very limited. About £25,000 is needed for an additional

ditch line, according to the Company's statements, that would permit bringing in sufficient water "to wash at least 10,000 cu. yd. per day." The 42,500 cu. yd. washed, during the initial working, showed a recovery of 7.3d. per cubic yard.

In the same vicinity a California syndicate has been investigating an extensive territory, upon which dredging operations are likely to be adopted if the preliminary work continues to be satisfactory; 30 tons of drilling machinery was taken to the field. The transport of dredge machinery will involve the building of a railroad. 'Pot hole' washing was attempted on a tributary of the Inambari river, with some success. A French syndicate is said to have taken an option on dredging ground in the Poto district. The Ambo Gold Mines Co., which was formed to exploit extensive alluvial ground on the Huallaga river, two days horseback ride from Cerro de Pasco, has been inactive since May as the result of an examination which indicated the value of the gravel to be \$0.45 per cu. yd., as compared with \$6 per cu. yd. in the earlier samplings. It is believed that gold chloride and shavings played an important role in the latter returns, having been presumably introduced when the samples were in transit from the property to the assayers. Recently a New York syndicate has formed the Peruvian Exploration Co., to exploit 1117 acres on the Marañon river (four days horseback ride from Cerro de Pasco); \$300,000 has been raised and it is expected that operations will commence by March 1915, using giants capable of handling 25,000 cu. yd. per day. The river will be diverted, in sections, to permit washing. There is stated to be 131,150,840 cu. yd. available, averaging \$0.809 per cu. yd. Near the Ecuador border investigations have been made for a London syndicate; this ground is said to be suitable for dredging. Native washings have been carried on for years in the region.

Silver Mining and Milling

The usual percentage of the silver exported is 'tied up' in blister copper, matte, and ores, also in lead bars, ores, and slags, and a small amount of silver ores of exceptional high content. The production of silver bullion from pan amalgamation and sulphides from lixiviation form a small percentage of the silver output. Cyaniding is not being done at any property, but the process will soon be adopted at Caylloma. Peru ranks sixth among the silver producing countries.

The most important silver property, other than those which ship argentiferous copper or lead products or ores, is the Sociedad Explotadora de Caylloma, in the Department of Arequipa. The work for the year was restricted to the development of the San Cristobal vein and the driving of a drainage adit for the mine, which will be nearly two kilometres in length: this is expected to be finished in March and make available considerable ore. In anticipation of this result a concentrating and cyaniding mill, of 100 tons capacity per day, will be erected and ready for operation early in 1915. The San Cristobal vein, which is the largest in the property, has been opened up for 300 metres, vertical depth, and averages 10 metres in width. The existing narrow gauge railway between the mines and the mill, 12 kilometres long, will serve for the transport of the ore. During the year only the sorted ore from the development and preparatory work in the San Cristobal mine was exported, amounting to 250 tons containing 60,000 oz. of fine silver. No ore was milled, as the old concentrating mill was closed down. The Santa Inés mines, in the Department of Huancavelica, continued to produce silver bullion at the rate of 150,000 oz. per annum. The pan-amalgamation plant treats 20 tons of run-of-mine ore per day, the tailing being now stacked for future treatment. There are numerous lixiviating plants scattered over the country, but principally in the Departments of Junin and Ancashs, which contribute 10% of the total silver produced. Near Cerro de Pasco the patio process is still in vogue for the oxidized silver ores that are being extracted by the natives from the old Spanish open-cuts. The Anglo French Ticipampira Silver Mining Co. in the district of Recuay, Department of Ancashs produces the largest amount of silver sulphides in Peru. This is treated by lixiviation. High-grade silver-copper ore is also shipped abroad.

Lead and Minor Metals

The lead industry continues unimportant as regards production, although the year will probably show the largest output, in view of the high price of the metal. The Yauli district, in the Department of Junin, is still the heaviest argentiferous lead ore exporter. There are two small lead furnaces, which ship lead bars containing much silver (over 1000 oz. per ton), in the Department of Ancashs—otherwise no lead smelting is carried on in Peru. Only one lead concentrating plant exists; this is on the Central Railroad of Peru close to the town of Yauli. Considerable lead slag, the remains of the early Spanish silver smelters, was exported.

The province of Pallasca, in the Department of Ancashs, is the only producing source of tungsten. Three companies are active, but two have not yet reached their anticipated production, because the milling plants are still uncompleted. The total monthly shipments are said to be 30 tons of concentrate averaging 60%. The San Gregorio property of E. E. Fernandini, near his smelter, is the only producer of bismuth. Shipments amounting to 200 tons of concentrate, averaging 20% bismuth, were made. The output is limited

by the trust. The exportations from the Minasragna deposits, of the American Vanadium Co. (30 miles from Cerro de Pasco), have been limited, because of the restriction of output. The interest displayed in coal containing vanadium has fallen off in view of the low prices quoted for the vanadiferous ash. The Santa Barbara mercury deposits, in the Department of Huancavelica, continue to be worked in a small way, the output being consumed at the Santa Inés plant and in the patio process near Cerro de Pasco. Deposits of tin of importance were reported to exist in the Departments of Lima and Libertad, but official or reliable confirmation is lacking.

Non-Metallic Minerals

Of the non-metallic products, petroleum occupies the first position. Coal production, as yet, is chiefly that from the Cerro de Pasco Co.'s mines, and is increasing. Borax will become an important product, according to the plans of the Borax Consolidated, Ltd. The exploration work of possible nitrate ground has not resulted in discovery of deposits likely to produce largely.

The oil industry, confined to northern Peru, continues to increase in production as well as importance; the output for 1913 will be over 2,000,000 bbl. Prices have been higher in view of the increasing appreciation of the high-grade benzine petroleum that is produced. The entry of the Standard Oil Co., as the controlling factor in the various companies, has brought the fields into more prominence. Drilling the deep sands, the wells being over 3000 ft. deep, has given profitable results in most cases. The Government continues to withhold oil lands from denouncement.

The coal industry is practically confined to the output of the Cerro de Pasco mines (for coke and power purposes), as lack of transport facilities prohibits shipments to the coast. Considerable coal and coke (about 100,000 tons) is imported annually. The Government has withdrawn several regions from denouncement, with the intention to interest foreign capital in the respective coals and thereby create a stimulus for building railroads.

The deposits of borax near Arequipa (in the department of that name), which are owned by the Borax Consolidated, Ltd., will be actively exploited in view of the concession granted by the Government, that exempts the product from any duty for 18 years, commencing from the date the Company begins to export at the rate of 20,000 metric tons of calcined borax. The export tax contemplated by the Chilean government on the calcined borax, may cause a decline of the operations of the Borax Consolidated, Ltd. in that country. Chile contributes 75% of the world's production. Investigations of supposed nitrate fields commenced in 1912, in the Department of Arequipa, were abandoned early in 1913, as the region examined did not cover nitrate of economic value. Mention has recently been made of a discovery of 500 acres of 9% nitrate ground in the Department of Libertad, but no data as to the tonnage are obtainable.

The Globe Mining District, Arizona²

By WILLIAM L. TAYLOR

Disseminated Sulphide Impregnations in Fracture Zones

The main representative of this type is the Miami-Inspiration deposit. It constituted apparently a single and continuous orebody at one time, later disrupted by faults. It consists of disseminated iron-copper sulphides in a brecciated zone of Pinal schist with intruded tongues of granite-porphry (Schultze granite). Its economic importance is at present limited to the horizon of secondary sulphide enrichment (chalcocite zone). The Miami Copper Co. holds the richest and thickest part of the orebody, but is exceeded in tonnage by the lower grade ore of the Inspiration company.

The Keystone has a smaller faulted part of the orebody between the Live Oak and Inspiration parts of the Inspiration Consolidated Copper Co.'s ground, and the Southwestern Miami is drilling on the western fringe and has reported chalcocite ore from several holes. Exact information is not given out, but it seems that the ore is capped by about 1000 ft. of overburden, and is rather low in grade. The total tonnage developed thus far is about 20,000,000 tons of 2½% ore for the Miami, 45,000,000 tons of 2% ore for the Inspiration, 2,500,000 tons of 2¼% ore for the Keystone, and perhaps 70,000,000 tons altogether. Still farther west the South Live Oak has reported ore in two holes out of a total of eight drilled, but it is not impossible that the ore reported occurred along steep and narrow veins rather than in a body similar to the Miami-Inspiration.

Claims to possibility for ore are put forward by the owners of the Barney, Needles, and Inspiration Extension groups, and hundreds of claims in the vicinity are held for good luck. It is rather difficult to delimit the possibilities from surface indications, as strong overthrust faults and recent covering by dacite and Gila conglomerate obliterate the original structure. Three holes were drilled on the Barney group while an option was held by the Miami people. The result was negative as far as can be learned and the option allowed to lapse. In this connection it is interesting to note how tremendously a piece of mountain side with no mineral whatever in sight increases in value simply by posting of location notices and making a few shallow cuts in Gila conglomerate or similarly promising formations, for the prices asked by the owners range from \$100,000 up to nearly \$1,000,000 for anything in what they consider to be in the 'schist-belt.'

A wonderful outcrop several miles farther west on Pinto creek inspired exploration work by the Cactus company. Some ore, at one time reported 2,500,000

tons, was found, but the Company collapsed and it is almost impossible to decide whether the failure was due to the physical condition of the property or to other reasons.

While prospecting has been carried on almost exclusively to the west of the Miami mine, the chances for an extension of the orebody to the southeast seem fair in my opinion, because the ore does not terminate by a gradual playing out, but is broken off by a fault close to its strongest development. The covering of Gila conglomerate on the downthrown side might possibly amount to several thousand feet, and as it stretches unbroken from here to Globe and the Pinals it is hardly attractive for exploration work aside from other factors that militate against it, such as water problems.

The Miami part of the district has been described several times, and rather exhaustively. Therefore I shall touch on it but briefly. The ore occurs as impregnations or in small interlinked veinlets in a zone of brecciated schist and porphyry. It is pyrite partly replaced by chalcocite. Sericite is a nearly constant accessory mineral. Kaolinization and sometimes chloritization has locally gone far. As sills of Schultze granite participate in the mineralization, it must be later or contemporaneous with that eruption. The surface indications are an intense reddish stain of iron oxide and sometimes a vivid green coloring by chrysocolla, but the local experience seems to be that the iron, rather than the copper stain marks the presence of ore.

Irregular Metasomatic Bodies of Secondary Ore

The Black-Warrior and Geneva mines work on orebodies that have been formed by a gradual penetration and replacement by chrysocolla of dacite, resting on an irregular erosion surface of Pinal schist. As mentioned before, the ore is wholly secondary and probably derived from the erosion of parts of the Inspiration orebody. Outside of chrysocolla, manganese oxide is prominent in these replacement zones. The minerals are sometimes found in kernels of concentric layers, but usually show no well defined structure. The dacite begins to show coloring at the ends of these orebodies and gradually changes to a soft crumbling material, very hygroscopic and stained black or greenish brown. The outlines of the original constituents are preserved, but the quartz generally has disappeared.

The orebodies are very irregular in outline and usually much bigger in horizontal than vertical extent. Similar in derivation are the 'copper conglomerates' of Gold gulch, where recent creek gravels cemented by limonite, chrysocolla, and copper pitch have

²Continued from *Mining and Scientific Press*, p. 449.

furnished commercial ore, though as yet only on a small scale.

Lastly, but not related to this type, I might mention two contact deposits near the Continental mine where Schultze granite approaches Devonian limestone. Strong magnetite and grossularite outcrops contain some very good copper ore (chalcocite, malachite, azurite, and chrysocolla), but the development work done thus far has not disclosed encouraging indications below. A 'white magnetic iron,' probably pyrrhotite, was reported to occur here in depth but this could not be verified.

Mineralogy of the Ore

The deposits of the district are remarkably poor in gangue minerals. Of course vein quartz occurs but only seldom in quantity or good crystals. Calcite is next in frequency, while dolomite and siderite are rare, and rhodochrosite was observed at the Cole & Goodwin mine only. Hematite, especially the micaceous variety, is frequent and in consequence also limonite. Ilmenite crystals of macroscopic size were seen in one locality. The ore minerals proper are: pyrite, chalcopyrite, bornite, enargite, chalcocite, cuprite, native copper, azurite, malachite, chrysocolla, brochantite, chalcantite, melanochalcite, copper pitch, sphalerite, goslarite, galena, cerussite, wulfenite, vanadinite, cuprodeseloizite, argentite, cerargyrite, silver bromide, native silver, hübnerite, and native gold.

In the district at large are found well developed crystals of orthoclase (Carlsbad twinning), muscovite, and tourmalin, the last only in very small individuals. Magnetite and garnet (grossularite) occur in contact zones near the Continental mine. Asbestos (probably fibrous serpentine) in small quantities is found as an alteration in limestone in the Old Dominion mine, also in good fibres up to two inches in length in the Apache mountains.

Genesis of the Ores

Since granite-porphyry sills participate in the primary mineralization at Miami and copper veins occur through the granite-porphyry (Schultze granite) area, there can be no doubt but that the mineralization here occurred later than, and most likely in consequence of, this eruption. The not very clear relation in this district seems to establish the Schultze granite as later than the diabase, therefore the Miami-Inspiration orebody and the veins in Schultze granite must be considerably later than the diabase intrusion.

In 1902 when F. L. Ransome wrote his admirable report on this district, the Miami orebody had not been discovered and Mr. Ransome considered the Schultze granite as part of the pre-Cambrian granitic eruption. In explaining the genesis of the ores, he naturally considered the diabase as the cause of the ore deposition, being the only Mesozoic eruptive of importance, according to his then theory. Since then the age of the Schultze granite has been established beyond a doubt at Ray, as I am informed, and in this district porphyry dikes cutting the diabase have also been connected

with great semblance of probability with the later Schultze granite eruption.

In broadening the relations established at Miami many geologists have been inclined to attribute all the deposits of the district to this granite-porphyry eruption in spite of Mr. Ransome's rather weighty arguments in favor of the diabase, the most important of which is probably the fact that even perfectly fresh diabase away from any fissure or vein contains traces of copper. My opinion is that the diabase is the source of the Old Dominion and related vein deposits, and that ore deposition continued through, or was revived by, the granite-porphyry eruption. That ore deposition had come to a standstill and oxidation was in full swing at the time of the Tertiary dacite extrusion is proved by the fact that round water-worn pieces of oxidized ore are included in the lowest dacite-tuff beds with pieces of limestone, quartzite, and diabase.

In fact, that acid porphyrites are the sources of most copper deposits recently discovered has tended to create a little prejudice in favor of these acid rocks and has veiled somewhat the fact that copper deposits connected with basic rocks were the main copper producers until Butte gained supremacy. The vein deposits of the Old Dominion type follow, as I explained before, intrusive dikes of diabase that cut as well through sediments as diabase sills, and represent therefore probably the last exertion of the volcanic cataclysm that sent up these startling masses of basic lavas. The furnace had been stirring for a long time, had skimmed off the slag and collected heavy metals in the centre of disturbance. A renewed outbreak of volcanism carried them upward. Of course these diabase dikes might have been only the passive channels for later mineralizers, as for instance the Schultze granite, and vapors and solutions derived from this source might have followed only the mechanical lanes opened by these diabase dikes, but I personally think not.

My main reason for considering the diabase the active mineralizer is the micaceous hematite, so surprisingly plentiful in the Globe district. Naturally the diabase is a magma rich in iron, and Mr. Ransome gives for normal diabase from Globe 8.50% FeO and 2.09% Fe₂O₃, but locally, and especially in the vicinity of the vein zones, diabase will occur where the percentage of iron must be considerably higher, as hematite replaces the normal biotite, and perhaps also magnetite replaces part of the augite. Veinlets of solid micaceous hematite cut through the solid diabase away from the prominent veins, and where dikes or sills of diabase have penetrated the limestone huge masses of hematite, mostly in the micaceous form, make their appearance. Some of the altered vein dikes, especially where diabase is the country rock, are now practically only white kaolinized material with stringers and individuals of micaceous hematite. The hematite is apparently a primary mineral and not a product of oxidation; and since it occurs as well in the diabase at large as in the veins, a close relation between this eruptive

and the ore deposition is established. Many authorities, especially in Europe, consider hematite rather typical for ore deposits connected with basic eruptives, and even if this should not be accepted universally, the Old Dominion seems to offer a good example for this theory. The lack of this mineral in the undoubtedly acid porphyry deposits of Miami and vicinity, and its prominence in the diabase veins affords a good criterion in adjudging the mineralization of veins in this district to either one period or the other. The veins of the Pinal schist area, for instance, would go with the diabase veins on account of their hematite gangue; a probability still more pronounced from their similarity in strike and dip with some of the undoubted diabase veins. More doubtful is the case of the zinc and lead veins, but still I consider them rather with the basic than the acidic group, because in the first place most of them have the same northeast-southwest strike as the Old Dominion, and some, especially those with chalcopyrite in addition to sphalerite and galena, have shown hematite occasionally, even if this mineral usually is lacking where lead or zinc gains the ascendancy. But perhaps some of the veins, especially the extremely rich ones of the Old Dominion, have benefited by both periods of ore deposition even if this should never be supported by undeniable evidence.

Order of Deposition

The hematite was apparently the first metallic mineral to be deposited. After that followed the sulphides. The deposition of hematite started apparently as a magmatic segregation, but continued into aqueous or pneumatolytic deposition. Sometimes sulphides will prevail almost to the exclusion of hematite, but the latter gains prominence again, either horizontally or vertically, in the same vein and usually even in the same ore-shoot.

The sulphide orebodies have two distinct bases: pyrite on one extreme; and a combination of primary bornite-chalcopyrite-pyrite, with perhaps even primary chalcocite, on the other. Both types blend, occasionally, but are developed in their extremes without transition even in one single vein (the Old Dominion) in different ore-shoots. Prominent chalcocitization is characteristic for the ores of pyritic base, while it appears somewhat lacking in the rich sulphides. Why this should be the case is hard to explain, since the theory that chalcopyrite might break up into chalcocite and pyrite has been discouraged time and again in spite of the surprising reversability of sequence in formation of copper minerals that gain in scope as their interdependence is investigated more thoroughly.

In this connection I might mention the fact that kernels of chalcopyrite were found in entirely oxidized ore along the Carrie vein less than 50 ft. from the surface; and even the lowest depth attained on this vein, about 800 ft. below, has failed to disclose any sulphides. In fact, I do not remember ever having seen any pyrite, chalcopyrite, or bornite whatever from the

Carrie-Buckeye mine, except in this one locality.

Another peculiar occurrence is that of the west orebody on the 13th level of the Old Dominion. Here is a thoroughly oxidized orebody not far from the old surface, but now buried under perhaps 800 ft. of later and overthrust rock (conglomerates, dacite, and Madena diorite). The same orebody has been opened on the 16th level, 300 ft. vertically below, and about 500 ft. on the dip. On the 16th level the ore is fully oxidized, but on the 13th chalcocite occurs in the same hand specimens with chrysocolla, malachite, melanochalcite, and cuprite, and sometimes also limonite. Fig. 9 illustrates the occurrence.

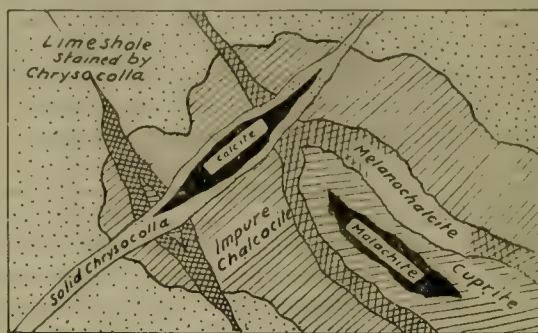


FIG. 9. HAND SPECIMEN FROM THIRTEENTH LEVEL WEST, OLD DOMINION MINE. LIME SHALE STAINED BY CHRYSOCOILLA, CONTAINING AREAS OF IMPURE CHALCOOCITE WITH STRINGERS OF HARD CHRYSOCOILLA CONTAINING MALACHITE AND VUGS OF QUARTZ OR CALCITE.

While this looks at a first glance like a re-development of chalcocite from oxidized ores, the fact probably is that chalcocite is the oldest of the minerals represented here and changes along fissures often concealed to melanochalcite and cuprite. The cuprite in turn is converted to malachite from the centre outward, while the surrounding chrysocolla is a later immigration and not a change *in situ*, this latter infiltration sometimes depositing malachite which also surrounds small vugs of quartz, or more rarely calcite crystals.

Another rather rare occurrence is that of flakes of native silver on chalcocite, as seen in the east orebody on the 9th level of the Old Dominion. Sometimes small sheets of native copper accompany the silver.

Zinc has been found only in one single place in the Old Dominion mine, that is, in the central orebody on the 14th level. It is found in a zone of intimate interaction of diabase with Cambrian limestone along the vein. The sphalerite here is of a light yellowish green color and traversed by veinlets of pyrite, therefore apparently the older sulphide, but the occurrence is so isolated that it hardly justifies general conclusions as to the sequence of metals.

Ore-Shoots

There is no law governing the occurrence of ore-shoots that I have been able to establish. One fact

stands out clearly, though, that when Carboniferous or Devonian limestone forms the hanging wall, the intrusive vein-dikes are liable to branch off the main fissure and pervade these limestones as dikes and sills, causing locally great and rich accumulations of ore. While we have had these orebodies only in the oxidized zone, the similarity of Bisbee shows that nothing prevents their recurrence in the sulphide horizon, provided we shall ever find limestone below the reach of oxidation.

The quartzites and the Cambrian limestone are less productive of ore outside of the veins proper, or at least only for a short distance, where they have been intensely fractured by the fault movements, but where they occur as detached blocks in the faults proper, or included between very closely spaced parallel faults, they contain some of the very choicest ore. In the upper limestones it is therefore more the deflecting of intrusive dikes and chemical exchange that produces bonanzas, while in the other rocks the bonanzas are caused by a mechanical shattering. But both occurrences are localized, and why they should have happened in one part of the vein, and fail in another otherwise apparently similar one, has defied my observation.

The joining of veins sometimes explains the occurrence of ore-shoots, as for instance the central orebody of the Old Dominion, where a vein which is probably the combination of the Buffalo and the No. 3 veins, joins the Old Dominion from the foot-wall, but in other cases such junctures have proved very discouraging. Generally it seems as if the combination of a flat vein with a steep one is more productive than the joining of the two steep veins. But there is one feature that might ultimately prove of great importance for the district. As Ransome mentioned already, the whole district is dissected by normal faults of different dip, tending to drop down triangular blocks between converging faults.

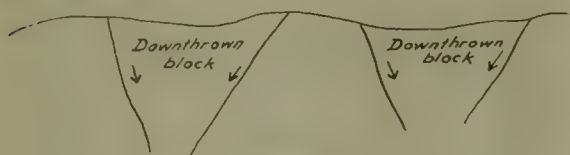


FIG. 10.

Such a system of faulting must necessarily produce strong lateral pressure. Therefore these faults will close again soon, except where resistant blocks of ground prevent this closing. The same is the case with the flat dipping veins, so numerous in the district, only that the closing pressure here acts vertically rather than horizontally.

Wherever masses of sediments have been included in the single veins or between the converging veins they have kept open channels for mineralization; and being fissured if large, or crushed by pressure where small, they have provided conditions for bonanza ore. Where two veins belonging to the same fault-block join, the ore is as a rule disappointing. This occurs frequently

enough to suggest that it will prove a rule ultimately. Of this there is a good example at the Buffalo mine.

As can be seen by comparing Fig. 11 and 12, the Buffalo is only a repetition of the same conditions that prevail at the Old Dominion vein, though on a much smaller scale. The plasticity of the diabase allowed the closing even of such a gash-vein as the Buffalo, where diabase forms both walls.

While many observations indicate that ore deposition must have been rather rapid in diabase-sediment contact zones, and far advanced before lateral pressure closed the feeding channels, there is surprisingly little

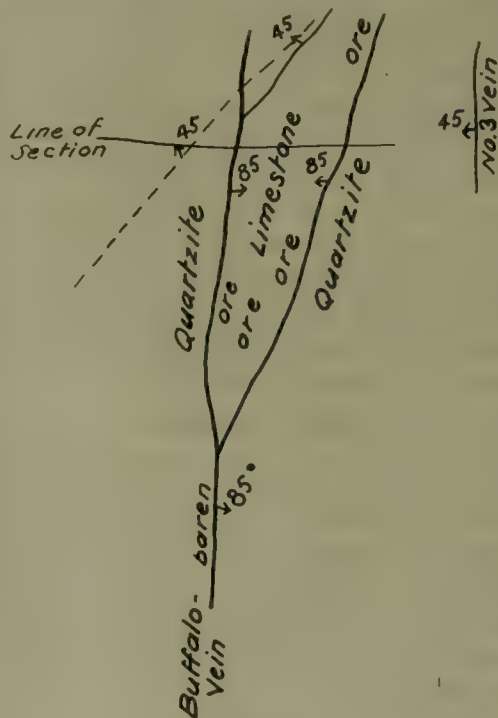


FIG. 11.



FIG. 12.

contact metamorphism, and the only true contact deposits that I have seen in the district point to the Shultze granite as their origin. These are the garnet-epidote-magnetite zones, with copper ore, near the Continental mine.

Contact Phenomena

In approaching diabase dikes a recrystallization of limestone can sometimes be noticed, and in one place on the 16th level west of the Old Dominion I have found limestone that appears to be impregnated with heavy silicates, but so small that only microscopical work could prove the occurrence. But there are frequently contact phenomena connected with the diabase intrusions that suggest an action akin to fusion, for instance, at the contact of diabase with Cambrian limestone where the limestone has changed to a transparent chert with turbid green to black inclusions and grades into aphanitic diabase of smooth surface, greasy to the touch. Layers of iron oxide have been formed rarely in the limestone also, which while non-magnetic now, probably were magnetic originally. These layers of iron alternate with others of quartz and cherty limestone.

At diabase-quartzite, and especially diabase-conglomerate or coarse sandstone contacts, round quartz grains or pebbles will be found imbedded in a diabase matrix; and this will grade into normal conglomerate with diabase magma in the interstices, or quartzite with nests of greenish minerals, perhaps chlorite. At a diabase-Ruin granite contact in the Continental mine, the large orthoclase crystals of the granite were found surrounded by diabase magma. All these occurrences are so closely intergrown that hand specimens will show both rocks in one piece.

In concluding this chapter I might point out how closely ore deposition in the limestone areas parallels the genesis of the Bisbee ores, as sketched by myself* in so far as not the solubility of certain limestone beds, but the intrusive dikes and sills gave an impetus to ore deposition which ultimately spread to the limestone also, especially where this has been pervaded by iron minerals, in this case micaceous hematite, or more rarely magnetite, pseudomorphs after which are found occasionally. These iron oxides I consider exudations of the intrusive magma.

While the Miami-Inspiration type of ore deposit has its proved tonnage, that is steadily but not largely increased by operations, it is not possible to compute the tonnage of the vein deposits in advance. The Old Dominion, though, has ore reserves that will last for several years, and in its east orebody it has a deposit that, with chalcopryrite-bornite and perhaps chalcocite as primary ores on the present deepest level, promises to continue to considerably greater depth. The west orebody is still in oxidized ore, and, while vicissitudes are bound to occur in orebodies of that type, a parallel to the very similar central orebody promises large

and rich sulphide masses for the contemplated deepening of the mine. The central orebody is in lean pyrite on the 16th level as mentioned before, after having been the only support and later on the mainstay of the mine for years, and furnishing wonderful chalcocite ore both as to quantity and quality until considerably below the 14th level.

That this pyrite horizon is the last of the orebody, I do not believe. In the first place, the bornite-chalcopryrite ore of the east orebody proves the existence of high-grade primary sulphides along the vein, and even if the rich limestone orebodies of the central and west orebody should have drained the lower parts of the vein of a part of their copper contents, a recurrence of high-grade sulphides in depth should remain a possibility, especially as a flat north-dipping vein should join the main Old Dominion vein a few hundred feet below the 16th level in these parts from the hanging wall. Besides this, all the observations confirming the primary nature of pyrite in veins cannot shake the fact that pyrite is secondary also, as shown by the sequence of (1) limonite in peat, (2) marcasite in lignite, (3) pyrite in coal. What reducing agents have accomplished in one place they also can do in others. I suspect, therefore, that the Old Dominion might help to eliminate the present belief that lean pyrite constitutes the absolute lowest limit of workable copper deposits, beyond which no recovery of copper is possible.

Outside of their main vein the Old Dominion has many other veins in its large territory, but partly or not prospected at all outside of their rich surface orebodies, and others that are being prospected in depth right now. Some of the more recent work indicates great possibilities for the very great number of veins in the district generally, that are lying idle at present. While there may not be a second Old Dominion awaiting enterprise and capital, the district is bound to flourish for a long time to come and see many a new mine rise to success.

In the course of this paper I have referred frequently to F. L. Ransome's report on the Globe district.* This has been written more than ten years ago, and while recent development has forced me to disagree with it in several minor instances, I cannot but admire how painstakingly and thoroughly Mr. Ransome worked out, in the short time allotted, a district as complicated as this one, and provided a basis for future research.

Mining Methods

Outside of the 'raise and sub-level' method of stopping developed at the Miami mine, which is a matter of record in recent magazine literature, there is very little extraordinary in the way of mining in this district. I might mention the adaptation of an inclined 'cut-and-fill' method for rather wide stopes in the Old Dominion mine, where the roof is good and the grade of ore uniform enough to eliminate hand sorting. The

**Mining and Scientific Press*, February 4, 1911, p. 203.

*U. S. Geol. Surv., Prof. Paper 12.

method is used both with open and square-set stopes. In the former I have seen stopes up to 40 ft. wide worked that way, while with the latter a width of six sets (30 ft.) was a maximum.

The stopes are worked with rising inclined face, and the ore slides automatically in the chutes over a floor of planks on top of the fill. (See Fig. 13.) The chute-

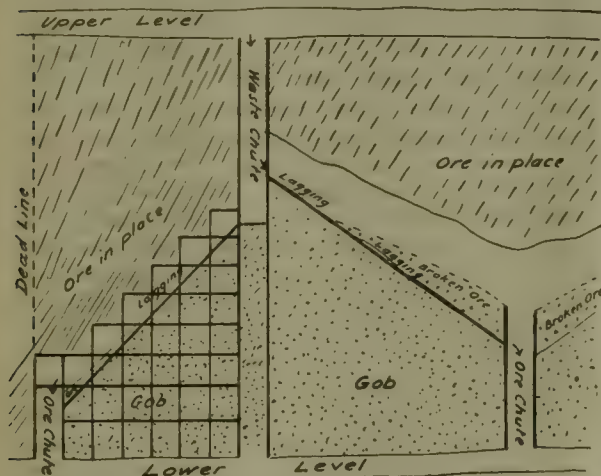


FIG. 13. SQUARE-SET STOPE AND CUT AND FILL STOPE.

raises are cribbed, and a few rounds of cribbing are placed above the plank floor to allow some of the ore to accumulate on this inclined floor, partly to protect the planks from wear and partly to give the men a better footing. After finishing a cut, these rounds of cribbing are removed, the ore run down the chutes. the raises cribbed up, the planks removed, and filling run in.

Fluorite in Smelting

By HERBERT LANG

Fluorite, a comparatively rare veinstuff in the mines of America, although abundant in those of some parts of Europe, possesses considerable interest in its metallurgical aspects, from the peculiarities of its action in smelting. It is unique in that, while a saturated substance in itself, it yet assists other and comparatively infusible matters to liquefy at a heat far below their melting points alone. In particular the native sulphates, such as those of lime and baryta (gypsum and barite or heavy spar) are enabled to melt by an addition of a comparatively small amount of fluorspar, forming a homogeneous slag having a rather low fusing point. Hence its application in some forms of lead smelting in reverberatories. It has been claimed by some, but mainly on hypothetical grounds, that the well known decomposition of fluorite by silica in the presence of steam takes place in the blast-furnace. In this case the fluoride of silicon should be evolved, while the silicate of lime would remain in the slag. From this point of view fluorspar would consti-

tute an ideal flux for silicious ores in lead and copper smelting. There is no doubt as to its effective decomposition by silica under any circumstances in the blast-furnace, but it would appear not to behave quite so favorably in ordinary practice, inasmuch as the silicon compound has probably not been detected in the gases. Furthermore, as the decomposition of the gaseous fluoride takes place in the presence of steam, which is an invariable concomitant of furnace educts, the probability seems to be that while that substance would most likely be formed, it would speedily be broken up, even before issuing from the furnace, leaving a residue of silica, which would descend again to the zone of activity below, there to become combined with the bases. The value, then, of the fluorite would depend wholly upon its calcium constituent and not, as several metallurgists have taught, in part upon the fluorine. The matter, however, is obscure; and the attention of experimenters might profitably be directed to an inquiry as to the precise part played by the volatile constituent.

As a fluxing agent fluorite is most closely comparable with limestone (calcite). The pure mineral contains 51.3% calcium, corresponding to 71.8% lime, while calcite of an equally pure quality has 56% lime. The difference, therefore, is material in this respect. In reverberatory smelting, where the action of the fluorine in determining the volatilization of silica would probably not be masked by the interference of the vapor of water, fluorite would doubtless be preferred as a flux, since one part of it should by theory saturate or expel a much larger proportion of silica than calcite could. The equivalent amount satisfied by one part of fluorite is 0.726 parts of silica, while one part of calcite satisfied 0.60 silica, assuming, which is practically always the case, that the bisilicate of lime, CaSiO_3 , is formed.

Fluorite is employed in various minor arts, especially in the preparation of castings, where it is held to be of special value as provocative of ready fusion, and as tending to purify in a certain measure the iron. It is likewise used in the manufacture of cements, in glass and enamels, in electrolytic lead and antimony refining, in the production of aluminum and in the manufacture of hydrofluoric acid, a substance of increasing use in the arts. No important deposits of fluorite have as yet been discovered in California, or at least none of sufficient purity to found an industry upon, but a more strict inquiry may reveal such. The principal localities thus far reported in this state are in Inyo county, where several slightly prospected locations are found. To the south in Arizona is the somewhat noted Castle Dome deposit, where the fluorite was found in connection with lead ores of exceptional purity, worked some years ago, and chiefly smelted at Melrose in Alameda county, in this state.

The market for fluorite is but small. Messrs. Levensaler & Spier, mineral brokers of San Francisco, report that the requirements would be met by two or three carloads per month, which may be 500 or 600 tons per year. This is supplied from the east.

The Buck Zinc Prospect Near Boracho, Texas

By J. A. Udden

*In the hills about 12 miles north of Boracho, in Culberson county, there is a zinc prospect known as the Buck mine. It is in a deep arroyo draining into a tributary of Coyote creek. The country rock consists of limestone of the Delaware Mountain formation. Work on the prospect has been desultory, by different people, and at different times. Ore was once packed out on burros, and shipped to Kansas City. A half carload of this ore was left near the Boracho station. A grab sample of this ore yielded 34% zinc. This ore came from two open cuts, sunk at the point where the first discovery was made on the east side of the arroyo.



THE BUCK CREEK ZINC PROSPECT. 1, OPEN CUT; 2, OPEN CUT;
3, SLOPE; 4, TUNNEL.

The largest of these cuts, 1 in the figure, is some 20 by 15 by 10 ft. in size, and is about 25 ft. above the bed of the arroyo. The other cut, 2, is about 20 yards to the northeast, and lower down. The country rock is a coarse-grained limestone, showing altered and mineralized streaks and cavities and a few small irregular veins, an inch or two in thickness, extending in different directions. Some of the veins are filled with calcite, some with smithsonite of fine and compact texture, and some with ferruginous material. Sphalerite of dark brown color was noted in some of the orebodies of irregular form, and greenish yellow sphalerite appears in streaky impregnations in the limestone. The whole has the appearance of a part of a cavernous system in a limestone partly filled by mineralizing solutions, this filling having later in part been dissolved away and to some extent oxidized by the leaching and weathering

effects of groundwater. A half dozen picked samples of the size of walnuts, from the walls of each of these two open cuts, give the following averages of zinc:

	Zinc, per cent.	Silver, per cent.
Open cut 1	26.0	None
Open cut 2	26.5	None

A piece of the limestone forming the country rock, taken a few feet from open cut No. 2, gave 2% of zinc.

A hundred yards to the northeast from these cuts, a slope, 3, about 40 ft. deep has been sunk on a vertical vein and about 15 ft. above this a short tunnel, 4, has been driven on the same vein. This vein is from 1½ to 3 ft. wide, bears about north 20° west, is filled with stalactitic calcite, laminated vertically, showing characteristic rippled surfaces of drip-stone and, in places, a transverse fibrous structure. In some places the filling is incomplete, leaving thin, open vertical fissures. The walls of the vein are straight, showing hardly any erosion or etching. The vein extends some distance above the tunnel. Samples taken across the vein in these workings gave the following assays:

	Zinc, per cent.	Silver, per cent.
Slope 3	0.5	None
Tunnel 4	1.0	None

A half mile southeast from these workings, two shafts have been sunk, about 80 yards apart. One of these is some 40 ft. deep, the other (to the northeast) 25 ft. These expose, in part, some limestone, some talus-like debris, containing weathered blocks and smaller fragments of limestone, and some sandstone and indurated white and purple clay and silt of Cretaceous age. An elongated patch of brown sandstone of Cretaceous age runs northwest immediately to the west of these shafts, and two other small elongated remnants of the basal sands of the Cretaceous are to be seen in a straight line between this patch and the two open cuts first described. Picked samples from the dumps of the two shafts contained no zinc.

Evidently the Delaware limestone has been traversed by an irregular series of cavernous openings, having a trend approximately parallel to that of the calcite vein. Owing to these openings, Cretaceous deposits found lodgment in some channels having the same trend, laid bare on the shore of the Cretaceous sea in the limestone. Present erosion has cut below the general level of the Cretaceous base, leaving only a few remnants lodged in the deepest depressions of the older rock. Mineralization of the ground must have taken place before the removal of the upper formation.

Evidently a successful exploration of this prospect will require much underground work, to locate orebodies in old seams, joints, porous layers, and cavernous openings, filled by the agency of the mineralizing solutions. The pockets already found may be merely some small off-shoots from a much greater system of ore beds in filled caverns, or they may have been the

*Published by permission of Wm. B. Phillips, director of the Bureau of Economic Geology and Technology, University of Texas, Austin.

main deposit. The size of the stalagmite vein and the depressions in the lower formation containing Cretaceous sandstone, suggest the existence of an extensive system of old cavernous openings. The conditions are kin to those existing in the Shafter silver mine, though much less appears on the surface of a cavern system, than was the case at Shafter.

This prospect is on a range of hills separated from the Delaware range proper by a valley draining to the east into Coyote creek. Between this valley and the Texas & Pacific railroad, which roughly parallels the valley at a distance to the south of from eight to fourteen miles, is an anticline whose axis trends a little north of west and south of east. This anticline forms the range of hills mentioned. The prospect is north of the axis of the anticline, and on its west end, which has a higher elevation than the east end. Deep ascending mineralizing currents would naturally collect near the highest point of such a structure, and this is another reason for considering further prospecting here warranted by the natural conditions.

Rock Drilling in Lake Superior Iron Mines

By P. B. McDONALD

The general standard of rock drilling practice in the iron mines of Michigan and Minnesota is noticeably higher than five years ago. The conditions which have brought this about have been principally the lowered prices for iron ores and the coöperation of mine superintendents with representatives of rock drill manufacturers for the purpose of improving the mechanism of the drills. Efforts have also been made to improve the personal efficiency of the miners under the general principles of scientific management, but these attempts have not accomplished much; the older Cornish miners do not take readily to such innovations as standardizing plans for placing holes, record keeping, etc., and the more ignorant immigrant labor refuses to understand these processes. Incidentally it is likely that some of the smoldering resentment so apparent in the copper country strike has been due to the antagonism of old style miners to the too officious advances of scientific management under the cover of paternalism; the mine managers point out that no strike occurred in the copper country for fifty years, but the fact is overlooked that during most of that time immigrant labor, such as Finns, Poles, and Austrians, was very much in the minority and the Cornish-American miner was dominant under conditions suitable to his own ideas of mining and living.

The present status of the rock drill in the Lake Superior iron mines is much different from a few years ago when nearly all drilling was by the two-man, mounted, reciprocating machine. The stope drill is now used for practically all the raise work requiring a power drill. The cost of raising has been generally reduced to less than half the former cost. It is probable that the stope drill has worked greater economies

than any other type. On account of the mass-like shape of the large iron ore deposits, raising is an important part of many of the mining methods in vogue.

The one-man, mounted, reciprocating drill for driving and stopping (over which there was so much controversy in the copper country) has had a number of sales in the iron region, and was an efficient drill for the 'medium soft' grades of ore. It was repeatedly demonstrated that one man could accomplish the same (or greater) drilling results with this drill as previously had required two men with the old type, heavy drill. However, a new development has taken place in this line in the iron region. Unlike the tough copper country rock, the majority of the iron ore is medium soft or soft, some of the latter varieties on the Mesabi range having been drilled with hand augers for years. It has been found that a small, automatically rotated, 'plug' drill, changed so as also to be used as a power auger, is possible; that is, such a machine will work as an auger in soft ground but when a hard seam is struck it changes to a hammer drill. This new style of drill promises to be a decided success, and is expected ultimately almost to replace the one-man piston drill in the iron mines.

The general use of smaller and lighter drills in driving and sinking is resulting in a trend to the European practice of shorter holes, better placed, and a shorter cut; it is found that with cuts of 4 or 5 ft. progress can be made faster than was formerly possible with 6-ft. cuts; the light drills permit greater flexibility in pointing the holes, and can be quickly moved back out of the way for blasting, thus encouraging more frequent blasting.

For drilling the unusually hard ores and for the hard rock sometimes accompanying the iron ores, such as jaspilite and quartzite, the two-man, reciprocating drill will be retained. Another type of drill which has been successful in the hard rock (more especially true in the copper country) is the Leyner drill. This can perhaps be called a hybrid type because it is a hammer drill and at the same time is mounted on bar or tripod; the water principle of washing out rock chippings is, of course, an important feature.

In sinking, a radical change has come about. In place of the two-man, piston drill on tripod or bar, little 'plug' drills are now used. Three-quarters of the shaft sinking in the iron region is now done by automatically rotated plug drills or 'hand sinkers,' and records are being made in speed of sinking.

On the Gogebic range, the Newport Mining Co. recently sunk an 11 by 18 shaft in quartzite 33 ft. in one week, with Jackhamers and the concrete lining was put in at equal speed. Contrary to first expectations these little hand sinkers can put down deep holes when necessary. Their principal advantages lie in their one-man principle, enabling twice the number of drills to be used in a shaft, and in the ease with which they can be removed for blasting.

Depth of water in the Suez Canal is now 33 feet.

Meeting of the Canadian Mining Institute

The sixteenth annual convention of the Canadian Mining Institute was held at the Ritz-Carlton hotel, Montreal, March 4, 5, and 6, with a large attendance of members. A. E. Barlow of Montreal, the president, in his opening address referred to the steady growth and progress of the Institute, which had attained a membership of 1029, of whom 113 had been added during the year. There were now eight branches, including the Rocky Mountain and Ottawa branches recently organized. He dealt at some length with the question of the development of Canada's iron resources, urging the exploration of the Archean rocks of the hinterland, which gave promise of holding large iron deposits, and advocated the granting of a bounty on iron ore.

Mineral Production for 1913

The preliminary report on the mineral production of Canada during 1913, by John McLeish, chief of the division of mineral resources and statistics of the Department of Mines, was presented. The total value of the output was \$144,031,047, as compared with \$135,048,296 in 1912, an increase of 6.65%. The metallic production was valued at \$66,127,821, and the non-metallic at \$77,903,226. The leading items in the metallic list were as follows: copper, 76,975,832 lb., value \$11,753,440; gold, 784,525 oz., \$16,216,131; pig iron, 1,128,967 tons, \$16,540,012; lead, 37,662,703 lb., \$1,754,705; nickel, 49,676,772 lb., \$14,903,032; silver, 31,750,618 oz., \$18,984,012. There was an increased production of all the metals except copper and silver, which showed slight decreases, the most important increase being in gold with 28%. Among non-metallic products increases are shown in all the important items except clays and lime, the largest being in natural gas with 41% in value. The cement output showed an increase of 21% in quantity. Coal was produced to the amount of 15,115,089 tons, of the value of \$36,250,311, as compared with 14,512,829 tons, valued at \$36,019,044, in 1912. The record of production by provinces showed that Ontario stood at the head of the list with a value of \$58,697,602, or 40.75% of the total; British Columbia came second with a value of \$28,529,081, or 19.81%; then followed Nova Scotia with \$19,305,545, or 13.4%; Alberta with \$13,844,622, or 9.6%, and Quebec with \$13,303,649, or 9.24%. In the above comparisons, no account is taken of the large iron smelting and steel making industries of Nova Scotia, as the pig iron used there is entirely from imported ore.

Reports were also presented by Theodore C. Denis, superintendent of mines for Quebec, and from Thomas W. Gibson, deputy minister of Ontario, showing the mineral production of those provinces for 1913. The Ontario report placed the value of the mineral production at \$52,999,957, of which \$37,508,955 was metallic and \$15,491,002 non-metallic, the total exceed-

ing the previous year's production by 9.6%. The production of gold was 220,837 oz., of which more than 94% came from the Porcupine mines. The output of silver was 29,681,975 oz., showing a slight decrease. The report points out that the high water mark in silver production was apparently reached in 1911, when the yield was 31,507,791 oz. The output of nickel had increased in value nearly 11%, and copper 16%. The production of pig iron was 648,899 tons, worth \$8,719,892, an increase of 10% in quantity. The conclusion is drawn that the producing capacity of the iron mines of the province has not kept pace with the expansion of the blast-furnace industry, as of the 1,228,269 tons of ore smelted in Ontario, only 132,708 tons was of domestic origin, the remainder being imported from the United States.

The list of nominations for officers was presented and George G. S. Lindsey, of Toronto, declared elected president by acclamation. Mr. Lindsey was for some years president and general manager of the Crow's Nest Pass Coal Co. and is now president of the North Alberta Coal Company.

Papers were read at the afternoon sitting on mining and milling at Cobalt, by St. George Campbell and Fraser D. Reid, both of Cobalt, and by George A. Guess, of Toronto, on pyritic smelting. E. D. Peters, of Dorchester, Massachusetts, gave an address on the production of heat in metallurgical furnaces, dealing principally with the reverberatory type and detailing the experiments which had resulted in the production of the present furnaces, 112 ft. in length, in which the ore was melted almost immediately after it had been thrown into the furnace and the slag drawn off without much loss of heat. The furnace was charged with 15 tons of quartz once in 45 minutes, and the heat of the furnace at the fire bridge was 1500° Centigrade.

Evening Lectures

In the evening there were two lectures illustrated with moving pictures. Austin King, chief inspector of mines for the Frick Coal & Coke Co., dealt with 'Safety in Coal Mines,' and H. W. DuBois, of Philadelphia, treated of 'Hydraulic Mining.'

On the morning of March 5 the members paid a visit to the tunnel which is being constructed by the Canadian Northern railway underneath Mount Royal. They were conducted by S. P. Brown, chief engineer of the work, and J. Austen Bancroft of McGill University. At the afternoon sitting Mr. Brown read a paper on 'Methods of Excavation in the Mount Royal Tunnel.'

On March 6 a number of papers were presented and addresses delivered. H. M. Payne, of New York, spoke on 'Efficiency Engineering Applied to Mining, Quarries, and Industrial Plants.' W. McAlpine Johnson, of

Hartford, Connecticut, described an electric furnace which he had produced for the treatment of complex zinc ores on a commercial basis. This furnace is claimed to produce more spelter or zinc by the use of less power than has hitherto been found necessary abroad, despite the fact that the Canadian ores are not of as high grade as those of Norway and Sweden. W. R. Ingalls, who has been experimenting for the Canadian Department of Mines with the view of making zinc smelting a profitable undertaking, congratulated Mr. Johnson on the success of his experiments.

A. Stansfield, of Montreal, gave a résumé of recent metallurgical experiments covering the most important advances in practice during the last 14 years. Howard W. DuBois, of Philadelphia, gave a history of the use of high carbon steel plates for sluice-way linings in hydraulic mining, which had overcome the expense of heavy wear and increased the output by 25%. A discussion took place on the present status of the Canadian iron industry, and a resolution was moved by Eugene Coste, and seconded by George G. S. Lindsey, directing the attention of the Government to the fact that the iron industry was greatly handicapped because extensive deposits of high-grade ore, such as were found in the United States, Newfoundland, and Cuba, had not been discovered in Canada, though it was believed that they existed. The Government was therefore urged to take such means through the proper channels, either by a geological survey or a special committee of experts, as would determine the extent and value of Canada's iron resources. The resolution was adopted.

Studies of Smelter Fumes and Gases

*As during the previous year, the investigations conducted at the San Francisco experiment station and the field work controlled from there have centred around the problems of copper and lead smelting, with especial reference to the reduction of the deleterious gases and fumes emitted by smelting furnaces, and the recovery of the valuable constituents, now wasted, of these fumes. Considerable time has been spent in attempts to find new uses and to encourage the extension of present uses of sulphur, arsenic, bismuth, selenium, and tellurium, which are found in such amounts in these wastes that if any large proportion of the whole were collected in commercial form the supply would exceed the present demand. During the year the laboratory work has been largely devoted to the quantitative study of the fundamental chemical reactions taking place in roasting and blast-furnaces, in the converter, and in other standard smelting equipment.

A large part of current operating practice is based on empirical generalizations that have gradually been developed in the art itself. Although practice must, of course, always be the court of final resort as re-

gards the merits of a given procedure, still there are many fundamental chemical problems on which more definite and accurate quantitative data are badly needed, and which can not be advantageously studied in industrial furnaces. These are receiving especial attention in the laboratory. At the same time the attempt is being made to render the field investigations and the work in co-operation with industrial plants throughout the country serve as a medium for carrying the theoretical conclusions and suggestions from the laboratory to a point where they may be readily interpreted into practical improvements and method of closer control by those in charge of smelters. A significant and encouraging fact is the cordial coöperation in this work which has been extended from the industries concerned, even in those cases where the work in question dealt with bettering the condition of the workman or of the surrounding community without immediate prospect of commercial advantage to the operating company.

This coöperation has in many instances been wholly informal, consisting merely of the exchange of suggestions or of especial facilities for making certain tests. In other instances it has taken a more definite form, as in connection with the Anaconda and the Selby smelter commissions. Both the Anaconda plant in Montana and the Selby plant in California have been in litigation either with farmers' associations of the local or the federal government over alleged fume damage for many years, and much time and money had been expended in court proceedings by both sides without apparently reaching any permanent settlement of the general questions at issue. The court proceedings in both these cases have within the last two years been suspended, and by agreement the questions of fact have been referred to commissions of disinterested experts for investigation and report as to what improvements are possible and practicable and what relief may be reasonably expected. While those commissions are entirely independent of the Bureau of Mines as an organization, the director of the Bureau was asked to serve on each of them as an individual, and, with the approval of the Secretary of the Interior, is so doing. Each of these commissions has its own staff of scientific and technical investigators, but the Bureau is assisting the broader aspects of their investigations, in the attempt to make such of the results as do not involve confidential data available for the broad general study of these problems.

The work of the San Francisco station has been under the general direction of F. G. Cottrell, chief physical chemist, with a staff consisting of L. H. Duschak, chemical engineer (from Jan. 9, 1913); V. H. Welch, assistant physical chemist (furloughed Jan. 16, 1913, and since then in the employ of the Anaconda commission); W. Eaton, assistant physical chemist (resigned Sept. 6, 1912); D. R. Kellogg, assistant physical chemist (from Jan. 2, 1913); and E. H. Zeitfuchs, mechanic and laboratory assistant.

*From the third annual report of the National Bureau of Mines, Joseph A. Holmes, director.

Application of the Magnetometric Survey to the Sudbury Nickel Deposits

By KIRBY THOMAS

The nickel minerals in the Sudbury, Ontario, district are almost invariably intimately associated with pyrrhotite, the magnetic iron sulphide, and likewise the pyrrhotite masses found in the nickel area, always contain more or less nickel and are generally commercially valuable as nickel ore. These nickeliferous pyrrhotite orebodies are found along the contact of the norite, an eruptive rock allied to the gabbro type, and a foot-wall of greenstone or granite, or as shoots or 'chimneys' accompanying the dike like 'offsets' from this contact. These contact orebodies are of a thickness up to 400 ft. and they often have a large areal extent and usually follow the contact on its dip presumably to great depths.

Measuring Magnetic Intensities

These pyrrhotite ore masses are distinctly magnetic though the attraction is not nearly as strong as in the case of magnetite orebodies of like magnitude. Owing to the fact that the Sudbury orebodies generally outcrop at the contact and extend downward and laterally along a sloping contact, about 30 to 45°, it is possible to measure the varying magnetic intensities, taking in to account the variations in distance from the needle with the increasing depth of the orebody and to note the 'curves' of the readings on either side of the actual contact.

The earlier operations in the district were confined to the prominent gossan outcrops, locally called 'burns,' but later it was found advisable to explore by diamond-drills, a method which has been very extensively and successfully applied in the district. However, the magnetic property of the ore was early recognized, and as long as ten years ago attempts were made to find the orebodies by using the dip needle, particularly in localities where the contact was covered by glacial drift or 'muskeg' (swamp). Owing to the fact that the gabbro dikes and masses often found in the foot-wall and other rocks associated with the ore were markedly magnetic also, and to the accidental but frequent presence of masses of magnetic iron ore in the drift overburden, these earlier attempts at exploration with the dip needle were generally unsatisfactory and often very misleading. In one instance a shaft was sunk on a 'magnetic centre' to the end of disclosing at about 50 ft. in the gravel a large boulder of magnetite. A little later, Thomas A. Edison became interested incidentally in a supply of nickel for his purposes and he undertook to show the Sudbury operators how to find the ore. A large staff of healthy college boys was sent afield to apply the great inventors' own particular ideas. Exhaustive magnetic readings were made

of selected areas on the nickel ranges. On the interpretation, or rather misinterpretation of these data some explorations by drilling were made, in one case to a depth of 1200 ft. but without any successful results. The fact seems to be in evidence that Mr. Edison's experts ignored the, even then, fairly well understood geologic features of the nickel-bearing formations and depended on the magnetic readings solely. The Edison incident further dampened the interest in magnetic explorations in the district. However, soon after this, the London directors of the Mond Nickel Co., interested by the development and success of the new science of magnetometric surveying as practised in Sweden, sent a Swedish expert with his new and precise instruments into the district and had extensive detailed surveys of the nickel areas made. It is said that on the records of these surveys, largely, if not solely, these London directors subsequently directed a campaign of drilling, sending their orders to the men in the field by cable each day. Be this as it may, the fact is that the drilling explorations of the Mond company for several years after this survey was made were admittedly disappointing and the succession of unsuccessful drilling explorations by this Company were attributed by the local wise men to the unreliability of the magnetic survey, corroborating a local judgment on the matter already founded on some experiences as noted.

The Canadian Copper Co., the other large Sudbury operating company, frankly avowed its disbelief in the efficiency of magnetic surveys in the district and the local property holders came to entirely disregard this possible aid in their limited attempts at exploration.

Comparison of Results

Two years ago, a new company making some explorations by drilling in Levaek township on the North range had a magnetometric survey made, but the contemporaneous explorations were not carried to a point to test the usefulness of these surveys. A year later, however, more complete drilling demonstrated it and revealed the possibilities of the magnetic survey, for the ore was found in the locality indicated by the survey and the meaning of the magnetic manifestations, before not well understood, was made clearer. Recently the Geological Survey of Canada took cognizance of the matter and a staff of the experts which had been engaged in making magnetic surveys of the Canadian iron deposits was sent to survey the area which included the No. 3 mine of the Canadian Copper Co. The survey was made by men who had no knowledge of the facts which had been actually demonstrated by drilling and later their deductions were compared with the known

conditions. The comparison was quite satisfactory and a discussion of this test and copies of the maps were published in a report of the Ontario Bureau of Mines. Eugene Haanel, director of the Mines Branch of the Department of Mines at Ottawa, continued the study of the question and as a result he has recommended to those inquiring that magnetometric work be done in the Sudbury district preliminary to and as an aid to testing by drilling. It is likely that henceforth there will be more attention paid to the possibilities of magnetic surveys in the district. The opportunity for its appli-

cation is very great as the total contact outcrop is more than 125 miles and not half of it has been explored at all and much of the remainder is at best only partly tested.

There is yet to be worked out the principles of interpretation of the magnetic data and the correlation of this with the geologic facts and relations. The surveys should be made under the direction of a geologist who is familiar with the district and who has the experience to enable him to competently interpret and apply all the available facts.

Accident Prevention in Mining

By EDWARD RYAN

*Accident prevention is a theme upon which one might dwell at great length, were he to endeavor to cover every industry, but as my work has to do with mines and mining, it is my purpose to speak to you for a few minutes on that branch of the work, with the hope that I may be able to leave with you some thought that will aid in this great movement, and possibly will strengthen the bond between employer and employee.

It is commonly supposed that by passing safety acts and having inspectors who visit the different mines every few months, all has been done that can be done for accident prevention. This is not so. Laws are merely educational means, and the penalties provided in the act are merely punishments for those who fail to learn their lesson. It is generally known that Nevada leads in laws looking to the prevention of accidents, and the protection of those who toil underground. We have taken 31 of the most important points of the law, the violation of which causes most of the accidents, and, under the heading 'Don't,' have pointed out to the employer and employee the frequent daily crises that must be provided for. These have been printed on cloth, and are furnished all operating mines, a copy being posted at the collar of each shaft and on each working level. This keeps constantly before the miner many things that must be avoided if accidents are to be lessened.

With these signs constantly before them, why do we have as many accidents as we do? There can be but one answer. The men are either incompetent, they willfully violate the provisions looking to their safety, or they are compelled to forego the exercise of the caution pointed out by the signs, by reason of the requirements of those in authority. We all know that men constantly working in an atmosphere of danger become careless of their surroundings. They do many things they ought not to do, and daily violate state laws and company rules. The operators are often to blame for the hap-hazard and careless manner in which men do

their work, by reason of lack of discipline. Some mine foremen—the great majority—are competent in all other lines of their work, but sadly deficient in discipline. At times they are carrying out the wishes of those higher in authority, but as a general rule I believe that the attitude of the management as regards carelessness is reflected by the men. If the superintendent is careless and indifferent, the men in turn will treat rules and regulations lightly. If, however, the superintendent shows an earnest desire to have all rules closely observed, if he makes accident prevention one of the leading features in his department, his foremen will usually reflect that attitude, and in turn will compel the men to adhere closely to all rules and regulations looking to their safety.

Operators, if they wish to surround themselves with home loving law abiding honest citizens, cannot afford to neglect discipline. Slipshod methods beget carelessness and indifference, surely resulting in disagreeable conditions. Lack of proper discipline results in the gradual elimination of the better men, with its resulting increase of inefficiency, and accidents. Lack of discipline is entirely too prevalent in some of the mines of our state, and the cause 'Disobedience of orders' would not be so frequently written in accident reports, were more attention paid to discipline. Let the employee know that all rules and regulations looking to his safety are to be obeyed, and if he shows a disposition not to obey, for his own sake get rid of him. Thus you will protect him from himself, and the careful employee from his careless fellow worker.

Centralize responsibility as much as possible. What is everybody's business, is nobody's business. The Nevada Consolidated Copper Co. has recently inaugurated a system which I believe will go a long way toward securing the coöperation of employees in the matter of accident prevention. A monthly bulletin is issued showing the number of accidents in all departments of the work. The name of the man in direct charge is given, and the accidents on the different shifts and in each department are written directly under that of the one in direct charge. All accident reports are care-

*From an address by the State Mine Inspector, delivered at the 'Safety First' conference, Reno, Nevada, January 27, 1914.

fully scanned by the management and comment is made in favor of those who show a clean record as far as accident prevention goes. Not long ago I was in one of the pits when an accident happened to a man on one of the steam-shovels. It was an unavoidable accident, and the accident itself revealed and outlined the method of prevention. The master mechanic was one of the first on the ground, and immediately took steps to prevent a like occurrence. Before night every shovel in the pit was equipped with the means to prevent a similar accident. It was the first that had happened in this man's department, and it had been his constant aim to furnish the men with all possible protection. Compare, if you please, the earnestness with which this man did his work, with that of a foreman who outlined all the points of his method of doing a certain kind of work and showed that it was perfectly safe. A short time thereafter an accident happened in this very branch of the work, and, upon investigation, I found that the method as outlined was not in effect, and that he had deliberately deceived his superior.

In going through one of the mines I came upon a miner who had drilled a number of holes in close proximity to a number of missed ones. This was against the rule of this Commission, but the shiftboss in permitting it reflected the wishes of the foreman.

Far better would it have been for one of our large mining companies had they followed closely the law relative to the use of gates on cages and not permitted them to be discarded by one who doubtless thought them a useless feature, and thus involved the Company in a damage suit, and perhaps criminal prosecution by reason of a man having fallen from a cage to his death.

I want to ask you mine managers this question: Do you believe that you are doing your full duty by simply passing laws, and rules, and regulations? Some two years ago, in an address before the Engineers' Club of this University, on the subject of accident prevention, I pointed out that the common mandates of humanity should cause us all to get together on this important subject. Already, in this state, since the passage of the Employers' Liability Law, some of the mine managers have met and discussed accident prevention. Such meetings are bound to bring good results. One becomes the teacher of the others, and, as a result, all have a better understanding of the needs of the industry. Why not go further in these meetings, and take the miners in? Let them know they have a duty to perform in this humane work. Almost daily we see men exposing not only their own lives, but those of others. Many do not seem to know that what they are asked to do or not to do is not in compliance with the law. Shiftbosses cannot constantly watch over them, therefore, they must share responsibility in carrying out the law. I believe that a better understanding and spirit of coöperation that will go right down to the bottom of the staff and grip the very heart of the miner, can be had by placing the matter right square up to him.

Zinc Smelting Capacity of the United States*

Operating company and location.	Retorts at close of 1913.
Illinois:	
American Zinc Co. of Illinois, Hillsboro ..	3,200
Collinsville Zinc Smelting Co., Collinsville ..	1,536
Granby Mining & Smelting Co., East St. Louis, ..	.....
Hegeler Bros., Danville ..	1,800
Illinois Zinc Co., Peru ..	4,640
Matthiessen & Hegeler Zinc Co., La Salle ..	5,256
Mineral Point Zinc Co., Depue ..	6,800
National Zinc Co., Springfield ..	3,200
Robert Lanyon Zinc & Acid Co., Hillsboro ..	1,840
Sandoval Zinc Co., Sandoval ..	996
Total	29,268
Kansas:	
Altoona Zinc Smelting Co., Altoona ..	3,960
American Zinc, Lead & Smelting Co., Caney ..	3,648
American Zinc, Lead & Smelting Co., Dearing ..	3,840
Chanute Zinc Co., Chanute ..	1,280
Edgar Zinc Co., Cherryvale ..	4,800
Granby Mining & Smelting Co., Neodesha ..	3,760
Kansas Zinc Co., Gas ..	2,520
La Harpe Spelter Co., La Harpe ..	1,856
Pittsburg Zinc Co., Pittsburg ..	910
Prime Western Spelter Co., Gas ..	4,768
Total	31,342
Oklahoma:	
Bartlesville Zinc Co., Bartlesville ..	5,184
Bartlesville Zinc Co., Collinsville ..	8,064
Lanyon-Starr Smelting Co., Bartlesville ..	3,456
National Zinc Co., Bartlesville ..	4,480
Tulsa Fuel & Manufacturing Co., Collinsville ..	6,232
Total	27,416
Pennsylvania:	
American Zinc & Acid Co., Burgettstown ..	.....
New Jersey Zinc Co. (of Pennsylvania), Palmer- ton ..	5,760
Total	5,760
West Virginia:	
Clarksburg Zinc Co., Clarksburg ..	2,736
Grasselli Chemical Co., Clarksburg ..	5,760
Grasselli Chemical Co., Meadowbrook ..	6,912
Total	15,408
Missouri:	
Edgar Zinc Co., St. Louis ..	2,000
Nevada Zinc Co., Nevada ..	672
Total	2,672
Colorado:	
United States Zinc Co., Pueblo ..	1,920
Total for all states	113,786

ADDITIONAL RETORTS BUILDING IN 1914

American Zinc Co. of Illinois ..	800
Granby M. & S. Co.	3,240
Hegeler Bros.	1,800
Matthiessen & Hegeler Zinc Co.	912
Mineral Point Zinc Co.	2,280
American Zinc & Acid Co.	3,456
Total	12,488

*From the report upon spelter production in 1913 by C. E. Siebenthal of the U. S. Geological Survey.

Discussion

Readers of the MINING AND SCIENTIFIC PRESS are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment. Insertion of any contribution is determined by its probable interest to the readers of this journal.

Progress in Gold and Silver Ore Treatment in 1913

The Editor:

Sir—I read Mr. James' article in the *Mining and Scientific Press* and was surprised to note that he made an attempt to compare the relative efficiency of different agitating and filtering equipment, drawing his logical conclusion from a major and minor premise, when both were composed of the one datum—"cost per ton"; apparently not considering relatively the tonnage treated, location of plants, or character of ores as having any bearing upon the subject at hand. I feel sure that provided he had compared Nevada Hills agitating, diluting, and filtering costs with those of some plant operating at a distance of 45 miles from a branch line of a railroad, and treating 140 tons per day, the ore being of such a character that it required very strong solutions of lime and cyanide, his conclusions would have been more favorable to the type of equipment in use here.

E. A. JULIAN.

Fairview, Nevada, February 9.

Solution Control in Cyanidation

The Editor:

Sir—I should like to add a word or two, if I may, in connection with the correspondence which has been going on in your columns between A. W. Allen and James S. Colbath. The question of the determination of free cyanide has always been a puzzling one, and as my book on the 'Chemistry of Cyanide Solutions' has been referred to by the writers, it may be as well to state that the method given on page 25 (2nd edition) of that book gives results approximating to the true 'free cyanide' only when the solution contains but little other impurity except zinc. At one time I made a good many investigations on this subject, but as a matter of fact I find that practically every operator works out his own method of testing, and eventually discovers an end-point which he can recognize and reproduce within reasonable limits in making his daily tests. Whether this point really corresponds with 'free cyanide' as defined is a matter of no practical consequence; what it indicates is a condition of the solution which has been found empirically to be suitable for performing the work required of it. In testing a solution with silver nitrate, using every precaution as to filtering, and working with perfectly clean vessels, a faint turbidity generally appears almost from the first, and becomes more and more marked.

The operator stops when this turbidity becomes clearly noticeable to him, the point depending on individual eye-sight, and individual opinion as to what constitutes a sufficient degree of cloudiness for a finishing point.

It is possible that both Mr. Allen and Mr. Colbath may be right. A system of testing which answers satisfactorily with solutions from one ore might fail completely in other cases. At the Santa Gertrudis mill at Pachueca it was found quite impossible to determine free cyanide, and the attempt was given up: the solutions were always tested with KI indicator and AgNO_3 run in until a distinct yellow turbidity remained permanent, the figure obtained corresponding to something less than the total cyanide. This condition was easily observed and solutions adjusted to correspond with a given strength as indicated by this test. No inconvenience whatever resulted from the failure to determine the actual free cyanide.

J. E. CLENNELL.

Oakland, California, March 9.

Vocational Training and Miners

The Editor:

Sir—Your editorial of March 7, on 'Vocational Training and Miners,' will, I fear, raise a hope that is not yet warranted. You say that the University of Cincinnati has arranged with owners of large plants for a coöperative course, one set of pupils working in the shops in the morning and in the school in the afternoon, and exchanging places with another set at midday. In this way, there is no interruption of routine, and yet school and work are taught at the same time. I fear that this news is too good to be true. It is the plan that I have been trying for years to have adopted. When such work has been done the students have been taken from school to the shops for periods of not less than two weeks, thus most effectually breaking up the necessary routine work of the school and of the shop. When the children are allowed to give half of their daily time to shop work, and the other half to school work, we will have fairly started on a sane educational system. Your statement that "it is the absence of vocational training that endangers the present free rise of a working man from the ranks to leadership," is absolutely true. Members of the Virginia City School of Mines organized among themselves a prospecting and development company, secured ground, and developed a profitable mine—even in the supposed dead and sadly abused mining district of Virginia City, where it now seems that a round of holes cannot be blasted in a streak of ore except by order of anxious stock brokers who are also the directors.

You furnish abundant proof of how a man is made 'class conscious' in the disagreeable sense in the articles contributed in answer to your question, 'What is the matter with prospecting,' and 'A Rejoinder,' but the question has not been answered, except by the work of prospecting and development that has been accom-

published by the members of the Virginia City School of Mines.

Frederick Burk, of the San Francisco Normal School, may not be able to tell you what is the matter with prospecting, but I am quite sure that he can tell you what is the matter with our educational system; and if his advice is followed, the mineral industry of our country will be greatly benefited, and in short order it will be possible to truthfully say that there is nothing the matter with prospecting.

G. McM. Ross.

Stockton, California, March 9.

[We can assure our correspondent that the plan advocated was actually put in operation at the University of Cincinnati some years ago and was found to work well. If it has been abandoned we have not learned that fact, but write subject to correction.—Editor.]

Mine Administration and Mine Bosses

The Editor:

Sir—Some time ago in your columns ran several articles by an old miner,* who had gone from 'Dan to Beersheba,' and at the end of his gypsy tour had only blame for the companies and unstinted praise for the miner. One other type only praises the miner so. That is the tenderfoot superintendent, the workings of whose mine consist of a shaft and one or two drifts. He will tell you how faithfully they work and how they never 'soldier.' Certainly they work, for he is on top of them all the time. Give him 10 levels and 250 men, and let him remain away from them, and see what they do.

As a matter of fact, much ore and efficiency is lost in all metal mines because the companies are niggardly in the number of shift bosses allowed. Take a shift boss who watches several levels, with the machine runners, trammers, shovelers, and timbermen, and follow him on his trip through the mine. He must see these men, but there is a likely streak going into the wall and it ought to be sampled; the men in the stope are breaking the ore too wide; the assays show that the ore in another stope has left the foot and is running in the hanging; or a rich streak has come into the drift and maybe it ought to be stripped. Meantime he must make his round and the ore must come up, and he cannot give his close attention to these important but smaller details. Eventually the mine goes on a leasing system. The ore is blocked. The lessees go on the blocks and give almost microscopic attention to its streaks, the courses of the ore, the timbering—to all the things that make money. A good shift boss can do the same, and extra shift bosses would be paid for easily out of the ore they would find. The closer to a leasing method a mine runs when on company account, the better it is run, and that ideal is approached by using a greater number

of competent underground bosses, and putting each man in charge of a block of ground not too large for him to handle it closely in all ways.

'A Miner' also tells of the gales of profanity directed at the men. I never saw that. It is not needful. I know a gold mine that lifted 90,000 tons last year from a single-compartment shaft without that. But the most interesting statement of 'A Miner' he makes again and again, namely, that there are mine bosses that make a man do "two days work." Those mines I do not know. I want to know them. I want to see one of them, and I want to make a low bow to the superintendent and his foreman. What I have seen at every mine is a new man land on the station, turn to the old hand and say, "What's a day's work on this mine?" Or translated it means, "What is the smallest amount of work that I can do and still hold my job?"

A PERPLEXED SUPERINTENDENT.

Cripple Creek, Colorado, February 10.

Milling Operations at the Eldorado Banket Mine, Rhodesia

The Editor:

Sir—The statement of milling operations at the Rhodesian Eldorado Banket mine, which appeared in your November 1 issue, is of interest, but would probably have demanded more attention if the combined recovery by amalgamation and cyanidation had not been shown to amount to something over 110%. This was evidently due to a printer's error. The metallurgical staff and the scheme of treatment should both be credited with the satisfactory results of the year's work, and I have therefore ventured on a corrected summary.

Tonnage treated	88,209	
	Value of gold	
	content.	Per cent.
Original ore	\$12.93	
Recovered by amalgamation.....	9.36	72.52
Mill tailing	3.57	
Recovered by cyanidation	2.76	21.24
Residue	0.81	
Total recovery		93.76

These figures are compiled from extracts from the annual report appearing in the same statement. It is also interesting to note that the actual recovery is within one per cent of the theoretical extraction; and that the total cost for cyaniding is 60c. per ton.

A. W. ALLEN.

Lonely Mine, Rhodesia, December 11, 1913.

Nitrate production in Chile during the first 10 months of 1913 was 2,551,744 short tons. The price in November was \$1.85 per 100 pounds. The Chilean government is alive to the fact that in the majority of nitrate works methods are out of date, therefore it is investigating the situation with a view to improving the mining and production of the mineral.

*'Mine Administration and Mine Bosses,' *Mining and Scientific Press*, March 1, 1913.

Concentrates

Most of these are in reply to questions received by mail. Our readers are invited to ask questions and give information dealing with the practice of mining, milling, and smelting.

A correspondent wishes to know if any reader of this journal has details of a Chilean (Bryan) mill being worked as an arrastre.

Oil production of the Balakhany-Sabunchy-Ramany, and Bibi-Eibat (Baku region) districts, of 2498 acres in Russia, since 1870, total 1,382,200,000 barrels.

Potash salts exported from Germany in 1913 totaled 1,829,617 metric tons. The agreed deliveries of the potash syndicate for foreign and domestic consumption in 1914 is to be 1,166,600 tons.

For ordinary steel shafting carrying pulleys, the horse-power transmissible per 100 revolutions may be found from the following formula: $2 \times S^3$, where S equals the diameter of the shaft in inches.

The circular shaft at the Champion Reef mine, India, has been bricked to a vertical depth of 3861 ft. It is now being fitted with steel girder dividers and 92-lb. steel rails as guides. This material weighs 700 tons and cost \$52,800. Two engines have been erected for hoisting.

Trolley wires have been dispensed with in the Bunker Hill & Sullivan mine, Idaho, and Mt. Morgan, Queensland. In place of these, electric storage locomotives are to be used in the former, and horse traction in the latter. The danger of overhead wires to employees has brought about these changes.

The ore deposits of Charters Towers, Queensland, occur as shoots in numerous distinct lodes of the ordinary fissure type, a prominent feature being the tendency of the lodes to split into branches which usually unite again; but which may become several hundred feet apart before doing so. The main workings of the mines are within an area of 4000 ft. square, and are down to a vertical depth of over 2600 feet.

Blasting rock is frequently done in large quantities. At the Kelly Butte quarry, Multnomah county, Washington, the face was 80 ft. high. Holes were bored and charged with 1250 lb. of 40% Du Pont 'straight' dynamite, and 560 kegs of Du Pont 'B' blasting powder. The work was well done, and no noise was made save that of the rolling rocks grinding against one another. The rock dislodged amounted to 21,373 cubic yards.

A simple though unusual arrangement was adopted at the mill of the Silverton Mines Ltd., Silverton, B. C., for driving the two, 8 ft. by 30 in. Hardinge mills there in use. Water under pressure being available, two small

Pelton wheels were used, one for each mill. The wheel was in each case mounted on a shaft set parallel with the axis of the mill and geared direct to the latter. Regulation of the water supply permits easy and simple control of the mill.

Turbo air-compressors are being used in America for air at all pressures up to 100 lb. Large installations have recently been erected for blast-furnace work, both the steam and air ends being turbines. The Tennessee Coal, Iron & Railroad Co. has recently installed a machine of this class which is giving a volume of 55,000 cu. ft. per minute at from 18 to 22 lb. pressure. This machine may be run either through exhaust or live steam, a regulator being supplied by which it is shifted from one to the other as the exigencies of the case demand, according to W. L. Saunders, in the *Compressed Air Magazine*. The largest air-compressing plant in the world is now in service on the Rand, and the fact that this plant is being enlarged from time to time is an evidence of the success of the turbo system.

Uranium minerals have been considerably discussed by the mining world of late, on account of the radium that they contain. According to Frank L. Hess, of the U. S. Geological Survey, Colorado and Utah supplied the only ores in this country in 1913. The output was 2140 tons of dry ore, containing an equivalent of 38 tons of uranium oxide. According to the Bureau of Mines estimates, the metallic radium content of the ores was 8.79 gm., or 16.40 gm. of radium bromide, worth about \$1,055,000. The total value of the carnotite ores sold was about \$142,000, representing the uranium value only, as little was paid for the vanadium content. The increased output in 1913 was about 50% over that of the previous year. Of the output, 19.25 tons of uranium oxide, containing the equivalent of 8.3 gm. of radium bromide, was exported to Europe. The Survey has been investigating the deposits in these two states.

The efficiency of native labor is often compared with that of white labor about mines. During September of the past fiscal year, the Champion Reef mine, India, employed a total of 6716 men, of whom only 143 were Europeans, mainly overseers. During the year, 277,336 tons of 'rock' was extracted from the mine, and if there were 3686 natives underground, as given in the report for September, the output per man was 75 tons per year; and figuring on the above and below surface employees, 6716 in all, the output was 41 tons per man. In Western Australia, in 1912, the ore mined was 2,688,868 tons, and the work done was 365 tons per year per man underground, and 204 tons per man of the total employed at mines. It would seem, therefore, that the relative efficiencies were about as five to one. At the Mt. Morgan mine, Queensland, ore produced per underground employee is 1.32 tons per 8-hour shift.

Special Correspondence

MANILA. PHILIPPINE ISLANDS

GOLD OUTPUT IN 1913.—SYNDICATE, KEYSTONE, AND COLORADO MINES.—DREDGING FIELDS.—CANSURAN HYDRAULIC PLANT.—AGUSAN BASIN.—NEW PLANT FOR THE BENGUET CONSOLIDATED.—MINING EXHIBIT.—PROPOSED STOCK EXCHANGE.

The past year shows a considerable increase in the gold production over 1912. The estimated figures for the past year are over ₱1,500,000, and the output for 1914 promises to be over ₱2,000,000.

The Syndicate mine, in Masbate, has just started operations, the mill having been completed in record time for this

turned from that country, bringing back a small bottle containing ₱35 worth of coarse gold which was taken from a hole dug for water less than a cubic metre in size. The Company is employing about 150 men. By May 1, it is hoped the first clean-up will be made. The following equipment will be in operation: About 1½ miles of hydraulic steel piping, ranging from 11 to 24 in. diameter; 1½ miles of flume and ditch; 4 miles of tramway; a 200-hp. Pelton water-wheel; a 150-kw. electric generator; an electric lighting plant; an air-compressor and drill; and a logging engine.

Considerable prospecting has been carried on in the Agusan river basin, and recently a prospector brought in some pyrite pebbles which gave fairly rich assays. It will be recalled that similar pyrite pebbles have been found in the banket of the Rand. A prospector who has just returned from Antique province, Panay, has brought in some good specimens of copper ore, containing metallic copper, cuprite, malachite, and some chalcopryrite. The deposits lie within 14 minutes' walk of the beach, and are said to be extensive.

R. Y. Hanlon, well known in the Philippines as a competent mining engineer, has gone to the United States to purchase machinery for the rehabilitation of the Benguet Consolidated property in Benguet. It is planned to install an up-to-date plant capable of handling 80 tons of ore per day. It is hoped that the plant will be in operation before January 1, 1916. The former mill on this property was washed away in the typhoon of October 1909.

Much of the machinery for the Rizal Cement Co. is now on the ground at Matiquio, Jala Jala peninsula, Laguna de Bay. This concern is capitalized at ₱1,000,000.

The Division of Mines of the Bureau of Science is preparing a comprehensive exhibit for the second Philippine exposition. The exhibit will contain many new minerals (not new to science), maps, pictures, and a large assortment of working models. It was expected that the provincial exhibits would be found to contain many valuable mineral specimens. Unfortunately, just a week before the opening of the exposition, the entire provincial exhibit was burned out and many samples from the provinces were destroyed or misplaced during the resulting confusion.

There is a movement on foot among the more conservative Manila business men to establish a stock exchange. This, if properly controlled, can do much to help the legitimate mining companies and also to protect the public from overenthusiastic promoters. The Division of Mines of the Bureau of Science is well aware of the evils existing and the harm done to the country, but has no authority to act in an administrative capacity. The mining industry is menaced by two evils which must be remedied namely: floric prospectuses and subsidiary companies.

The political situation has improved somewhat, and it is hoped that, when the 'independence bogey has been put to sleep,' capital will again be forthcoming to grease the machinery of business which of late has become somewhat clogged.

PLATTEVILLE, WISCONSIN

BAD WEATHER INTERFERES WITH WORK.—METAL PRICES DURING FEBRUARY.—ORE PRODUCTION BY DISTRICTS.—PROSPECTING.

February was this year still further kept from making a good showing in the production of ores on account of severe winter weather, heavy snowfalls, and at times exceedingly bad roads, affording neither wagoning nor sledding for the outlying producers. The metal markets advanced at the beginning of the month, spelter being quoted on the St. Louis exchange at \$5.40, but the little gains made were not long upheld, and the close of the month saw metal back on a basis of \$5.20 per 100 pounds. Large consumers were indifferent to the requirements of their trade it seems, during the month, and spelter producers were operating on about two-thirds



THE NORTHERN PHILIPPINES.

country, about eight months. This is an all-sliming decantation plant, Hardinge ball and pebble mills being used instead of stamps and tube-mills. The Keystone company, operating two Lane mills, has sent two shipments of precipitate to Manila; but so far it has not been learned what the recovery of bullion was, although it is said to be satisfactory. The Colorado mine continues its steady progress.

In the dredging fields, the new boat on the Umirai river is about to begin operations, and from the Malaguit encouraging reports have been received. The sixth dredge in the Paracale district is about to be constructed, and the output in 1914 from this district is estimated to exceed ₱1,000,000. In the Cansuran district of Mindanao, hydraulic machinery for the Cansuran company is already being installed. Some difficulty has been experienced due to transportation troubles, but this will soon be overcome. D. M. Carman has just re-

capacity purposely trying to maintain prices. This course on the part of spelter manufacturers undoubtedly served to hold the price where it remained. Zinc ore was especially in good demand, the finished ore ruling steady for the month at an average of \$14 per ton for 60% grades. A top price was reached for premium grade out of the Linden district of \$43. The lower grades were not in such good demand, and The Mineral Point Zinc Co., which usually sets the pace in bidding had little competition in the field from local buyers or outside smelters. Conservatively estimated there was held in bins at the close of February 4500 tons of reserve zinc ore concentrate which will act against higher prices until this surplus is eliminated. Carbonate zinc ore producers in the northern districts could not get to track with their output at all, and as fast as roads improve pile their product alongside of track where it will be available as soon as a demand sets in, and most likely the spring break up will prevent carting for several weeks. Lead was in poor demand and shipments were exceptionally light.

Deliveries by districts for the month of February from mines to separating plants in the field, and thence to smelter were reported as follows:

Camps.	Zinc, pounds.	Lead, pounds.	Sulphur, pounds.
Benton	4,684,000	83,500	2,337,300
Livingston	2,620,000	.....	.....
Galena	2,366,000	.....	.....
Hazel Green	2,340,000	.....	.....
Cuba	2,104,000	.....	1,407,600
Linden	1,852,000	164,920	315,900
Platteville	1,790,000	.....	.....
Shullsburg	1,610,000	75,000	.....
Harker	892,000	.....	.....
Highland	448,000	61,300	.....
Montfort	138,000	.....	.....
Mineral Point Locals	34,000	.....	.....
Mineral Point Zinc Co.	2,300,640	.....	.....
Total	23,178,640	384,720	4,060,800

Regardless of weather conditions prospecting with drilling machines was prosecuted vigorously, especially in the southern districts of the field, and invariably with excellent results. One strike occurred in the Mifflin district, but the men only remained out a few days, returning on promise that better wages would be paid at the first opportunity following improvement in ore prices.

SYDNEY, NOVA SCOTIA

METAL MINING PROSPECTS.—NOVA SCOTIA STEEL & COAL CO.'S OPERATIONS.—COAL MINING AND THE ACADIA COAL COMPANY.

Metal mining in the province has been practically at a standstill. In Guysborough county it is stated that a good body of manganese ore has been discovered. It will be interesting to see whether any valuable development will be made or only a poor prospect, such as has frequently been offered from this county in the past. At Ingonish, in Victoria county, a small gold mine is being steadily opened to a productive stage. No plant has as yet been ordered, but the complete laboratory equipment keeps the concern abreast of development. This is the only gold mine operating in the island of Cape Breton.

The Nova Scotia Steel & Coal Co. has just completed the most profitable and promising year of its existence. The facts given in the annual report show that the earnings amounted to \$1,225,953, an increase of 25% over 1912. The sum of \$527,886 is carried over to credit of profit and loss account, after providing for depreciation, sinking fund, interest, and dividends. Considerable improvements have been

made in the mining plant and in the steel works. In the latter department, a new open-hearth steel furnace has been started successfully. The iron ore mines of this Company, on Bell Island, Newfoundland, are extensive, and now reach the large total of 91 square miles, held under title from the crown. Some of the undersea workings are as far as three miles from the shore, and at that distance the ore is 25 ft. thick. This gives an idea of the extensive reserve of ore that this corporation holds.

Coal mining in the province appears to be falling into bad repute. Following the trouble with the finances of the Drummond mine, belonging to the Intercolonial Coal Co., the Acadia Coal Co.'s mine has ceased operations. The reason assigned is that there is no profit, at present prices and costs, in operating the mine. This statement has evoked considerable feeling in the district, and there is a disposition on the part of the workers to force the provincial government to challenge the Company's statement and take a hand in the dispute. Some time ago there was a proposal mooted, that the government should acquire some mines of its own, and if this idea was seriously given, now is the chance to carry it out. During the latter part of February there have been a number of meetings at Halifax between Mr. Evans, the general manager of the Acadia Coal Co., Charles Fergie of the adjoining Drummond mine, and C. J. Coll, a former manager of the Acadia, and it seems likely that some deal will be consummated whereby the Acadia mine will probably be operated by the Intercolonial Coal Company.

KALGOORLIE, WESTERN AUSTRALIA

WAGES AT NORSEMAN AND MEEKATHARRA.—THE LANCEFIELD TO START AGAIN.—VICTORIOUS MINE.—OROYA LINKS IN 1913.—BULLFINCH RESERVES.—NEW PLANT FOR CHAFFERS.—FINGALL AND ASSOCIATED OPTIONS.

The Norseman wages agreement having expired, a fresh agreement, to remain in force until December 10, 1916, has been duly entered into and signed. The basis of pay is 8 cents per shift higher than the Kalgoorlie schedule, and this was accepted by the Chamber of Mines. The Mararoa is the only mine at Norseman on the dividend list, and as the bottom of the mine is unprofitable, it will soon cease to be on this list. The Meekatharra miners' union recently submitted a new schedule to the Chamber of Mines, but as it contained advances from 18c. to \$1.08 per shift, it was returned as frivolous, and the men are still working under the old schedule which is 20c. per shift above Kalgoorlie rates. Only three mines are paying dividends at Meekatharra and they are all owned and worked by working miners. There are three capitalized companies at work, but none of these has so far returned anything to shareholders.

The Kalgoorlie & Boulder Firewood Co., one of the principal creditors, has bought the Lancefield mine for \$27,800, this being the only tender submitted for the property. This mine has produced \$4,140,000 from 540,000 tons, or \$7.66 per ton, but has never paid its way, and when it closed down the company was \$200,000 in debt. The ore reserves in the mine were estimated by Bewick, Moreing & Co. at 250,000 tons assaying \$8 per ton; but this grade was not considered profitable. There is a 40-stamp mill, and a sulphide plant consisting of 8 Krupp ball-mills, 6 Edwards furnaces, filter-presses, etc., on the mine, and all are included in the sale. The mine is now in charge of J. Dunstan, at one time metallurgist at the Associated, and subsequently inspector of state batteries. Mr. Dunstan expects to make a profit of selecting the ore, and so raising the grade slightly above the general average of the mine.

The Associated Northern company's Victorious mine at Ora Banda is proving disappointing on No. 6 level. The first ore-

shoot met with is only 40 ft. long and assays \$14.75 per ton. A blank of 77 ft. intervenes, and then a second shoot 30 ft. long assaying \$19.20 was opened. The drift has been continued another 36 ft. in barren country. Owing to the creep in the upper levels, little if any oxidized ore is available, and there is talk of stopping the treatment plant. It is not quite decided if developments in the sulphide zone warrant the installation of a sulphide plant. The Company's old Iron Duke lease at Kalgoorlie is also nearly worked out.

During 1913 the Oroya Links company treated 139,130 tons, yielding \$748,700 and a profit of \$139,600, besides placing \$6000 to bullion reserve and equipping and overhauling the Croesus shaft at a cost of \$21,800. The directors have just declared a dividend of 5%, amounting to \$71,890. As expenditure on capital account is now complete, a minimum profit of \$15,000 monthly is anticipated in the future. The Croesus shaft is down 939 ft., and cut the lode at a depth of 932 ft., and followed it in the shaft for 7 ft. The first 3 ft. assayed \$6.50 and the last 4 ft. \$4.80 per ton.

On December 31, 1912, the ore reserves of the Bullfinch Proprietary mine were estimated at 177,300 short tons, of a recoverable value of \$10.36 per ton. Since then 52,677 tons has been treated, returning \$690,100, equivalent to \$13.10 or \$2.74 per ton over the general average of the mine's reserves. The extremely rich ore on which the mine was sold has been drawn on to some extent, and as it cuts out a little below 100 ft., it cannot last much longer. To give some idea of how rich this ore may be judged from the fact that 1776 tons treated returned \$430,000. It will be interesting to know what new estimates A. Hay, the present manager of the mine, will give. The north and south series of lodes have been opened during the year, but are not up to the average estimated a year ago.

The directors of Chaffers have decided to install a new sulphide plant with a capacity of 7000 tons per month, and the management is already busy dismantling the old plant. The development done since John Morgan's report, dated May 1912, has opened no reserves except the ore broken in opening the lodes. Most of the work since done has merely shown that the west branch of the No. 3 lode carries assay values of \$26 per ton for a length of 180 ft., and that No. 4 lode assays \$8 per ton over 326 ft. for the full width of the drift. The west branch of No. 3 lode is 427 ft. from the shaft, and No. 4 lode 529 ft. west, and as this drift is quite isolated, the ventilation is bad, and there is no level above or below to connect with. Mr. Morgan estimated the ore reserves as 75,000 tons returning \$6.60 per ton, but that quantity will soon be eaten up by a plant treating 7000 tons per month.

The Great Fingall company has acquired a six months working option on the Big Bell mine, 18 miles west of Cue. Two big lodes, one quartz and the other schist, the latter 60 ft. wide, run through this property, and, according to careful sampling, average \$6 per ton. Prior to Hope Nicolson, the manager, securing the option, the mine had been thoroughly sampled by the Great Boulder Proprietary people, but was turned down by Richard Hamilton as unsuitable.

The directors of the Associated appear so convinced that the calc-schist intrusion has 'knocked the bottom' out of the mine that they have acquired an option on the North Thompson mine at Porcupine, Canada, in addition to the interest in the Keeley mine at Cobalt. During last year the whole attention of the management of the Associated has been concentrated on the upper levels of the mine above the calc-schist, but nothing striking has been discovered, so the company is emigrating. Up to date, quite a lot of money earned by mining companies in Australia has been lost by their emigrating to other parts of the world, but the Associated may be luckier than the Great Fingall, Boulder Perseverance, Lake View Consols, and many others, who all had disastrous experiences.

The Ivanhoe mine produced gold worth \$158,000 from the treatment of 20,240 tons of ore in January. This was divided into 9170 tons of sand, 9020 tons of slime, and 2050 tons of concentrate. The 100-stamp mill worked 2925 days. The profit was \$48,500. The main shaft is down 2953 ft. in country, assaying traces. The rock-crusher station has been burned, and the mine will be shut down for three weeks. At the Associated, a turbo-generator set has been working for about four years. Connection has recently been made with the power lines of the Kalgoorlie Power & Lighting Corporation, and the forty odd motors in the plant are being driven from this source. If satisfactory, the turbo will probably be stopped. A creep in the Bullfinch has affected the mine from the surface to the 210-ft. level.

The gold output of the state in December was valued at \$2,260,000, and a total of \$26,784,000 for 1913, against \$26,208,000 in 1912. Since 1886 the gold output is valued at \$547,500,000. Principal yields in December were as follows, all being low on account of the Christmas and New Year holidays:

Mine.	Tons.	Value.	Profit.	Dividend.
Associated	8,343	\$ 48,000	\$ 370	.....
Associated Northern:				
Iron Duke	*735	14,000	3,800	.....
Victorious	6,515	31,200	100	.....
Bullfinch	6,330	67,200	40,300	.....
Golden Horse-Shoe	19,749	97,000	†33,500	.....
Gt. Boulder Proprietary	*15,194	230,000	128,000	328,100
Gt. Boulder Perseverance	14,088	77,000	2,400	.....
Great Fingall	4,379	49,000	†9,500	.....
Ivanhoe	19,380	172,800	62,400	.....
Kalgurli	9,720	97,000	43,200	.....
Lake View & Star	16,022	87,000	16,800	60,000
Mountain Queen	*4,000	18,700	4,800	.....
Queen of the Hills	3,656	28,800	5,700	.....
Sons of Gwalia	13,950	101,000	19,300	81,250
South Kalgurli	9,529	43,000	3,800	.....
Yuanmi	9,890	85,300	65,700	87,500

*Including tailing re-treatment. †Loss.

NEW YORK

BRITISH COLUMBIA COPPER CO.'S AFFAIRS.—COBALT NEWS.—BRADEN OUTPUT.—MASS CONSOLIDATED, ST. MARY'S MINERAL LAND, AND OSCEOLA CONSOLIDATED REPORTS.—GEOLOGICAL WORK IN CHINA, AND FINANCES.

As mentioned in previous letters, the British Columbia Copper Co. is being reorganized. On March 17 the Company announced that 315,101 shares of the stock had been deposited out of a total outstanding of 591,709. Also a good deal was deposited with the trust company. As a result of these deposits, the plan for the organization of a new concern, to be known as the Canadian Copper Co., Ltd., is declared operative. During the year ended December 31, 1913, the Company's revenue was \$1,904,693, against \$2,491,288 in 1912. The profit was \$111,856, but in writing off \$465,736, and paying dividends of \$88,756, there was a deficit of \$442,596. The present surplus is \$523,140. F. R. Weeks, in charge of development at the Gardner and Vancouver properties at Copper Mountain, states that reserves are about 1,000,000 tons of average grade ore. The Hedley Gold Mining Co., also operating in British Columbia, has declared a dividend of 30c. per share. In 1913 net profits were \$405,254, and dividends \$360,000. The present surplus is \$272,095. For the three months ended January 21, 1914, the Granby Consolidated made a profit of \$167,861.

In a winze below the 225-ft. level of the Cobalt Lake mine, the '2B' vein is 2½ to 3 in. wide, containing 5000 oz. per ton and good milling ore on either side for several feet. The mill may be increased to 175 tons per day capacity. Ex-

traction in 1913 was 81.3%. Preliminary work for the draining of the lake is in progress. It is probable that the Van Cutsem interests in the Cobalt Townsite, Cobalt Lake, City of Cobalt, Townsite Extension, and Cobalt Reduction companies will be consolidated with a capital of \$7,500,000. The Nipissing main shaft is 900 ft. deep, the lowest point in the district. Silver shipped in February was 697,506 oz. The Company has declared quarterly dividends of 5% each. La Rose has also paid a 2½% distribution. The last annual report of the Casey Cobalt Mining Co. shows that reserves of silver blocked out in the mine, in stopes and on dumps, are 1,438,500 oz. Ore treated was 7444 tons, yielding 256,697 oz., with 84.1% recovery. The tailing assayed 6.5 oz. per ton. The total expenditure was \$150,862, equal to 22.7c. per ounce. A dividend of 24c. per share was paid. During the 11 months ended September 30, 1913, the Cobalt Townsite Silver Mining Co. of Canada, Ltd., treated 34,125 tons of ore averaging 21.12 oz. silver per ton. Shipments of concentrate, slime, ore, and bullion amounted to 1,987,922 oz., worth \$1,206,594. The cost was 23.44c. per ounce. Net earnings were \$629,623, as against \$512,082 in 1912. Dividends of \$1.44 per share were paid. Ore reserves contain 2,140,560 oz. silver. The lower-grade ore is of greater extent than was expected, and a half interest in the Northern Customs mill was purchased.

During February the Braden mills treated 79,296 tons, averaging 2.08% copper. The recovery was 68.63%. This figure is somewhat lower than in January, when an extraction of 72.70% was made on ore averaging 2.15%. The copper production was 2,362,000 lb. The production would have been greater had it not been for a shut-down in the power-plant which delayed operation several days. This was due to one of the electric generators being out of commission.

Like all other copper mines in Michigan, the Mass Consolidated Mining Co. suffered through the miners' strike in 1913. At present, conditions are approaching normal, and the Mass mine is being restarted. Development has been done at several levels at 'B' and 'C' shafts. A considerable tonnage is developed on the Evergreen and Ogima lodes, according to the superintendent, E. W. Walker. Results were as follows:

'Rock' stamped, tons	78,250
Refined copper output, pounds	1,213,545
Average price received, cents per pound	15.6
Total revenue	\$189,557
Mine and milling expenses	157,591
Total expenses	217,564
Deficit	28,006
Strike expenses	40,274

The St. Mary's Mineral Land Co. owns over 107,146 acres of land in the copper districts of Michigan, and holds shares in a number of mining companies, the Champion being the most important. The lands held are not sold outright, but the Company helps in the formation of new companies and in development of properties. The income during 1913 was \$846,739, including cash on hand from 1912, \$150,370; dividends from the Champion, \$450,000; notes collected, \$215,000; interest, \$10,170; and wood and timber, \$14,661. Expenses were \$621,835, including dividends of \$480,000; Winona assessment, \$56,778; Houghton assessment, \$37,222; taxes, \$25,255; and salaries, \$14,275. Cash on hand at the end of 1913 was \$224,903. The assets consist of 93,033 acres of unsold land, 14,113 acres of mineral rights, 269,016 shares in 18 mines, \$34,276 notes receivable, and \$224,903 cash. There are no liabilities.

The Osceola Consolidated Mining Co. is one of the more important copper mines in Michigan, and the report for 1913 shows the following:

'Rock' stamped, tons	735,044
Copper production, pounds	11,325,010

Copper sold, pounds	10,958,926
Revenue from copper	\$1,753,626
Total revenue	1,774,810
Net profits	381,967
Dividends, deficiency taken from surplus	721,125
Surplus	1,549,300
Cost per pound of copper, cents	12.30

Operations were hampered by snowstorms, scarcity of trammers, and the strike. Only one-man machines are now used in the mines. The new electric pumps, costing \$33,541, are saving \$500 per month. No. 5 stamp has been remodeled.

It has just been made public that M. L. Fuller and F. G. Clapp are making the geological surveys in China upon which the Standard Oil Co. is to undertake development under terms of the agreement noted in the editorial columns last week and in the news columns earlier. Messrs. Fuller and Clapp are graduates of the Massachusetts Institute of Technology who, after some years on the United States Geological Survey, resigned to go into general consulting work. With offices in Boston and Pittsburgh, they have been brought into intimate contact with the oil industry, and their employment indicates the care with which the Standard is going into its new venture.

In its issue of February 7, the *North China Herald* states that China has better security to show now than last year, or even during the past 10 years. There is also the added security of the salt revenue, and remote provinces have promptly sent in their collections to the foreign banks, even when the central government had little control over them. These collections are increasing. The most noteworthy change in the monetary position is that the Chinese have brought out their money and are using it for business. While the total stock of silver is being reduced day after day, the total with the foreign banks following the same course, the stock with the native banks has been rapidly increasing. Not for years have the native banks had so much *sycee* in their control as at present, in spite of the fact that credit has been rapidly expanding during this period. The holdings in Shanghai by banks and others consist of £5,350,000 in *sycee* or currency, and £170,000 in bars, an increase of £67,000.

TORONTO, CANADA

BOUNTY ON IRON ORES URGED.

The Ontario Associated Boards of Trade, together with other interests closely identified with mining in northern Ontario, have adopted a resolution for presentation to the Dominion Government asking that a bounty be placed on all iron mined and shipped from mines in Canada. They also ask that a commission be appointed by the Canadian Government for investigating conditions and report to the Government on the same. Notwithstanding the immense resources of iron ore in Canada, and particularly in northern Ontario, the production of iron ore for 1913 was valued at only \$424,072. This is largely due to the fact that only a very small percentage of Canadian ores are available for blast-furnaces until they have been concentrated or beneficiated in some manner. The cost of this beneficiation and the heavy expenditures necessary for plant and equipment in opening up iron mines of this character, has placed them at a disadvantage in competition with American ores, and it is believed that if a bounty sufficient to offset this difference were to be paid by the government, that it would greatly stimulate iron mining throughout Canada, and particularly in Ontario, and that the local ores could supply the greater part of the requirements of Canadian furnaces. In 1913, while iron ore to the value of only \$424,072 was mined, the value of the pig iron produced from Ontario furnaces was \$8,719,892.

General Mining News

ALASKA

KNIK

(Special Correspondence.)—Doheny and Thompson, the new owners of the Gold Bullion mine, are freighting in 100 tons of mining equipment, including a cyanide plant. The Alaska Gold Quartz Mining Co. is driving an adit during the winter. All prospectors coming in from the Matanuska-Nelchina placer camp speak well of the new district, and they have taken in 100 tons of supplies from Knik, the nearest outfitting



KNIK, ALASKA.

point, for summer use. Several thawing plants are on the ground. The Burke party has a hole down 55 ft. in muck on Crooked Creek bench. The last 5 ft. panned black sand and broken quartz.

Knik, February 9.

ARIZONA

The itinerary for the U. S. Bureau of Mines rescue car No. 3 in this state is as follows, during March and April: March 7 to 12, Clarkdale; 13 to 18, Wickenburg; 19 to 24, Ray; 25 to 31, Tucson; April 1 to 6, Bisbee; 7 to 12, Clifton; 13 to 18, Morenci; 19 to 24, Globe; and 24 to 30, Miami.

COCHISE COUNTY

Following up its 'Safety First' work, the Copper Queen company requires every man starting work on its property to have a physical examination and prove his fitness for the class of labor at which he will be employed.

GILA COUNTY

(Special Correspondence.)—The Miami mine produced 102,416 tons of ore in February. The mill is treating 3500 tons per day at present. Development covered 2610 ft. A Socorro fan will be installed underground. Of the seven main structures for the Inspiration company's plant, the American Bridge Co. will finish the shop and warehouse first. Steel work for the crushing plant and storage-bin is nearly complete, and the main shafts' head-frames are well under way. One hundred cars of steel for the concentrating plant are expected to arrive soon. A trestle, to span Geneva gulch and enter the mill above the ore-bins, will be 1800 ft. long and 120 ft. above the foundations at the highest point. McArthur Bros. have finished steam-shovel work at the site of the 5,000,000-gal. reservoir. Work at the smelter is progressing rapidly.

Miami, March 14.

MOHAVE COUNTY

(Special Correspondence.)—A week's trip through this county by a Los Angeles mining man has shown him that there is more activity on many properties than for several months past. The Arizona Venture Corporation is installing a gasoline hoist and machine-drills at its mine 60 miles south-east of Kingman.

Los Angeles, California, March 9.

CALIFORNIA

AMADOR COUNTY

According to C. H. Dutton, collector of minerals for the exposition to be held at San Francisco in 1915, this county will be well represented. He visited every Mother Lode mine from Plymouth to the Zella at Jackson, and promises of help were made.

ELDORADO COUNTY

There is said to be a good deal of activity in the Union mining district, three miles north of Eldorado. The Woodland Mining Co., working the Orum mine, has recently been incorporated with a capital of \$250,000. The hoist is being overhauled and a 10-stamp mill is being built. They will be driven by 40 and 20-hp. gasoline engines, respectively.

INYO COUNTY

No. 1 well, drilled in Death valley for the Pacific Coast Borax Co. by D. H. Wallace, is down 1000 ft. This was done in 17 days. The entire well shows a series of hard salt strata, each from 1 to 20 ft. thick, alternating with similar strata of clay more or less saline. To 250 ft. the salt is sodium chloride, but from this point to the bottom, principally sodium sulphate. No significant potash results are reported. No. 2 well is being drilled about six miles north of No. 1.

The Standard Consolidated Mining Co. operates a gold mine at Bodie, and its report covers the year ended February 23, 1914. The superintendent, C. E. Grunsky, Jr., gives the following information: Work was mainly devoted to treating the balance of the tailing in the ponds, prospecting in the mine, and economizing generally. The tailing held out to September 1913, and 10,151 tons was treated, worth \$5.43 per ton. Five lessees worked at the beginning of the year; but save one, they ceased mining before their terms were up. The last lease was taken over by the Company and was the only one which produced good ore to the Company's advantage. The mine produced 6342 tons of ore to September, averaging \$13.08 per ton. Stoping was done on 15 different veins at a cost of \$10.50 per ton. The total bullion from all sources was \$132,944, with 96.3% recovery. Costs per ton of mine ore were \$16.97, and per ton of pond tailing \$2.79, totaling \$135,595. Milling operations were stopped, but exploration for ore is being continued. A dividend amounting to \$44,598 was paid, making \$5,274,408 to date. The total output to date is \$16,457,839. Cash on hand is \$20,448, and bonds \$25,284. Excess of assets over liabilities is \$79,715. The present condition of the Company's property is not encouraging.

MARIPOSA COUNTY

(Special Correspondence.)—D. E. Upton is in Mariposa on his way to Mt. Pinocke, on the south fork of Merced river, a few miles southeast of the Hite Cove mine. He will examine the Little Wonder property of 14 quartz claims owned by H. Kiburg and F. H. Catheywood. The mine is said to be opening well. E. P. Kellogg and W. H. Reed, of Tonopah, Nevada, have gone to the old Dingley mine, while G. L. Kennedy, formerly of Tonopah, and William Melbourne, have been making an examination for some time. David F. Degan, of Kansas City, Missouri, and George Meesey, of Los Angeles, passed through Mariposa on the way to Jerseydale to examine the Comet mine. Mr. Degan is one of the owners of this property. It is equipped with a modern 10-stamp mill, concentrators, and assay office. It is expected extensive development work will be done in the near future. Chas. A. Schlage-tee, landlord of the Mariposa hotel, visited his mine, the Golden Gate, in company with an engineer who took a number of samples. These showed high gold content, probably assaying over \$30 per ton. A deal is said to be pending. L. C. Worthington and Thomas Smith have been examining the

old Barley Field mine, owned by Sam Landren. Mr. Worthington states that he has decided to install a small stamp-mill on this property and test it thoroughly. John Smithers and Bill Keener came in from the new discovery on the south fork of the Merced river, bringing in some rich quartz specimens. They report traveling over 10 ft. of snow, and will return as soon as the weather settles. James Westfall, who is a third owner in this find, has been expecting them in for the past 10 days, and his partners tell him it was so good they stayed the limit, 'on grub.' The old country road south of town has been changed recently, and the 'boys' have been having a great time with the rockers and pans, some of them cleaning up \$10 to \$12 per day. This calls to mind the early

per share on April 15. This is the second for the current year. C. H. Mallen is manager.

PLACER COUNTY

The El Dorado & Placer Gold Mining & Power Co. is working satisfactorily its new dredge at Poverty bar in the middle fork of the American river. The site is near the Butcher ranch. The boat has 79 buckets of $3\frac{1}{2}$ -cu. ft. capacity each, and can dig to a depth of 35 ft. The machinery is operated by five electric motors of a combined capacity of 220 hp. The hull is 45 by 85 ft. Twelve men are employed. The Company has invested \$125,000, and it has ground that yields over 50c. per cubic yard in gold. N. J. Martin is superintendent.

SHASTA COUNTY

Several copper-gold-zinc-silver claims in the Heroult district are attracting attention. High-grade ore is being opened in a vein 2 to 4 ft. wide in the Shasta-Belmont. Ore is to be sent to the Mammoth smelter in May. Good ore has been opened in the Arps, adjoining the Bully Hill. Work is to be resumed at the Minnie Healy, Missing Link, Endless Chain, and others. Results of experiments at the Noble Electric Steel plant, by R. C. Palmer and C. S. Smith of the Forest Service, in the manufacture of charcoal and other products from wood, are said to have been highly satisfactory.

The Balaklala Copper Co., whose option on the Hall fume process expires on March 28, has extended it for another six months.

TUOLUMNE COUNTY

(Special Correspondence.)—W. D. Murray, a prospector, reports having uncovered a rich vein 6 in. wide on government land adjoining the old Excelsior mine, near Confidence, and substantiates his story by exhibiting pieces of quartz liberally speckled with gold. The Tuolumne Deep Channel Mining Co. proposes to soon begin prospecting on the property of W. N. Sledge, near Confidence, which it recently has taken under bond. The property, which is traversed by an ancient river channel hidden beneath a lava covering, consists of 130 acres. The depth to bedrock will be ascertained by borings and an adit will then be driven to open the gravel. Los Angeles people have taken a bond on the O. K. group of three patented claims, adjoining the Tarantula mine on the north and operations have begun with a few men. The finding of a body of good ore on the first level of the Columbus mine last week, on the opposite side of the vein heretofore followed, has greatly encouraged the management of the property. The ore shows free gold and also contains a large percentage of sulphide.

Sonora, February 28.

In the matter of Matthew Harter v. C. W. Ayres, in which the formed sued the latter for \$25,000 and other monies obtained through a deal in 1911 for the Omega quartz mine and gravel channel at Jamestown, the court ordered an interlocutory judgment that, within 60 days Ayres pay to Harter \$12,750, or one-half the purchase price of the Omega mine, together with interest from date of the purchase at 7% from December 15, 1911, and that Ayres pay to Harter one-half of the sum Harter expended in working the mine, with interest thereon at 7% from the date of the rescission of the contract. The court also directed that Harter make Ayres a deed to one-half of the Joe Hooker mine. Should Ayres fail to make the payments within 60 days from the notice of the judgment, then Harter becomes the sole owner of the Omega mine. Should Ayres make the payments to Harter, aggregating about \$15,000, then Harter will own one-half of both the Omega and Hooker properties and Ayres will own the other half.

The McAlpine mine and contiguous properties consist of about 80 acres on the Mother Lode, 17 miles by road from Chinese. McAlpine hill is 2200 ft. above sea-level. In the early days, gold worth \$750,000 was recovered in a primitive mill, from 150 ft. below the outcrop of the vein. After being



MARIPOSA AND TUOLUMNE COUNTIES, CALIFORNIA.

days of '49 when placer mining was a paying business in Mariposa creek. The claims were only 12 ft. long from rim to rim, and assayed over \$1500 to the claim. A distance of some 6000 ft. below Mariposa was barren of gold, and undoubtedly a slide covered up the original gravel, which will some day be opened. The Mariposa mill is now crushing 180 tons of gold-bearing ore for Payne and Turner from the lease on the Giant, a half-mile southeast of Mariposa.

There has been a number of men working on the copper properties about $2\frac{3}{4}$ miles southeast of Mariposa. There are about 25 claims located on this belt, which has been bonded by David Ross and associates, and the owners are open-cutting Gossan in many places. The iron capping pans some fine gold. The country rock to the southeast is granite, and northwest is schist with a diorite wall. Several stringers of high-grade kaolin are being opened. There has been a big slide at the Mt. Buckingham mine, covering 150 tons of \$20 ore, and sliding down a big oak tree which is now in the mouth of the adit standing up as perfectly straight as if it had originally grown there. This is hard luck, as the owners expected to mill this ore at the Sweetwater 10-stamp mill as soon as the roads improved.

Mariposa, February 23.

NEVADA COUNTY

Good-grade quartz has been opened in the Rose Hill at Grass Valley. At McGee ranch, adjoining the old Idaho-Maryland mine, S. Watson and Wasley Bros. are extracting fine specimens. The Brunswick company will pay a dividend of 6c.

shut down for many years, a vertical shaft was sunk 455 ft. and crosscutting done at 200 and 375 ft. A further 200 ft. of driving will be necessary at 375 ft. to cut the rich shoot above. Several buildings are on the property, and water and electric power is obtainable nearby. In a few months the mine should be able to supply 75 tons of ore per day.

COLORADO

CLEAR CREEK COUNTY

(Special Correspondence.)—The Idaho Springs district produced 118 cars of ore in February, against 102 cars in that month of last year. The increase in metal value was \$10,000. Shipments from the Donaldson mine average 50 tons of \$70 gold-silver smelting ore per week. The vein was cut 1900 ft. in the Rockford adit. J. F. Wernecke of the Empire Zinc Co. of Denver is making ready to construct an electrolytic smelter in this city, which will be placed in the vicinity of the Newhouse tunnel. Electric machinery, costing \$5000, has been started at the War Dance mine, operated by the Rockford M. L. company.

Idaho Springs, March 3.

EAGLE COUNTY

It is just over a year since the rush to the Eagle district took place. Since May 1913 the Lady Belle has been shipping ore regularly. The North Dakota has sent out some ore, and the Best Chance has its bins full. The Lady Belle No. 4 and Grand View have cut ore. Besides the mines just mentioned, there are the South Dakota, Eagle King group, Selmas, Little Mary, Little Mary No. 1, Chester group, Rainbow, Contact, Kingston, Clinton's, Montana, Irma, and Inez, all being prospected.

The Iron Mask mill, near Red Cliff, has been working continuously for five years, treating the zinc-lead-gold-silver ore from the Iron Mask mine. The tonnage has varied from 80 to 120 per day.

FREMONT COUNTY

Miners in the Oak Creek cañon, near Canon City, claim to have opened a rich vein 1000 ft. long and from 2 to 8 ft. wide, containing gold, silver, lead, tungsten, uranium, and vanadium. For three miles around, the country has been staked. Snow is interfering with prospecting just now.

GILPIN COUNTY

The property of the Buckley Mining Co., next to the Gunnell mine at Central City, has been taken over by a number of prominent Salt Lake and Utah men and the Company reorganized. R. P. Morris is president. The mine has already produced \$200,000. The main shaft is down 630 ft. and is well equipped. The mine is drained by the Newhouse tunnel. Ore reserves are about 200,000 tons, worth \$14.05 per ton, mostly gold.

LAKE COUNTY (LEADVILLE)

Work at the Yak tunnel will result in changing the direction of the main bore from its present course. The Moyer drainage lateral is being altered for the main track to go through it, and so avoid the heavy ground just above the cut-off to the Cord winze. This winze is producing a large tonnage of sulphide ores, and the stopes are of great size. The Walker adit, in South Evans gulch, is in about 225 ft. in hard rock. The Consolidated Virginus Mining Co. is working the Virginus through the old Puzzler adit. W. E. Bowden and S. J. Sullivan are owners of the property. Development includes the opening of a body of ore abandoned by the old owners. Lessees at the Star of the West have opened a small vein assaying up to 2000 oz. silver and 40% lead.

TELLER COUNTY (CRIPPLE CREEK)

There are 20 lessees at the Golden Cycle mine extracting profitable ore.

During January, Stratton's Independence produced 5683

tons of ore averaging \$5.68 per ton. Low-grade mine and dump ore treated, 10,900 tons, with a mill profit of \$5500, a mine loss of \$3000. Development has been stopped to reduce expenses. Philip H. Argall, general manager, expects to open a good shoot of ore at 400 ft. shortly.

IDAHO

CUSTER COUNTY

(Special Correspondence.)—Two new discoveries have been made this winter on the upper middle fork of the Salmon river. A shipment of one ton of ore to the smelter returned \$83. A six-ton mill-run is being made on another which assays about \$100 in gold per ton.

Stanley, February 25.

MISSOURI

Missouri has only two smelters at present which are handling zinc concentrate, one in St. Louis, St. Louis county, and the other at Nevada, Vernon county, their retorts in 1913 totaling 2672.

JASPER COUNTY

Miners' phthisis is apparently prevalent in the district mines, and work is being done by the Jasper County Anti-Tuberculosis Society to help minimize the complaint.

MONTANA

SILVERBOW COUNTY

The Butte & Superior flotation plant treated 30,900 tons of ore in February, yielding 10,422,047 lb. of zinc from concentrate averaging 51.75% zinc, with 89.81% recovery. Rich ore is being mined on the 900-ft. level. The Butte-Duluth leaching plant treated 3200 tons with 89% extraction. The copper output was 65,000 lb. of electrolytic and 40,000 lb. of precipitate. Machinery for the new 1000-ton capacity in 8 hours crushing plant is on the property. The purchase of the mine by the American Metal Co. has fallen through, according to the president of the Butte-Duluth, A. B. Wolvin. At 1500 ft. in the East Butte there is 4 to 5 ft. of 5 to 6% copper ore and 10 oz. silver per ton. In February the Butte-Ballaklava shipped about 2400 tons of ore. Seventy feet of fair ore is being mined at 1200 ft. There is 30 in. of 20% copper and 25 oz. silver ore at 2400 ft. in the Tuolumne mine. February earnings were \$6500.

NEVADA

ESMERALDA COUNTY

(Special Correspondence.)—The directors of the Diamondfield Black Butte Reorganized Mining Co. will probably erect a mill in the near future. The Butte-Goldfield company will also install mining machinery within the next month or two. Goldfield, March 15.

NYE COUNTY

It is announced that the Morning Glory claim, application for patent to which was adverse on report of a Forest Ranger, has been clear listed for patent, the objections having been withdrawn. The case attracted some attention and was discussed in the *Mining and Scientific Press*, June 28 and August 2, 1913.

STOREY COUNTY

The Mexican Gold & Silver Mining Co. is being sued by A. F. Coffin, of San Francisco, for \$75,000 for alleged libel. Similar suits have been filed by several other share brokers of that city.

WHITE PINE COUNTY

During February there were only 18 disabling accidents at the mines and works controlled by the Nevada Consolidated Co., according to *Safety First*, its monthly bulletin. This is a reduction of 15 from preceding months.

NEW MEXICO**GRANT COUNTY**

United States Bureau of Mines rescue car No. 3 will be at the Chino copper mine at Santa Rita from May 1 to 5.

UTAH**BEAVER COUNTY**

A cyanide plant of 15-ton daily capacity is being operated by A. B. Blainey and others, lessees at the Sheep Rock mine. It is probable that a Kelly filter-press will be installed.

JUAB COUNTY

In unprospected ground of the Eagle & Blue Bell, at Eureka, a drift on the 1550-ft. level has cut 24 in. of silver-lead-gold ore worth about \$20 per ton. The mine is producing 100 tons of ore per day.

SALT LAKE COUNTY

After trying a number of fume-control devices, the American Smelting & Refining Co.'s Murray plant is now working full blast with no smoke issuing from its smelter stack.

WASHINGTON**FERRY COUNTY**

(Special Correspondence.)—The following ore shipments were made from Republic mines to smelters in January: Republic Mines Corporation, 8077; Ben Hur Leasing Co., 5177; Quilp, 401; Knob Hill, 2906; Rathfon Reduction Works, 44; and Black Tail, 185 tons. The San Poil mill treated about 3000 tons, of which 594 tons, included in the above, came from the Knob Hill mine. A meeting of the creditors of the Republic Mines Corporation was held at Spokane on March 7. There are several liens on the claims and taxes to be paid. On the 200-ft. level, the Ben Hur Leasing Co. is developing the vein north and south of the shaft. At the south, \$17 gold has been opened. On the 300-ft. level, the north drift is being extended beyond where the vein has produced over 100 tons of ore per day for the past six months. A stope is being raised to 200 ft., and contains 2000 tons of \$13 ore. The 400-ft. level north drift has been driven 350 ft. on the vein, and good shipping ore has recently been opened. At 600 ft., the south drift is in \$1 to \$9.20 ore. The Company employs 55 men, has good machinery, is in good financial condition, and has a lease until October 12, 1915. Five feet of ore worth \$31 per ton has been cut 150 ft. below the lower adit level of the Knob Hill.

Republic, February 27.

WYOMING**CROOK COUNTY**

There has been a rush to the new gold district near Eothen, in this county, 23 miles west of Belle Fourche, in South Dakota, near the boundary of the two states. Sixty claims have been staked. In a shaft sunk by Brownfield, Atwood, and Pearson, rich ore has been opened. There are good roads from Belle Fourche to the district.

NATRONA COUNTY

The Standard Oil Co. has started refining oil at its large plant at Casper. The oil supply comes from the Midwest's pipe-line to the Salt Creek field.

CANADA**BRITISH COLUMBIA**

A carload of molybdenite ore has been shipped from a mine at Sheep Creek, near Nelson, owned by Ross and Bennett. This is about the first of such ore sent from the province. Good progress is being made with the Hedley Gold Mining Co.'s power dam on the Similkameen river. Forty men are employed. Receipts from the Trail smelter from 1407 tons of ore and 100 tons of concentrate, from the Le Roi No. 2 mine were \$28,666 in January. The profit was \$8260. From 2241

tons of ore the Van Roi produced 210 tons of zinc concentrate worth \$18,329.

ONTARIO

The Wettlaufer Mines Co. has suspended work on the South Lorrain property. The last ore shipment was 14 tons of 204 oz., and 70 tons of about 1200 oz. silver ore. The annual report of the Cobalt Lake Mining Co. shows that the reserves contain 4,796,940 oz. of silver, an increase of 2,661,900 oz. over 1912 on account of draining Cobalt lake. The 1913 output was 973,676 oz. Dividends were \$315,000.

On April 1 the Porcupine Crown company will pay its first dividend, amounting to \$60,000. Two shifts are sinking the main shaft of the Dome mine from 425 to 575 ft. Cold weather has delayed erection of new machinery at the mill. The Dome Lake shaft is down 275 ft. During January the Hollinger mill treated 12,813 tons of ore worth \$13.57 per ton, with 96.33% extraction. Costs were \$5.012 per ton, and the profit \$101,663. Diamond-drilling covered over 1000 ft. with good results.

On the 75-ft. level of the Teck-Hughes, at Swastika, four inches of rich gold-bearing ore is being driven on. The McIntyre mine is to be connected and worked at 600 ft. by a cross-cut from the Pearl Lake mine. Ore worth \$8 has recently been opened.

KOREA

The Seoul Mining Co., operating the Suan concession, in Whang Hai province, reports the following results for February:

Stamps working	40
Time, days	26½
Ore crushed, tons	5453
Total recovery	\$42,027
Operating expenses	21,500
Net earnings	20,527

The Oriental Consolidated Mining Co. produced bullion worth \$141,225 from 24,705 tons in January. There was a shortage of water at Tabowie and Kuk San Dong. The Taracoi tube-mill plant was stopped permanently on January 14, as it was not economical and was a technical failure. The leaching method is again being used, and results are satisfactory. The net saving, compared with regrinding and agitation, should be considerable. The February clean-up was worth \$149,000.

MEXICO**MEXICO**

The El Oro mill treated 22,420 tons of ore and 15,680 tons of tailing in January, yielding \$258,860. Including \$5300 profit from the railway, the net return was \$126,090. The rate of exchange on which these figures were calculated is ₱2.70 Mexican for \$1 United States currency.

The Esperanza Mining Co.'s profit for the last quarter in 1913 was \$216,000. Additions to the mill are practically complete, and in December 26,720 tons of ore and tailing was treated. The San Carlos vein is narrower and broken above No. 9 level. No. 12 and 13 levels are lower grade than No. 10 and 11 levels. On No. 13 the ore is 5 ft. wide. Reserves, estimated by the consulting engineers, amount to 114,000 metric tons of dry ore with a profit of \$420,000, and a profit of \$240,000 in old tailing.

PUEBLA

(Special Correspondence.)—Owing to the continued activity of the 'constitutionalists' in the Aire Libre district, the Teziutlan Copper Co. has shut down its mine and smelter. T. Skewes Saunders, the superintendent, has gone to England. The rebels have been robbing mails, blowing up bridges, holding up trains and robbing passengers, dynamiting freight trains, looting towns, mines, ranches, etc., and demanding large sums of money from mines and other industries.

Aire Libre, February 9.

Personal

H. C. CARR is on his way to Brazil.

HUKLEY WELLS is in San Francisco.

CHARLES BUTTERS left for London last Wednesday.

FREDERICK BRADSHAW was in San Francisco this week.

E. H. LESLIE and THOMAS T. READ were in Pittsburgh last week.

D. C. JACKLING and SEELEY W. MUDD have been to the new gold rush near Ray, Arizona.

KIRBY THOMAS has removed his office from 42 Broadway to 43 Exchange place, New York City.

MILTON C. DUNHAM has returned to West Bridgewater, Massachusetts, from Abangarez, Costa Rica.

A. E. DRUCKER has opened offices at 62 London Wall, London, where he will engage in consulting work.

HENRY KRUMB has returned to Salt Lake City from the East, where he has been on business for several months.

W. R. CALVERT, of Utah, is in Wyoming looking over the oil fields in the interests of the U. S. Bureau of Mines.

J. P. IDDINGS will lecture at Yale University March 23 to April 3, inclusive, on 'The Problem of Volcanism.'

A. R. GORDON, general manager for the New York & Honduras Rosario Mining Co. at San Juanito, Honduras, is in New York.

POPE YEATMAN sailed from the Braden mine, Chile, on February 5, and is expected to arrive in New York about April 1.

W. F. WHITE, president of the Aguacate mines, sailed from New York on February 28 for Costa Rica; he expects to remain about a month.

M. E. LOMBARDI, in charge of the field operations for the Kern Trading & Oil Co., of San Francisco, has returned from a trip through the Westside fields.

C. J. LONDON, of Philadelphia, will be in Colombia for the next four or five months; while there his address will be, care of Empresa Hanseatica, Barranquilla.

Guests present at the presentation dinner of the Mining and Metallurgical Society of America, in honor of Mr. and Mrs. H. C. HOOVER, were as follows:

Alexander, Miss
Barbour, Mr. and Mrs. Percy
Ball, Mr. and Mrs. S. H.
Bates, L. W.
Bates, L. W., Jr.
Best, W. N.
Beck, E.
Campbell, Prof. Wm.
Cogswell, Mr. and Mrs. W. B.
Cuntz, W. C.
Church, John
Dana, R.
Dunham, W. P.
Dudrefret, Mr. and Mrs.
Devereux, Mr. and Mrs.
Dwight, Mr. and Mrs. A. S.
Dorr, J. V. N.
Eilers, Mr. and Mrs. Karl
Eldred, Mr. and Mrs. Byron
Eveland, A. J.
Finlay, Mr. and Mrs. J. R.
Grothe, Dr.
Garrey, Geo. H.
Gruver, J. R.
Hoover, Mr. and Mrs. H. C.
Hewes, Mr.
Hastings, J. G.
Hawkins, J. D.
Hunkton, L. D.
Holmes, J. A.
Ingalls, Mr. and Mrs. W. R.
Jennings, Mr. and Mrs. Hennen
Jennings, Mr. and Mrs. Sidney
Johnson, W. McA.

Kemp, Mr. and Mrs. Jas. F.
Kunz, Geo.
Kirchhoff, Mrs. Chas.
Linton, Robert
Lidell, Mr. and Mrs.
Lindgren, Mr. and Mrs. W.
Laun, W. F.
McKelvie, Mr.
Mausser, S. T.
Mein, Mr. and Mrs. W. W.
Mercer, J. W.
Morse, Mr. and Mrs. W. S.
Munroe, Mrs. H. S.
Pomeroy, Mr. and Mrs. W. A.
Pierce, F. E.
Prosser, Mr. and Mrs. H. A.
Reno, J. W.
Riordan, D. M.
Rand, Chas. F.
Rand, Miss
Read, Mr. and Mrs. T. T.
Spillsbury, E. Gybbon
Spillsbury, Miss Beulah
Stone, Geo. C.
Stone, Miss
Stoughton, Mr. and Mrs. B.
Sharp, Mr. and Mrs. W. G.
Stearns, Mr. and Mrs. Thos. B.
Sussman, Mr. and Mrs. Otto
Struthers, Jos.
Traylor, S. W.
Tillson, Mr. and Mrs. D. F.
Wilkins, H. A. J.
Westervelt, W. Y.
Walker, Arthur.

The U. S. Civil Service Commission announces an open competitive examination for assistant explosives engineer, on April 8, 1914, at places throughout the country, and information will be given by writing to Washington, D. C. The subjects are physics, general chemistry, mining engineering, and education and experience. The salary ranges from \$1620 to \$2100 per year.

Society Meetings

MARCH	
Name.	Date.
Old Freibergers.....Hofbrau, New York....	25
APRIL	
American Chemical Society	8-11
American Institute of Electrical Engineers	10
American Electro-Chemical Society	16-18
Institution of Mining and Metallurgy.....London....	16
MAY	
Mining and Metallurgical Society...San Francisco....	4
National Fire Protection Association	5-7
American Iron and Steel Institute	22
Institution of Mining and Metallurgy.....London....	21
JUNE	
American Institute of Electrical Engineers	22 or 26
American Society for Testing Materials	23-27
Society for the Promotion of Engineering Educa- tion	29 to July 2
American Society of Mechanical Engineers.....end of June	
Franklin Institute	Philadelphia....end of June
AUGUST	
American Inst. Mining Engineers..Salt Lake City....	10-14
SEPTEMBER	
American Institute of Electrical Engineers.....not fixed	
American Chemical Society	9-12
OCTOBER	
American Institute of Electrical Engineers.....	9
American Iron and Steel Institute	23-24
NOVEMBER	
American Institute of Electrical Engineers	13
DECEMBER	
American Society of Mechanical Engineers	7-8
Society of Gas Lighting (annual meeting).....	10
Society of Naval Architects	11-12
American Institute of Electrical Engineers	11
American Museum of Safety	11-20
Geological Society of America	30-31

Obituary

GEORGE WESTINGHOUSE, who died of heart disease at his New York home March 12, was one of the men we like to think of as typically American. Of German-Dutch descent, his ancestors had been in this country since before the Revolution. Educated in the public schools and Union College, then but a small institution, serving while still a boy as a volunteer in the Civil War, he early turned his attention to invention, in that following in the footsteps of his father. He was born at Central Bridge, New York, in 1846, and before he was fifteen had invented a rotary engine. His first great invention, the air brake, was made in 1869, and for the next ten years he was mainly concerned in its introduction and improvement. This led naturally in 1880 to studies and inventions in connection with automatic signaling, and that to lights, and so in 1886 into electrical work. Here his great achievement was the setting of the alternating current to work, and power generation just as naturally made him a pioneer in the steam-turbine field. He became a great manufacturer as well as inventor, and a public citizen of the sort that is a national institution. It is pleasant to record that his success was widely recognized during his lifetime, and it is to be noted that he was successful because of natural ability, unfailing industry, and because his work was useful. It was directed to increasing safety and decreasing waste, and it answered to the world's needs.

The Metal Markets

LOCAL METAL PRICES

San Francisco, March 19.

Antimony	9 — 9½c
Electrolytic copper	15½—15¾c
Pig lead	4.25—5.20c
Quicksilver (flask)	\$39.50
Tin	42½—44 c
Spelter	6½—6¾c
Zinc dust, 100 kg. zinc-lined cases, 7½ to 8c. per pound.	

EASTERN METAL MARKET

(By wire from New York.)

New York, March 19.—Although copper has been down to 12.95c. per lb., it is on the upward turn, demand being strong and more business doing. There was an increase in domestic enquiry and prices went above 14 cents. Copper mining stocks are a trifle higher. Lake copper is 15c. Rio Tinto is paying a dividend of \$8.10 per share. Lead and spelter are quiet with practically no change. Tin is firm at 38.25c. In London, copper is £61 8s. 9d. to £64 18s. 9d.; lead, £19 17s. 6d.; spelter, £21 10s., and tin, £174 7s. 6d. Aluminum in February varied from 18.50 to 19 cents.

SILVER

Below are given the average New York quotations in cents per ounce, of fine silver.

Date.	Average week ending.
Mch. 12.....	57.87
" 13.....	58.00
" 14.....	58.12
" 15 Sunday.....	58.12
" 16.....	58.12
" 17.....	58.12
" 18.....	58.00

Monthly averages.

1913.	1914.	1913.	1914.
Jan.	57.58	July	58.70
Feb.	57.53	Aug.	58.32
Mch.	57.87	Sept.	60.53
Apr.	59.26	Oct.	60.88
May	60.21	Nov.	58.76
June	59.03	Dec.	57.73

Writing on February 26, Samuel Montagu & Co. say as follows: The undertone continues good, and prices have been well maintained. Business during the week has been unusually active, and the shipment to Bombay will be considerable. Great stringency for delivery exists in that city, and a premium of over 2½% is quoted for spot silver. The stock in Bombay has risen from £50,000 to £80,000, and the offtake from 110 to 120 bars per day. An Indian currency return shows a decrease in the note issue of 20 lacs, in the holding under the denomination of silver rupees of 5 lacs, and under that of gold of 10 lacs. It is reported that a famine is beginning to be felt in the United Provinces of India, owing to a shortage of rain. The trouble, it is feared, may assume serious proportions before the monsoon breaks in June. Sir James Mes-ton, the lieutenant governor, who has opened a relief fund, stated that the deficiency of the rainfall is greater than that of 1907. Fortunately, the succession of so many years favorable to agriculture has given the populace ability to resist a certain amount of adverse circumstance. In China, trade and the government's position is bright. Holdings of silver in Shanghai total \$5,520,000. A shipment of \$35,000 was made from San Francisco to Hongkong.

COPPER

Quotations on copper as published in this column represent average wholesale transactions on the New York market and refer to electrolytic copper. Lake copper commands normally 1-5 to 1-4c. per lb. more. Prices are in cents per pound.

Date.	Average week ending
Mch. 12.....	14.00
" 13.....	14.00
" 14.....	13.95
" 15 Sunday.....	13.95
" 16.....	13.95
" 17.....	14.00
" 18.....	14.13

Monthly averages.

1913.	1914.	1913.	1914.
Jan.	16.54	July	14.21
Feb.	14.93	Aug.	15.42
Mch.	14.72	Sept.	16.23
Apr.	15.22	Oct.	16.31
May	15.42	Nov.	15.08
June	14.71	Dec.	14.25

Copper amounting to 30,000,000 lb. was booked for export at 14½c. per pound on March 16. The American Smelting & Refining Co. supplied about 8,000,000 pounds. Exports to March 12

were 19,330 tons. The Sultjelma company, operating an Elmore flotation plant in Norway, produced 1070 tons of copper concentrate in February. The German consumption of the red metal in January was 14,101 tons, against 14,968 tons in the same month of 1913. Of the 1914 imports, 12,323 tons was from the United States.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.	Average week ending
Mch. 12.....	4.00
" 13.....	4.00
" 14.....	4.00
" 15 Sunday.....	4.00
" 16.....	4.00
" 17.....	4.00
" 18.....	4.00

Monthly averages.

1913.	1914.	1913.	1914.
Jan.	4.28	July	4.35
Feb.	4.33	Aug.	4.60
Mch.	4.32	Sept.	4.70
Apr.	4.36	Oct.	4.37
May	4.34	Nov.	4.16
June	4.33	Dec.	4.02

QUICKSILVER

The primary market for quicksilver is San Francisco, California, being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending	Mch. 5.....
Feb. 19.....	39.00
" 26.....	39.00

Monthly averages.

1913.	1914.	1913.	1914.
Jan.	39.37	July	41.00
Feb.	41.00	Aug.	40.50
Mch.	40.20	Sept.	39.70
Apr.	41.00	Oct.	39.37
May	40.25	Nov.	39.40
June	41.00	Dec.	40.00

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date.	Average week ending
Mch. 12.....	5.10
" 13.....	5.10
" 14.....	5.10
" 15 Sunday.....	5.10
" 16.....	5.10
" 17.....	5.10
" 18.....	5.10

Monthly averages.

1913.	1914.	1913.	1914.
Jan.	6.88	July	5.11
Feb.	6.13	Aug.	5.51
Mch.	5.94	Sept.	5.55
Apr.	5.52	Oct.	5.22
May	5.23	Nov.	5.09
June	5.00	Dec.	5.07

TIN

New York prices control in the American market for tin, since the metal is almost entirely imported. San Francisco quotations average about 5c. per lb. higher. Below are given average monthly New York quotations, in cents per pound:

Monthly averages.

1913.	1914.	1913.	1914.
Jan.	50.45	July	40.70
Feb.	49.07	Aug.	41.75
Mch.	46.95	Sept.	42.45
Apr.	49.00	Oct.	40.61
May	49.10	Nov.	39.77
June	45.10	Dec.	37.57

The following tin statistics for February are from L. Vogelstein & Co.'s monthly report: Shipments from Straits to London, America, and Europe, 6544; from Australia, 201; Billiton sale, 185; imports of Chinese tin into England and America, 510; imports of Bolivian tin to England, Germany, and France, 1346; total supplies of 8766 tons, against 7263 tons in February 1913. Monthly deliveries of standard tin in England were 1610; Holland, 1232; America, including Pacific, 3420; Europe, 575; and Bolivian-Chinese, 656; a total of 7493 tons. Visible supplies are as follows: in England, 4366; landing and in transit, 975; afloat from Straits, 4003; and Australia, 301; Banca spot in Holland, 1155; Billiton spot and afloat, 356; Continent spot and afloat, 1123; U. S. stocks and landing, 1554; and afloat to U. S., 4605; total visible supplies of 18,443 tons, against 13,410 tons in February 1913, and 17,170 tons in January 1914. The average price in New York was 39.885c. per pound, and in London from £173 5s. to £188 per ton.

The Stock Markets

SAN FRANCISCO STOCKS AND BONDS

(San Francisco Stock and Bond Exchange.)

March 18.

BONDS

Listed	Bid	Ask	Unlisted	Bid	Ask
Associated Oil Co.	\$ 97	98	Natoma Consol. Co.	—	26
Unlisted.			Pac. Port. Cement Co.	100	—
Ass. Oil Co.	—	81	Santa Cruz Cement Co.	83	—
General Petroleum Co.	84	40	Union Oil	—	88

STOCKS

Listed	Bid	Ask	Unlisted	Bid	Ask
Amalgamated Oil	84	84	General Petroleum	—	4
Associated Oil	42	42	Noble Electric Steel	5	—
E. I. du Pont pfd.	—	90	Natoma Consol.	50c	—
Giant	—	87	Pac. Port. Cement	—	62
Pac. Oil Refining Co.	—	57	Riverside Cement	—	63
Pacific Crude Oil	—	30c	Santa Cruz Cement	45	48
Sterling O. & D.	1	1	Stand. Port. Cement	20	—

NEVADA STOCKS

(By courtesy of San Francisco Stock Exchange.)

March 19.

Atlanta	\$.40	Montana-Tonopah	\$1.00
Belcher	.59	Nevada Hills	.35
Belmont	7.80	North Star	.39
Con. Virginia	.18	Ophir	.52
Florence	.70	Pittsburg Silver Peak	.34
Goldfield Con.	1.82	Round Mountain	.35
Goldfield Oro	.17	Sierra Nevada	.15
Halifax	.98	Tonopah Extension	1.70
Jim Butler	1.07	Tonopah Merger	.55
Jumbo Extension	.31	Tonopah of Nevada	7.12
MacNamara	.09	Union	.13
Mexican	1.10	Victor	.27
Midway	.36	West End	.86
Mizpah Extension	.46	Yellow Jacket	.42

CALIFORNIA STOCKS

(Latest Quotations.)

Bid.	Ask.	Bid.	Ask.
Argonaut	\$2.75	Central Eureka	\$0.68
Brunswick Con.	\$1.05	Mountain King	0.54
Bunker Hill	1.90	South Eureka	2.00

COPPER SHARES—BOSTON

(By courtesy of J. C. Wilson, Mills Building.)

March 19.

	Bid	Ask		Bid	Ask
Allouez.....	\$ 40	41	Mohawk.....	\$ 44	45
Ariz. Commercial.....	5	5	Nevada Con.....	15	15
Butte & Superior.....	36	36	North Butte.....	28	28
Calumet & Arizona.....	68	68	Old Dominion.....	49	49
Calumet & Hecla.....	415	420	Osceola.....	78	80
Copper Range.....	38	38	Quincy.....	62	62
Daly West.....	2	3	Shannon.....	6	6
East Butte.....	11	12	Superior & Boston.....	2	2
Franklin.....	6	6	Tamarack.....	39	40
Granby.....	89	89	U. S. Smelting, com.....	41	41
Greene Cananea.....	37	37	Utah Con.....	10	11
Isle-Royale.....	20	21	Winona.....	4	4
Mass Copper.....	2	2	Wolverine.....	47	47

NEW YORK CURB QUOTATIONS

(By courtesy of E. F. Hutton & Co., Kohl Building.)

March 18.

	Bid.	Ask.		Bid.	Ask.
Braden Copper....	8	8 1/4	Mason Valley....	2 3/4	3 1/4
Braden 6s.....	160	165	McKinley-Dar....	35c.	90c.
B. C. Copper.....	1 1/4	1 1/2	Mines Co. Am....	2 1/4	2 1/2
Con. Cop. Mines....	1 1/4	1 1/4	Nipissing.....	6 1/4	6 1/4
Davis-Daly	1 1/4	1 1/4	Ohio Copper	1/4	1/2
Ely Con.	4	6	Phelps-Dodge.....	15	25
First National.....	2 3/4	3	Stand. Oil of Cal.	348	350
Giroux	1	1 1/4	Tri Bullion	1/4	1/4
Hollinger	16	17	Tuolumne	5/8	1
Iron Blossom....	1 1/4	1 1/4	United Cop. com.	1/4	3/8
Kerr Lake	4 1/4	4 1/4	Yukon Gold	2 3/4	3
La Rose	1 1/4	1 1/4			

NEW YORK STOCK EXCHANGE

(By courtesy of J. C. Wilson, Mills Building.)

March 19.

	Bid	Ask		Bid	Ask
Amalgamated	\$ 75	75	Miami	\$ 24	24
Anaconda	35	35	Nevada Con	15	15
A. S. & R., com	89	89	Quicksilver, com	1	1
Calif. Pet., com	28	28	Itay Con	21	21
Chino	41	42	Tenn. Copper	35	35
Guggenheim Ex	64	65	U. S. Steel, pfd	109	110
Inspiration	17	17	U. S. Steel, com	64	64
Mexican Pet., com	69	69	Utah Copper	51	50

LONDON QUOTATIONS

(By cable, through the courtesy of Catlin & Powell Co., New York.)

March 19.

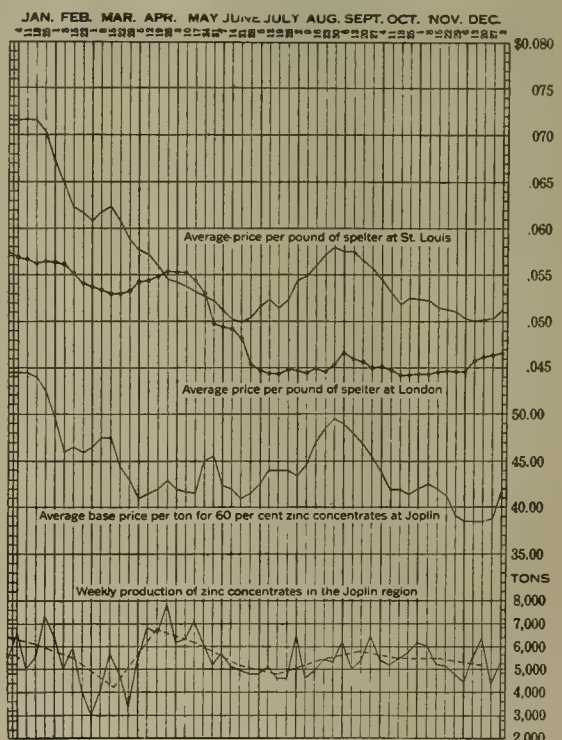
£	s.	d.	£	s.	d.
Alaska Mexican	1	7	6	Mexican Eagle, com.	2
Alaska Treadwell	8	5	0	Mexico Mines	5
Alaska United	3	2	6	Messina	1
Arizona	2	0	0	Oroville	0
Camp Bird	0	12	6	Pacific Oilfields	0
Cobalt Townsite	2	10	0	Rio Tinto	70
El Oro	0	15	0	Santa Gertrudis	0
Esperanza	0	17	6	Tanganyika	2
Granville	0	10	0	Tomboy	1
Kern River Oilfields	0	8	9		

AUSTRALASIAN

March 19.

£	s.	d.	£	s.	d.
British Broken Hill	2	1	3	Mount Elliott	4
Broken Hill Prop.	2	0	0	Mount Lyell	1
Golden Horse-Shoe	2	7	6	Mount Morgan	3
Great Boulder Prop.	0	15	0	Waihi	2
Ivanhoe	2	13	9	Waihi Grand Junction	1
Kalgurli	1	17	6	Zinc Corporation, Ord.	1
Mount Boppy	0	12	6		

Zinc Production and Prices in 1913*



*According to the United States Geological Survey.

COAL OUTPUT of Ohio in 1913 was 34,500,000 long tons.

Monthly Copper Production

AHMEEK COPPER MINING CO., Kearsarge, Michigan. \$1,250,000 in \$25 shares; 24,796 shares owned by Calumet & Hecla; 1800-ton mill at Hubbell; concentrate smelted by Calumet & Hecla smelter. Total in 1913, 9,100,000 pounds.

ALLOUEZ MINING CO., Allouez, Michigan. \$2,500,000 in \$25 shares; controlled by the Calumet & Hecla, which owns 43,000 shares and \$250,000 in notes of the Company; ore is milled by the Lake Milling, Smelting & Refining Co., in which the Allouez owns half. Total in 1913, 4,200,000 pounds.

ANACONDA COPPER MINING CO., Butte, Montana. \$108,312,500 in \$25 shares; controlled through Amalgamated Copper Co. by Thos. F. Cole, J. D. Ryan, and Standard Oil interests; 10,000-ton concentrator and smelter at Anaconda; 5000-ton concentrator and smelter at Great Falls, Mont.; also 70-ton electrolytic refining plant at Great Falls. Production figures include copper from all companies which ship custom ore to Anaconda smelters.

Month.	Pounds.	Month.	Pounds.
July	21,181,000	November	25,250,000
August	22,500,000	December	25,100,000
September	22,600,000	January 1914	24,400,000
October	18,400,000	February	21,300,000

ARIZONA COPPER CO., LTD., Morenci, Arizona. \$379,974 in 5s. shares; controlled by Edinburgh Investors; mill at Morenci is being enlarged to 3000-ton capacity and a new 1200-ton smelter near Clifton has just been started.

Month.	Pounds.	Month.	Pounds.
July	2,800,000	November	2,800,000
August	1,800,000	December	2,920,000
September	1,800,000	January 1914	3,474,000
October	3,550,000	February	3,063,000

BRADEN COPPER CO., La Junta, Chile. \$2,332,030 in \$10 shares and \$4,000,000 in 6% convertible bonds; entire stock held by Braden Copper Mines Co.; \$12,000,000 in \$5 shares; \$5,000,000 in convertible bonds; controlled by Guggenheim interests; two mills at La Junta; 3000-ton capacity smelter at Racagua.

Month.	Pounds.	Month.	Pounds.
July	1,046,000	November	1,592,000
August	1,572,000	December	2,122,000
September	1,322,000	January 1914	2,426,000
October	2,600,000	February	2,362,000

BRITISH COLUMBIA COPPER CO., LTD., Greenwood, B. C. \$2,958,545 in \$5 shares; controlled by Newman Erb; 600-ton sampling plant and 2500-ton smelter.

Month.	Pounds.	Month.	Pounds.
July	618,379	October	688,000
August	700,000	November	682,383
September	626,761	December (est.)	800,000

CALUMET & ARIZONA MINING CO., Warren, Arizona. \$6,285,710 in \$10 shares; has absorbed the Superior & Pittsburg Copper Co. by stock exchange; controlled by Hoatson and other Lake Superior interests; 3000-ton smelter at Douglas. Total in 1913, 51,710,000 pounds.

Month.	Pounds.	Month.	Pounds.
June	3,000,000	November	4,600,000
July	3,800,000	December	5,230,000
August	4,500,000	January 1914	5,798,464
October	4,500,000	February	5,948,300

CALUMET & HECLA MINING CO., Calumet, Michigan. \$2,500,000 in \$25 shares; controls the Ahmeek, Allouez, Centennial, Isle Royale, La Salle, Osceola, Tamarack, and Superior copper mining companies, as well as a number that are non-productive; controlled by Agassiz and Shaw interests; 2 mills on Lake Linden, capacity 15,000 tons; smelter Hubbell, Mich.; electrolytic refinery and smelter at Buffalo, N. Y.; figures include output of subsidiaries. Total in 1913, 53,420,000 pounds.

CANANEA CONSOLIDATED COPPER CO. S. A., Cananea, Sonora, Mexico. Capital \$20,000 in shares of \$100; entire stock owned by Greene Consolidated Copper Co.; \$10,000,000 in \$10 shares; 945,320 shares are held by Greene Cananea Copper Co.; \$50,000,000 in \$100 shares, which is controlled by Thos. F. Cole and J. D. Ryan; 2 mills and smelter at Cananea, 3000-ton capacity. Total in 1913, 37,050,574 pounds. Output does not include copper from custom ores, which amounts to about 600,000 lb. per month, exclusive of Miami.

Month.	Pounds.	Month.	Pounds.
June	2,908,000	October	3,160,000
July	3,328,000	November	3,150,000
August	3,186,000	December	2,976,000
September	3,148,000	February	2,282,000

CENTENNIAL COPPER MINING CO., Calumet, Michigan. \$2,250,000 in \$25 shares; 44,350 shares are held by Calumet &

Output of Lake Superior mines estimated.

Hecla Mining Co.; ore milled by Lake Milling, Smelting & Refining Co. Total in 1913, 1,400,000 pounds.

CERRO DE PASCO MINING CO., Cerro de Pasco, Peru. \$10,000,000; entire stock held by Cerro de Pasco Copper Co.; \$60,000,000 in \$1 shares which is owned by Cerro de Pasco Investment Co., which is controlled by J. B. Haggin, and Morgan estate; 3000-ton smelter at La Fundicion; monthly production figures not given out; output in 1912 was 45,000,000 lb. copper.

CHINO COPPER CO., Santa Rita, New Mexico. \$3,500,000 in \$5 shares; 121,200 shares are held by Guggenheim Exploration Co.; controlled by Sherwood Aldrich and C. M. MacNeill; 5000-ton mill at Hurley, N. M.; concentrate smelted at El Paso.

Month.	Pounds.	Month.	Pounds.
July	4,831,200	November	4,402,909
August	6,050,867	December	4,525,792
September	4,435,873	January 1914	6,138,140
October	4,914,944	February	5,769,948

CONSOLIDATED COPPER MINES CO., Ely, Nev. \$800,000 in \$5 shares; \$3,000,000 in convertible bonds; is a recent merger of the Groux, Butte & Ely, Chairman, and Copper-mines companies, controlled by Thos. F. Cole, Wm. B. Thompson, Charles F. Rand, and Jas. Phillips, Jr.; reduction plant not yet built; production so far derived solely from Groux; ore treated at Nevada Con. smelter.

Month.	Pounds.	Month.	Pounds.
August	541,189	November	136,539
September	204,307	December	197,649
October	160,911	January 1914	148,411

COPPER QUEEN CONSOLIDATED MINING CO., Bisbee, Arizona. \$2,000,000 in \$10 shares; owns 100,000 shares of Greene Cananea; almost all its stock is held by Phelps, Dodge & Co., Inc.; \$44,995,000 in \$100 shares; 4000-ton smelting plant at Douglas, Ariz. Total in 1913, 85,389,630 pounds.

Month.	Pounds.	Month.	Pounds.
July	7,439,864	November	6,473,792
August	7,590,994	December	3,132,452
September	7,775,560	January 1914	8,099,847
October	7,653,153	February	6,448,770

COPPER RANGE CONSOLIDATED MINING CO., Painedale, Michigan, \$39,369,200, in \$100 shares; owns 99,659 shares of Baltic M. Co., 99,699 shares Copper Range M. Co., 99,345 shares of Tri-mountain M. Co., half interest in Champion Copper Co., 16,392 shares of Copper Range R. R. Co., and \$870,000 in Copper Range R. R. bonds; controlled by Wm. A. Paine; production is derived from the Baltic, Champion, and Tri-mountain companies, each of which mills its ore; concentrate is smelted by Michigan Smelting Co., Houghton, which is owned by mining companies. Total in 1913, 24,996,000 pounds.

Month.	Pounds.
January 1914	3,276,000

DETROIT COPPER MINING CO., Morenci, Ariz. \$1,000,000 in \$25 shares; owned by Phelps, Dodge & Co.; 1300-ton mill and 350-ton smelter. Total in 1913, 22,352,299 pounds.

Month.	Pounds.	Month.	Pounds.
July	1,549,224	November	1,922,352
August	2,187,223	December	2,021,034
September	2,102,818	January 1914	1,590,681
October	1,861,178	February	1,814,214

EAST BUTTE COPPER MINING CO., Butte, Mont. \$3,000,000 in \$10 shares; owns 83% of the stock and all bonds of the Pittsmtont Copper Co., which holds 90% of the stock and all bonds of Pittsburgh & Montana Copper Co.; controlled by Wm. A. Paine; 350-ton mill and 1000-ton custom smelter.

Month.	Pounds.	Month.	Pounds.
July	1,060,257	November	1,002,190
August	1,162,006	December	1,324,560
September	1,233,018	January 1914	1,099,860
October	1,040,977	February	1,193,960

FRANKLIN MINING CO., Demmon, Mich. \$4,166,650 in \$25 shares; controlled by R. M. Edwards and the U. S. S. R. & M. Co.; 1000-ton mill. Total in 1913, 1,040, 000 pounds.

GRANBY CONSOLIDATED MINING, SMELTING & POWER CO., LTD., Phoenix and Hidden Creek, British Columbia. \$14,349,565 in \$100 shares; controlled by General Chemical Co. interests; 4400-ton smelter at Grand Forks and 2000-ton smelter at Anyox. Total in 1913, 21,511,747 pounds.

Month.	Pounds.	Month.	Pounds.
June	1,789,000	October	1,779,552
July	1,654,000	November	1,888,767
August	1,827,300	December	1,605,381
September	1,824,560	January 1914	1,793,840

MASON VALLEY MINES CO., Yerington, Nev. \$770,000 in \$5 shares; \$1,000,000 in 6% convertible bonds; controlled by W. B. Thompson; 1000-ton smelter at Thompson, Nev., also smelts ore of Nevada-Douglas Copper Co. and custom ore; smelter production. Total in 1913, 14,694,000 pounds.

Month.	Pounds.	Month.	Pounds.
July	990,000	November	1,174,000
August	966,000	December	1,372,000
September	918,000	January 1914	944,000
October	1,052,000	February	1,254,000

MIAMI COPPER CO., Miami, Ariz. 746,935 \$5 shares issued, \$22,000 in 6% bonds convertible at \$17 outstanding, controlled by General Development Co. (Lewisohn interests). 3000-ton mill at Miami, concentrate smelted at Cananea. Total in 1913, 33,944,795 pounds.

Month.	Pounds.	Month.	Pounds.
July	2,890,000	November	3,517,800
August	3,097,500	December	3,301,316
September	2,688,600	January 1914	3,258,950
October	2,862,050	February	3,193,300

MOCTEZUMA COPPER CO., Nacozari, Sonora, Mexico. \$2,000,000; entire stock owned by Phelps, Dodge & Co.; 2000-ton mill; concentrate smelted by Copper Queen. Total in 1913, 36,694,013 pounds.

Month.	Pounds.	Month.	Pounds.
July	2,693,006	November	3,517,800
August	3,542,047	December	3,139,613
September	3,024,121	January 1914	3,024,556
October	3,178,136	February	2,642,543

MOHAWK MINING CO., Mohawk, Mich. \$2,500,000 in \$25 shares; controlled by Stanton interests; 3000-ton mill, Traverse Bay; concentrate smelted by Michigan Smelting Co. Total in 1913, 5,369,000 pounds.

MOUNT LYELL MINING & RAILWAY CO., LTD., Queenstown, Tasmania. 1,300,000 shares of £1 each. Operates an extensive copper property, two railways, blast-furnaces, converters, and three super-phosphate works in Australia. During past fiscal half-year treated 142,615 tons for 5,470,080 lb. copper, 187,097 oz. silver, and 4050 oz. gold.

Month.	Pounds.	Month.	Pounds.
Dec. 25 to Jan. 21....	911,680	Jan. 22 to Feb. 18....	1,189,440

NEVADA CONSOLIDATED COPPER CO., Ely, Nevada. \$10,000,000 in \$5 shares; has absorbed the Cumberland-Ely Copper Co.; controlled by American Smelters Securities Co. through the Utah Copper Co., which owns half of the Nevada Con. stock; the Nevada company owns the Steptoe Valley Mining & Smelting Co., \$10,000,000; 16,000-ton mill and 1500-ton smelter at McGill, Nevada. Total in 1913, 64,972,829 pounds.

Month.	Pounds.	Month.	Pounds.
June	6,344,863	October	5,898,330
July	5,403,919	November	5,443,047
August	5,989,973	December	5,500,000
September	4,441,671	January 1914	5,791,122

NEVADA DOUGLAS COPPER CO., Mason, Nev. \$4,054,800 in \$5 shares, \$276,900 in 6% convertible bonds; also \$158,200 6% refunding bonds; controlled by A. J. Orem; ore smelted at Mason Valley smelter.

Month.	Pounds.	Month.	Pounds.
June	392,288	October	583,330
July	399,451	November	678,120
August	354,760	December	581,447
September	426,070	January 1914	409,202

OHIO COPPER CO., Bingham, Utah. \$12,292,700 in \$10 shares, \$1,326,000 in 6% convertible bonds; 3500-ton mill at Lark, Utah; concentrate smelted at Garfield.

Month.	Pounds.	Month.	Pounds.
July	601,700	October	720,000
August	689,400	November	796,000
September	685,900	January 1914	722,400

OLD DOMINION COPPER MINING & SMELTING CO., Globe, Ariz. \$4,050,000 in \$25 shares; 155,245 shares are owned by the Old Dominion Co., which is owned by Phelps, Dodge & Co.; 300-ton mill, 2400-ton smelter. Production figures include custom ore smelted. Total in 1913, 30,810,000 pounds.

Month.	Pounds.	Month.	Pounds.
July	2,526,000	November	2,150,000
August	2,524,000	December	2,613,000
September	2,679,000	January 1914	2,797,000
October	2,037,000	February	3,066,000

OSCEOLA CONSOLIDATED MINING CO., Osceola, Mich. \$2,403,750 in \$25 shares; owned by Calumet & Hecla; 2 mills, 4000-ton capacity, at Torch Lake. Total in 1913, 11,325,010 pounds.

PHELPS, DODGE & CO., Inc. \$44,995,000 in \$100 shares; controlled by C. H. Dodge, James Douglas, and others; owns the Copper Queen, Moctezuma, Detroit, and Burro Mountain copper companies, Stag Canon Fuel Co.; indirectly controls Old Dominion, United Globe, and Commercial Copper Mining Co.; members of the firm control the El Paso & Southwestern railway, and have large interests in the Rock Island and Great Northern

railways. Production figures include all properties under its control and copper derived from custom ore, the latter ranging from 750,000 to 1,000,000 lb. per month. Total in 1913, 154,454,144 pounds.

Month.	Pounds.	Month.	Pounds.
January 1914	13,411,595	February	11,441,123

QUINCY MINING CO., Hancock, Mich. \$2,750,000 in \$25 shares, controlled by W. R. Todd; 4500-ton mill at Mason; 340-ton smelter at Ripley.

Month.	Pounds.	Month.	Pounds.
January 1914	1,484,000	February	1,632,900

RAY CONSOLIDATED COPPER CO., Ray, Ariz. \$11,975,740 in \$10 shares; controlled by Sherwood Aldrich and C. M. MacNeill; 8000-ton mill at Hayden, Ariz.; concentrate smelted in A. S. & R. smelter adjoining. Total in 1913, 53,745,934 pounds.

Month.	Pounds.	Month.	Pounds.
July	4,097,177	November	4,753,000
August	4,401,000	December	5,232,167
September	4,470,551	January 1914	5,705,000
October	4,871,516	February	5,600,000

SHANNON COPPER CO., Metcalf, Ariz. \$3,000,000 in \$10 shares; controlled by N. L. Amster; 500-ton mill and 1000-ton smelter at Clifton. Total in 1913, 13,640,000 pounds.

Month.	Pounds.	Month.	Pounds.
July	880,000	November	1,110,000
August	1,248,000	December	1,078,000
September	1,232,000	January 1914	938,000
October	1,216,000	February	904,000

SHATTUCK ARIZONA COPPER CO., Bisbee, Ariz. \$3,500,000 in \$10 shares; controlled by Duluth investors, ore smelted at Calumet & Arizona smelter. Total in 1913, 13,219,756 pounds.

Month.	Pounds.	Month.	Pounds.
August	1,001,624	November	995,429
September	1,163,237	December	1,050,781
October	993,224	January 1914	1,276,636

SOUTH UTAH MINES & SMELTERS, Newhouse, Utah. \$4,300,000 in \$5 shares, \$1,300,000 in 6% convertible bonds; controlled by Samuel Newhouse; 1000-ton mill; concentrate smelted at Tooele, Utah. Total in 1913, 1,883,129 pounds.

Month.	Pounds.	Month.	Pounds.
June	142,817	October	239,453
July	195,254	November	232,003
August	230,410	December	260,167
September	249,323	January 1914	284,092

TAMARACK MINING CO., Calumet, Mich. \$1,500,000 in \$25 shares; owned by Calumet & Hecla; 2 mills, 3500-ton capacity, at Torch Lake. Total in 1913, 4,142,000 pounds.

TENNESSEE COPPER CO., Copperhill, Tenn. \$5,000,000 in \$25 shares; \$1,500,000 in 6% convertible bonds; controlled by Jas. Phillips, Jr., and Lewisohn interests.

Month.	Pounds.	Month.	Pounds.
June	1,379,220	October	1,392,162
July	1,295,804	November	1,688,000
August	1,143,019	December	1,700,000
September	1,309,985	January 1914	1,474,890

UNITED STATES SMELTING, REFINING & MINING CO. \$44,871,150 in \$50 shares; copper production chiefly derived from its subsidiary, the Mammoth Copper Mining Co., Kennett, California.

Month.	Pounds.	Month.	Pounds.
September	1,750,000	December	1,440,682
October	1,658,436	January 1914	1,572,917
November	1,700,000	February	1,629,902

UNITED VERDE COPPER CO., Jerome, Ariz. \$3,000,000 in \$10 shares; owned by W. A. Clark; 1000 to 1200-ton smelter at Clarkdale; monthly figures not given out, estimated at about 3,000,000 lb. Total in 1913, 37,750,000 pounds.

UTAH CONSOLIDATED MINES CO., Bingham, Utah. \$1,500,000 in \$5 shares; owns the Highland Boy Gold Mining Co. and 5000 shares of International Smelting & Refining Co. stock; ore smelted at Tooele.

UTAH COPPER CO., Bingham, Utah. \$15,625,990 in \$10 shares; owns half of Nevada Consolidated; controlled by A. S. & R. Co., Sherwood Aldrich, C. M. MacNeill, and W. B. Thompson; 2 mills, 20,000-ton capacity, at Garfield; concentrate smelted at Garfield plant of A. S. & R. Co. Total in 1913, 119,939,809 pounds.

Month.	Pounds.	Month.	Pounds.
July	9,849,043	November	10,787,426
August	10,900,000	December	10,624,790
September	11,992,780	January 1914	10,649,000
October	10,236,575	February	9,492,898

WOLVERINE COPPER MINING CO., Kearsarge, Mich. \$1,500,000 in \$25 shares; owns \$80,000 interest in Michigan Smelting Co.; controlled by J. R. Stanton; mill on Traverse Bay treated 388,500 tons during last fiscal year. Total in 1913, 4,488,000 pounds.

Output of Lake Superior mines estimated.

Book Reviews

MINE SAMPLING AND VALUING. By C. S. Herzig. With a chapter on 'Sampling Placer Deposits,' by Chester Wells Purington. P. 163. Ill., index. Published and for sale by the *Mining and Scientific Press*. Price \$2.

In writing a full and comprehensive book on this subject Mr. Herzig has made a welcome and valuable contribution to the literature of mining. The sampling and valuing of mining properties is a subject that is almost ignored by most writers, except for an occasional article upon some particular phase of the subject. Since T. A. Rickard published 'The Sampling and Estimation of Ore in a Mine,' no book adequately covering this subject has appeared, so this present volume supplies a long felt want in an important field. Mr. Rickard's book was compiled from a series of different articles and letters written by himself and other engineers, and was therefore not a systematic and complete text-book. Such a work Mr. Herzig now supplies. It is written by a practical engineer for the benefit of mining students and young engineers who are striving to gain practical experience. Most of our schools of mines give the students so little information and training in this important branch of mining that Mr. Herzig's book should appeal both to students and teachers. The experienced engineer will not fail to find many points of interest or value, for every man has certain methods of his own which are often useful to others, and Mr. Herzig's book is based largely upon his personal experience and practice. The author is a graduate of the Columbia School of Mines, and has had a vast amount of experience in many parts of the world, including the Rand, Australia, the United States, Mexico, Central America, and Siberia. He is exceptionally well qualified by training and experience to write upon the subject of mine sampling. The chapter on 'The Sampling of Placer Deposits' contains an excellent description of the most approved modern methods and practice for the valuation of alluvial deposits, written by Mr. Purington. The subject is treated in the clear and authoritative manner that is indicative of the wide experience and thorough knowledge of the writer. The chapter not only contains a fund of valuable information, but is also written in a delightfully lucid, readable style.

MANUAL OF HYDRAULIC MINING. By T. F. Van Wagenen. P. 123. Index. D. Van Nostrand Co., New York, 1913. For sale by the *Mining and Scientific Press*. Price \$1.

The fourth edition of this popular little book. The work has been revised and brought up to date by the addition of considerable new matter. Being intended for the use and guidance of the practical miner, the book is very elementary and simple. There are lessons in arithmetic and problems in elementary hydraulics which may be of assistance to those who lack a common school education. The tables and formulae are useful, but the miner must make his calculations by 'rule of thumb' methods, as there are no adequate explanations of the formulae given.

HYDRAULIC DATA. Compiled by H. D. Coale. P. 90. Ill., index. Published by the Pacific Tank & Pipe Co., Los Angeles, California, 1913.

Nearly all of the most useful tables and formulae for hydraulic work are found in this convenient little volume. Although this book is largely an advertisement of the products of the company, yet it will be of great value to all those engaged in hydraulic work of any kind. The tables for the flow of water through wood pipe, for the contents of round tanks, and for water pressures are especially complete. The book is distributed gratis to hydraulic engineers, superintendents of water works, and others.

Recent Publications

THE OIL FIELDS OF CRAWFORD AND LAWRENCE COUNTIES. By R. S. Blatchley. State Geological Survey. (Illinois), Bull. 22, p. 422, Atlas, Urbana, 1913.

This long expected report covers the two leading counties of the Illinois oilfields and includes detailed structural maps as well as sections, drill records, and all needful data. The Illinois oilfield, while it seems now to have passed its prime, had produced to the end of 1913, 208,112,868 bbl. of oil worth approximately \$153,000,000. Situated in an open prairie country of few rock exposures, the finding of the field came as a great surprise in 1905. The maximum production, 33,143,262 bbl., was attained in 1910, but while the output has since declined, this has been more than offset by the increase in the selling price of the oil.

The State Geological Survey began work in the fields within a few months of the first discovery and has published various brief reports upon it. Mr. Blatchley's bulletin is, however, the first comprehensive study based upon close detailed work. It is welcome as affording an excellent guide for the close drilling that must be done to insure the maximum of production from the territory. It is to be regretted that the report has been so long delayed, but it is to be remembered that other and shorter bulletins were issued in ample time to aid in the actual exploration of the territory. Whether, along the deeply buried overlapping edge the Mississippian and lower Pennsylvanian formations, there are other oilfields still to be found cannot be answered with certainty though it would seem to be entirely probable. If there are any such fields Mr. Blatchley's report will be of the greatest assistance when they are found as well as in further work in southeastern Illinois.

University of California publications, Berkeley, 1913:

THE PETROGRAPHIC DESIGNATION OF ALLUVIAL FAN FORMATIONS. By Andrew C. Lawson. Vol. 7, No. 15. P. 10.

PRELIMINARY REPORT ON THE HORSES OF RANCHO LA BREA. By John C. Merriam. Vol. 7, No. 21. P. 22. Ill.

NEW ANCHITERINE HORSES FROM THE TERTIARY OF THE GREAT BASIN AREA. By John C. Merriam. Vol. 7, No. 22. P. 16. Ill.

NEW PROTOHIPPIINE HORSES FROM TERTIARY BEDS ON THE WESTERN BORDER OF THE MOHAVE DESERT. By John C. Merriam. Vol. 7, No. 23. P. 7. Ill.

IS THE BOULDER 'BATHOLITH' A LACCOLITH? A problem in ore genesis. By Andrew C. Lawson. Vol. 8, No. 1. P. 16.

New Zealand Geological Survey publications, Wellington, 1913:

LIST OF THE MINERALS OF NEW ZEALAND. By P. G. Morgan and J. A. Bartrum. P. 32. This country contains a large number of minerals, but so far many of them have not been found in commercial quantities.

SEVENTH ANNUAL REPORT OF THE GEOLOGICAL SURVEY. P. 23. Maps. This work included field work in the Buller-Mokihinui subdivision, the coal possibilities of the Westport flats, cement materials near Cape Foulwind, Poerua gold mine, boring for coal near Nelson, building material near Nelson, geology of the Te Puke district, and other investigations.

MINERAL PRODUCTION OF BRITISH COLUMBIA, 1913. Preliminary review and estimate by Wm. Fleet Robertson. Bulletin No. 1, 1914. P. 35. Victoria, B. C., 1914. This publication was reviewed in this journal January 24, 1914.

MINE OPERATORS and others who wish a copy of the California law covering workmen's compensation can obtain it upon request addressed to the Industrial Accident Commission, 525 Market street, San Francisco.

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EDITORIAL

MINE OWNERS operating in Mexico have been unable in certain places to pay the customary taxes because of the disturbed conditions of the country and the closing of the tax offices. In all such cases, it has been ordered that titles be not forfeited until a sufficient time after the reopening of such offices to determine whether or not the operator wishes to continue his ownership.

TITLES to mining claims in Western Australia are granted on certain terms for a period of twenty-one years, renewable for a like term at the pleasure of the state government. In 1893 the Great Boulder Perseverance property of 24 acres, at Kalgoorlie, was located, and recently a renewal of the lease was allowed. Since the start of operations the mine has produced approximately 2,470,000 tons of ore, yielding gold worth \$26,100,000, of which \$7,000,000 has been paid in dividends.

ESTIMATES of the ore reserve at the Ajo property of the Calumet & Arizona Copper Company, announced in the annual report made public this week, total 40,258,000 tons with an average copper content of 1.51 per cent. Of this 28,303,600 is sulphide ore containing 1.50 per cent copper and 32,481,200 tons is available by steam-shovel mining. Experiments are being made upon leaching the carbonate ore by a new process with every prospect of success, and flotation has been found to give an excellent recovery of the sulphides. A new 'porphyry' is evidently about to be brought into production.

AN aspiring author is said to have been advised by a veteran compiler of comic operas that the essential requirement was to have a large chorus, to keep it well down in front, and to have it sing all the time; the words were unimportant. This advice seems to have been taken to heart by one of our successful firms of brokers, as it makes liberal use of special despatches from the Alaskan manager to the New York office on every occasion. One recently published announced that the workings were now in a "very fine quality of Gabbro quartz and Galena free gold." Evidently the words do not matter if such rubbish sells shares. The manager in this case is a technical man who knows better and should write his cables with more care.

QUEER ways to raise capital are continually coming to light. The *Wall Street Journal* recently printed an advertisement from a confiding Argentinian who wished capital for exploration and development of a gold mine in his country on the basis of retaining a 30 per cent royalty. The only evidence submitted that the mine was valuable, was the statement that chemists of the Argentinian mint had analyzed the ore and found it to contain $87\frac{1}{2}$ grains, 8 grams per 1000 kilograms, roughly \$9 per ton. It is a long venture to make on one assay.

STANDARDIZATION is the order of the day, and engineers will read with interest the suggestion of Mr. Lloyd Robey with regard to the need of standardizing screen tests and a method of accomplishing uniform results. Mr. Robey's discussion of the subject is based upon work done while superintendent of the mill and cyanide plant of the New York & Honduras Rosario Mining Company, and this, with the significant results of Mr. E. M. Hamilton's studies of cyanide at the Butters Divisadero which we also print, draws attention to the fact that Central America is more than a land of perennial revolutions; it is a region in which technological studies of moment are being conducted and mining is done by most modern methods.

MEDICAL examination of men applying for work will be required at the Copper Queen mines hereafter. This is the natural and inevitable result of the newer laws regarding compensation for accidents. If the companies must assume the direct burden of expense in all industrial accidents, they must necessarily refuse to employ men who are not physically able for the work to be performed. The reasons are as sound as those that forbid a railroad employing a man who is color-blind as switchman or locomotive engineer. It is probable that in time a certificate of physical soundness will be required at all the larger mines. About two years ago this requirement was made at a number of New Zealand mines, and, while there were minor strikes as a result, the system was adopted and is now in force. A defective has no place in a mine.

United States Steel Corporation Report and Finances

Publication of the report of the United States Steel Corporation for 1913 brings out, as usual, most interesting figures. The Corporation is our largest industrial concern, and its business is eagerly watched as an index of prosperity, just as its methods are widely copied as reflecting the best development of corporation management. In general, public opinion is not unfriendly to the Steel Corporation. It is recognized that, passing the initial injection of water into the capital, the company has been ably and conservatively managed. While manufacturing costs have increased rather than the reverse, and hence fail somewhat to

confirm the enthusiastic claims for efficiency of large units that were especially current at the time the Corporation was formed, methods of production have been improved, quality has been maintained, working conditions, while still leaving much to be desired, are distinctly better and are steadily improving, foreign trade has been greatly stimulated, and the competition of the so-called 'trust' has been fair and even generous. If prices have been maintained at an artificial level, as permitted by our tariff laws, they, at least, have not been pushed to the limit during periods of unusual demand. On the whole, we believe that the general public looks upon the United States Steel Corporation as a successful venture into big business, and wishes it well rather than the reverse.

In 1913 business opened well and heavy orders were carried over. As a result, the output of plates and finished products equaled 88 per cent of the total annual capacity of the mills. The cement production amounted to 93 per cent of capacity. Taking into account the amount of plant that must always be down for one reason or another, this is an excellent showing, only dimmed by the heavy curtailment of the last quarter of the year. The size of the business conducted is well known and need not be restated. It is sufficient to say that 28,837,451 tons of iron ore was mined, that the blast-furnace production amounted to 14,080,730 tons, and that a total of 12,374,838 tons of iron and steel products were sold. The figures are large, but not strikingly different from those for 1912, nor, presumably, from those that will be announced for 1914 and immediately succeeding years. There is another phase of the annual report that deserves more attention.

When the Corporation was organized, preferred and common stock was issued. Shortly thereafter, part of the preferred stock, drawing 7 per cent dividends, was exchanged for bonds paying 5 per cent. At present the Corporation has outstanding bonds and debentures amounting to \$627,097,376; preferred stock, \$360,281,100; and common stock, \$508,302,500. In addition there is \$589,542 outstanding in the stock of subsidiary companies not held by the Corporation and \$9,865,809 of purchase money certificates and similar obligations. In a broad way, all the common stock represented water when the Corporation was formed, and much of the preferred stock had represented water when the constituent companies had been organized. Since the United States Steel Corporation began operations, it has consistently put excess earnings back into the business until much of the stock that originally stood for water now stands for property and plant. In the judgment of some students there is property to cover the whole of the securities. In the meantime bonds have been maturing, and have been retired, though it is to be noted that other bonds have been issued. For example, from April 1 to December 1, bonds and mortgages aggregating \$110,158,174 were retired, but during the same period there was \$106,-

757,480 of new bonds and mortgages issued, sold, or assumed. There is now a total of \$9,388,000 in bonds subject to sale; practically the amount needed to retire the certificates issued in the course of the year in purchase for iron ore properties. Apparently the Corporation makes little headway in the matter of retiring its fixed obligations, and in that it but follows the usual custom of American corporations political and private. It is being rapidly forgotten that a bond is a note, secured usually by a mortgage. A farmer expects to pay off the mortgage on his farm, and we think him a poor financier if he does not do so. But the managers of big business corporations apparently have given up all hopes of 'paying the mortgage.' All they expect to do is to issue new bonds in place of old ones, and, if the market be not propitious, they substitute short-time, high-rate notes or certificates, in hopes that a better financial season may follow.

This is even more true of municipal financing than of corporation management, and as a result we are levying a permanent tax on industry. Probably the reason that manufacture of pig iron costs more per ton now than formerly is the large interest charge; which enters into all phases of manufacturing cost. It is one of the elements in the much discussed increased cost of living. Where will it end? It is said that when Switzerland nationalized its railways, an actuary was employed, a proper sinking fund established, and in time the bonds which represented the first cost were retired. The example seems worth while. Mining companies must retire their debentures, since their raw material eventually comes to an end. Why should not manufacturing and transportation companies be held to the same requirement? It is impossible to assume that future generations will meet the obligations if there be no real wiping out of indebtedness as we go. There will inevitably be repudiation on a large scale, just as has happened a number of times in the past. In issuing refunding bonds, our financiers merely deceive themselves.

The importance of this in connection with the Steel Corporation report lies in connection with the suggestion there made that bonds may be issued to offset the cost of the new steel plant at Duluth. If this is to be generally done, we believe it will be bad policy as well as bad business. The Corporation assumed a heavy load of water when it began its career. The public has been tolerant so long as profits were going back into the business, but if new plant is to represent new debt, with a corresponding higher interest charge entering into manufacturing costs, the demand for a return to old conditions and for absolute free trade will undoubtedly receive strong stimulus. It will hit the Corporation first and will hit it hard, because the Corporation is large and conspicuous; not because it necessarily deserves punishment more than others. Probably its record, in fact, is clearer than those of most of the big corporations, and certainly it is better

than those of most American cities. Such facts, however, rarely influence the course of political action when a movement has gained headway. If the farmer pays his mortgage, why not the financier?

Sodium and Potassium Cyanides

Cyanogen is the active element in solution of gold and silver in the well known cyanide process. There would seem to be no reason why the effectiveness of the reagent chosen should not be measured by the amount of cyanogen present, unless there are conditions under which only part of it is made free to recombine. Acting on the assumption that it was all available, the sodium cyanides, because of lower price, have come into wide use with a curious nomenclature; '130 per cent' cyanide, meaning a compound having a strength of 130 as compared with the 100 of potassium cyanide. In this issue Mr. Charles Butters presents figures carefully tabulated and showing that under certain conditions, at least, the sodium cyanide fails to give the results theoretically anticipated. The source of the figures, and their completeness, set at rest any question of their accuracy. They must be accepted at their face value. The important question is whether they point to an exception or a rule, and we hope other metallurgists will follow Mr. Butters' example in sending us results of tests that they have made. A hasty inquiry develops the fact that at one large property a careful series of tests showed that because of lower extraction the sodium cyanide was not economical even if furnished free. An equally careful test made by the same metallurgist at another property showed that the value of the salt was directly proportional to the amount of cyanogen present. Evidently the character of the ore is an important matter. Neither Mr. Butters, Mr. Hamilton, nor Mr. Clennell is prepared at present to offer an explanation of why the reagents do not accomplish the result that by all known laws of chemistry should be brought about. There is a hint that other elements in the salt may or may not enter into the reaction in particular cases, but the whole subject evidently needs renewed investigation. The metallurgical world has evidently too soon settled down to the comfortable feeling that the chemistry of cyanidation was known and that mechanical improvements only were to be expected. The manufacture of the cyanides is a highly special industry calling for much technical knowledge, and now that attention is directed to the matter, important aid in solution of the problem may be expected from the manufacturers. It is their business to produce the salt that can be most economically used in each situation; a matter in which they have shown much skill. The men in the field must help by determining what the actual results of mill work are under widely differing conditions. It is not a case for jumping at conclusions, but for painstaking study of records and the making of careful tests. Send in your results as fast as they are obtained so that each may benefit by the other's experience.

Relative Efficiency of Sodium and Potassium Cyanide

By CHARLES BUTTERS •

On my recent trip to my mines in Salvador, I had our consulting engineer, E. M. Hamilton, get up for me a table showing the results obtained at Divisadero upon the various kinds and strengths of cyanide that we have been using for the last seven years. There has been a continual discussion going on among our staff as to which was the best kind and strength of cyanide to use at our various mines. At our Minas Prietas works in Mexico, M. F. Perry determined that the ordinary cyanide of 99% strength was more economical for us than the 130%. This was not determined on a small scale, but after many months' run upon the same kind of ore until it was conclusively settled that the so-called 130% cyanide was more expensive for us than the 99 per cent.

I asked Mr. Hamilton to write out for me a few notes which are appended, together with the table which he compiled for me, and comment by J. E. Clennell. I am sure these figures will be of great interest and I should be very much pleased if my brother metallurgists would go through their books and make up, if possible, a similar set of figures.

It is by no means certain that the same results will be obtained everywhere, and it may be that there is something in this that every metallurgist should go into carefully. Naturally, I am obliged to face these figures for Divisadero and order 99% cyanide. I am satisfied that this will not suit the cyanide manufacturers, but if the above facts are found to be true in many places, the manufacturers of cyanide will have to meet them.

The Detailed Figures

Mr. Hamilton's table of figures is given opposite and his comment follows:

From time to time in the technical press the question of the respective merits of 'potassium cyanide 99%' and 'sodium cyanide 130%' have been brought forward. At the Butters Salvador mines and the Divisadero mine of the Butters Divisadero Co. certain small indications have lately led to a reopening of this question as far as it concerns the above-named companies.

At the Divisadero mine a table was compiled from the metallurgical sheets and store books covering the whole period during which the mill has been running, from its start in 1906 down to December 1913. During this period there has been uniform metallurgical treatment, and an apparent general uniformity in the kind of ore sent to the mill; in a word, there has been no variation in conditions apparent during this time which might reasonably account for any such differences as are shown in the table. The figures cover long periods, and it is to be noticed that on the 99% side the extractions show a large preponderance in

the nineties, whereas from the end of 1911, where the change back to 130% occurs, up to the end of 1913, the nineties are conspicuous by their absence.

In the cyanide columns there is debited against the 130% a loss of 30% plus $\frac{1}{2}$ lb. of 130% cyanide. Taking the price laid down at the mine as 17c. gold per pound of 100%, or 22c. gold per pound of 130%, this shows a loss of 30% at 17c. (or 5c.) plus $\frac{1}{2}$ lb. at 22c. (or 11c.), giving a total of 16c. per ton of ore. Add to this a loss of 3.4% on extraction, which on a head assay-value of \$6 per ton amounts to 20c., and there is a combined loss of 36c. per ton of ore, or \$3200 per month on a basis of 9000 tons.

I offer no explanation of these figures because I have none to offer, but in the light of them there is no option but to order 99% cyanide for the future. I hope that the various makers will take notice of these figures and try to shed some light thereon for the benefit of the mining industry. May I also be permitted to express a hope that in the event of an increased demand for the lower grade cyanide, they will not seize the opportunity to dilute 130% sodium cyanide down to 99% by the simple addition of sodium chloride or carbonate, but will continue to furnish a double salt containing a fair proportion of potassium cyanide, on the lines of that which used to be supplied eight or ten years ago?

What Is the Cause?

Upon this Mr. Clennell comments as follows:

In reference to the question of difference between so-called '99% potassium cyanide' and '130% sodium cyanide' I have never investigated this point on a working scale, but have on several occasions made small-scale experiments in which the invariable result has been to show that solutions containing equal amounts of cyanogen give identical results, whatever the nature of the metal with which it is combined. It is quite possible that in a particular ore the presence of sodium chloride or sodium carbonate may be beneficial. Not knowing all the circumstances, it is impossible to say whether the difference shown in Mr. Hamilton's figures is really due to the different brands of cyanide or to some other cause.

Tungsten ores were produced during 1913 in six of the western states, Colorado, California, Idaho, Arizona, South Dakota, and Nevada, according to Frank L. Hess, of the U. S. Geological Survey. The output for 1913 was equivalent to 1525 tons of ore carrying 60% of tungsten trioxide (WO_3), and was valued at about \$640,500. The production in 1912 was 1330 tons, valued at \$502,158. Boulder county, Colorado, produced 953 tons of ferberite during 1913.

CYANIDE CONSUMPTION AND COMBINED EXTRACTION, BUTTERS DIVISADERO COMPANY

SODIUM CYANIDE, 130%				CYANIDE, 99%			
Year.	Month.	Lb. per ton of ore.	Extraction, per cent.	Year.	Month.	Lb. per ton of ore.	Extraction, per cent.
1906	May			1908	April	3.0	88.7
	June	5.3	91.7		May		
	July	3.3	89.5		June	3.0	92.5
	August	3.7	91.0		July	2.9	91.9
	September	3.6	91.2		August		
	October	5.3	91.7		September	3.6	92.7
	November	3.9	93.1		October	3.6	92.3
	December	4.3	91.8		November	2.9	91.9
1907	January	3.8	94.3		December	2.2	92.5
	February	2.8	91.4	1909	January	2.3	91.5
	March	2.7	89.6		February	2.4	92.6
	April	2.6			March	2.0	93.2
	May	2.7	89.6		April	2.1	94.3
	June	2.7	88.9		May	1.6	93.7
	July	2.6	89.5		June	2.3	93.0
	August	2.7	89.1		July	2.1	94.9
	September	2.6	88.4		August	1.4	95.0
	October	3.4	89.5		September	1.3	94.5
	November	3.6	82.9		October	1.6	94.8
	December	3.1	80.9		November	1.8	94.3
1908	January	3.4	85.6		December	1.9	91.9
	February	2.9	89.2	1910	January	1.6	87.4
	March				February	2.0	88.7
	April				March	2.0	90.6
1912	January				April	2.1	88.1
	February				May	2.7	88.8
	March	1.8	91.2		June	shut down	
	April	2.0	88.7		July	2.4	92.0
	May	1.8	90.6		August	2.2	92.9
	June	1.8	89.6		September	2.0	92.5
	July	2.2	88.3		October	2.1	92.3
	August	2.0	88.7		November	2.3	89.2
	September	1.3	88.9		December	1.8	92.6
	October	1.3	87.8	1911	January	2.1	92.7
	November				February	1.9	91.7
	December				March	2.0	91.7
1913	January	1.6	89.6		April	2.0	93.8
	February	1.9	87.9		May	1.9	93.8
	March	2.0	85.3		June	2.1	91.2
	April	2.2	86.9		July	2.1	91.9
	May	2.0	87.4		August	2.0	91.3
	June	2.4	82.5		September	1.9	92.2
	July	2.0	85.8		October	2.0	91.1
	August	1.7	85.8		November	2.1	90.4
	September	2.1	81.1		December	1.8	90.5
	October	1.7*	90.0				
	November						
	December	1.4	92.8				
Average		2.64	88.6	Average		2.17	92.0

*Sodium cyanide 120%.

NOTE.—The months left blank are those in which both kinds of cyanide were used in the plant.

Functions of a Mint

It is quite a fallacy to imagine that a mint can ensure the circulation of gold in a country. In many a European country where a gold mint exists, gold currency is conspicuous by its absence. The mint no more performs the operation of supplying currency than the atrophied eyes of fish in the Kentucky caves perform the action of sight, according to Samuel Montagu & Co. of London. The essential function of

a gold mint is to provide for the internal needs of the country that sets it up. Unless that country possess the power to put gold coin to common use, the only circulation would be similar to that which ensued when the daughters of Danaus, of ancient mythology, were condemned to pour water into a cask with no bottom, namely, a circulation not in, but outside the cask. If a country possess a balance of trade in its favor, and be suited by custom and individual wealth to handle gold coin, a gold mint becomes a useful adjunct to its currency system.

Ore Treatment at the Prestea Block

By HUGH F. MARRIOTT

°This mine is situated in the Gold Coast Colony, West Africa. It is provided with three shafts. The main shaft is equipped with a steel head-frame containing two jaw-crushers, and is served by a direct-acting steam hoist. At the north shaft hoisting is done by an electric main engine and an electric sinking and main engine. An aerial ropeway conveys ore as broken in the mine from shaft bins to crusher station.

The crusher station has a bin capacity of 470 tons and is equipped with three electrically driven jaw-crushers, each capable of crushing 40 tons per hour. From the foot of the crusher station the ore is again elevated by an aerial ropeway to the level of the top of the mill and is dumped into the mill bins. The mill bin capacity is 1550 tons, thus making the total bin capacity on the surface 2600 tons, or, at 25,000 tons per month, three days' supply.

The mill consists of 110 stamps, and crushes an average of 8.6 tons per stamp per 24 hours through 10-mesh screens. Grading tests have been made on ore taken from the bins to ascertain the effect of the fine material on the subsequent treatment processes. There is not yet sufficient evidence that any variation of procedure at this stage will be of advantage. The pulp from the mill is collected in a launder and conducted to the Cobbe-Middleton pan house. Following on the suggestion of W. R. Feldtmann in his recent report, a set of spitzluten is being erected at this point to relieve the pans of the material which does not require finer grinding. This will now pass directly to the amalgamating tables. The experimental tests indicate that by this means the whole work of regrinding can be accomplished by 70% of the pan equipment. The surplus pans will thus constitute a useful standby. An automatic sampler has also been introduced immediately below the mill, and is designed to give an accurate record of the total gold content of the material passing from the mine into the reduction plant. This will be further dealt with later on. The coarser material from the mill is further crushed by the pans to a plus and minus 60 product. The reground material from the pan-house flows to the amalgamating tables, the concentrate clean-up from each pan having been first subjected to amalgamation in one locked pan, which is specially used for this purpose. The remaining coarse sand which passes the pans is separated in spitzluten and sent to three Bigelow pans and thence returned with the main product to the amalgamating tables. These are apportioned as required to the coarser or finer products. They have hitherto been run as shaking tables, but experiments are now being made to see if they will not catch an equal amount of gold as fixed tables and thus save much of the attention and cost of upkeep. The preliminary experiments have

been successful as far as the finer material is concerned, but the tables containing the coarser material were found to scour. This difficulty should disappear when the hydraulic separation and secondary regrinding equipments are installed and adjusted.

The gold caught by amalgamation constitutes 56.8% of the total product. The pulp is again classified hydraulically, and then passed over Wilfley concentrating tables. The concentrate goes to roasting furnaces and the tailing to the cyanide vats. The tendency is to increase the amount going to the roasters, as it is considered that a better extraction and greater profit are obtained by this system. The roasted ore is fed into Bigelow pans, where it is both amalgamated and treated with cyanide at the same time, and, after being subjected to further agitation and cyanide, is filter-pressed and the solution passed through a zinc-box. The concentrate going to the roasting department is more than can be dealt with by one furnace, but when the new one is installed the capacity of the plant should be adequate. The gold recovered from the roasting department is 18% of the total product, and the extraction by this process is 95%. The tailing from the Wilfley tables runs into collecting tanks and is then transferred to leaching vats by belt-conveyors and subjected to ordinary treatment. The gold recovered in the cyanide plant is 6.2% of the total product, and the extraction by this process is 34%. The sand residue assays about \$1.62 per ton. The tailing is removed by cars running under the vats, and the quantity required for refilling the stopes in the mine, about half the total output, is drawn to the heads of the various filling passes by locomotives, while the remainder is run out to tailing dumps by hand labor. Owing to the increasing distance of dumping points on level ground, the disposal of tailing by the present method has become inconvenient and expensive, and arrangements are being made to elevate the cars on an incline plane by mechanical haulage, thus bringing into use a large area of dumping ground much nearer the cyanide works. The slime, which is separated out above the Wilfley tables, runs into the slime pond and remains untreated. It is estimated to contain about \$2.40 per ton of dry slime. Various experiments have been made from time to time on this product with a view to recovering a profit therefrom. The most recent have been to pass the slime over a concentrating table and to agitate the concentrated product with cyanide. Experiments have also been made in agitating the whole of the slime with cyanide without separating out the concentrate. The increased extraction obtained by concentration does not justify the extra cost of installing and running the necessary plant. It has therefore been decided to proceed on the lines of dewatering the slime as far as possible and to treat the whole of the dewatered material with cyanide in agitating vats. The experiments in this direction have resulted in a recovery of 96c. out of a total gold content of \$2.40 per ton of dry slime.

*Abstract from a report made on the property in 1913.

Hydraulicking on the Klamath River

By J. H. THELLER

The débris law does not affect Siskiyou county, as the drainage is directly westward to the Pacific ocean, hence hydraulic mining in this county is still carried on.

The River Bend mine is on the Klamath river, 25 miles west from Hornbrooke, 25 miles north from Yreka, and 15 miles east from the junction of the Klamath and Scott rivers. The prevailing rocks of the country in that vicinity are granites and schists. It is the former that largely contributes so many rich pockets to the prospector. The deposit which is being mined is an ancient channel of the Klamath river, running nearly parallel to its present course, but lower than it. From the work already performed, the old channel shows a width of 100 ft. from rim to rim, although prospect drifts run at intervals of 600 ft. ahead of the work failed to reach the inner rim. The prospect work had to be discontinued owing to bad air, hence no definite results were obtained, although indications point to the widening of the channel.

Character of Bedrock

The bedrock is a hard schist, very rough and water-worn, with a general dip to the southeast. Soft streaks of black shale are encountered at intervals. This shale is highly tilted, forming an excellent stopping place for the gold already caught. In cleaning this shale it is found advisable not to strip it clean with the giant, but to have men pick it at right angles to the dip to a depth of about two feet. If it be washed clean with the giant or taken up parallel to the dip, the gold sinks deeper and is lost. The hard bedrock is different; it may be piped clean, the crevices only being cleaned by hand. Where this soft bedrock occurs, large quantities of gold are found. In the centre of the channel the bedrock is high and very hard, falling off abruptly on either side about six or eight feet, where it again rises forming the rims. At the contact of the hard schist and shale there is a blue clay separating the two. This is termed 'sluice robber', as any gold contained in or picked up by it will be carried through the sluices. We have experienced no trouble in handling it, since the clay is entirely broken up when hit by the stream of the elevator, thus delivering any gold contained therein to the riffles.

The bedrock is, on an average, at a depth of 30 ft., the best gravel occurring within 5 ft. of the bottom, although the pay-streak has an average depth of 10 ft. The gravel-gold is much lighter in weight than the bedrock-gold, although the former has a greater fineness than the latter. Resting on the pay-streak is a gravel of finer texture, but of poorer grade. Topping this is overburden. The entire mass constitutes a bank about 30 ft. high.

The pay-gravel is dark blue in color, and consists of

heavy, well rounded rocks, together with much wash. It has a shingled appearance while in place, contains medium sized boulders, the largest of which weigh from 500 to 1000 lb. 'Bulldozing' has been found more economical than moving them with a derrick. All boulders larger than $10\frac{1}{2}$ in. diameter must be broken, or thrown aside on a clean strip of bedrock, as the size of the elevator throat is $10\frac{1}{2}$ in. Black sand forms but a small part of the gravel. Although the degree of concentration is not definitely known it will approximate one-quarter of a pound of black sand per cubic yard of gravel. Assays of it show no platinum, and it is valueless except for the free 'flour gold' which it contains. Sulphide minerals, such as cubical iron pyrite and arsenopyrite, which occur in the gravel also mineralize the bedrock. They assay \$18 per ton, but no attempt is made to save them. It is chiefly due to these sulphides that the pit-water, or water flowing from cracks in bedrock, is heavily charged with arsenic. This water attacks all parts of metal with which it comes in contact, so that it is found necessary to paint with asphaltum all pipe-lines, parts of the elevator, and other pieces of metal which are in contact with the pit-water.

Water Supply

The water supply is from two separate sources. The system includes 11 miles of ditch and $1\frac{1}{2}$ miles of flume. The ditch supplying the two giants and the 8-in. Evans water-lift brings the water from Dogget creek, two miles east of the mine, and delivers it to a penstock 115 ft. above the works. The ditch carries an average of 350 miners inches. The pipe-line at the intake is 22 in. tapering to 13 in.; branches feeding the giants are 11 in.; the branch supplying the lift is 11 in. tapering to 9 in. The water-lift is used only in case of an emergency, such as the choking of the elevator. The elevator-water is brought from Buckhorn creek, ten miles to the west. The main ditch is 4 ft. on the top, $2\frac{1}{2}$ ft. deep, and 2 ft. wide on the bottom. The grade is $\frac{5}{8}$ inch in $16\frac{1}{2}$ ft. It will convey 700 miners inches of water, but only carries 375 at the present time. The water is delivered a distance of two miles to a point 2000 ft. above the property. From there it is conveyed down the mountain through a flume for one mile, discharging into a gulch which takes the water the remaining distance. It is caught by a dam 375 ft. above the mine, from which it flows to a penstock, and thence through a pipe-line to the elevator. The pipe at the



intake of the penstock is 24 in. diameter, tapering to 11 in. at the nozzle of the elevator. The length of the pipe-line is 1040 ft. Slip-joint pipe is used until water-level is reached, and flanged pipe from that point to the elevator.

There are two giants (No. 2 Joshua Hendy) in operation. They consume approximately 350 miners inches of water, working at an effective head of 90 to 100 ft. Three and three and one-half-inch nozzles are used. One of the giants is used to cave the gravel, the other to drive it to the elevator. The elevator is one of the Campbell type, having a 3½-in. nozzle, a 10½-in. throat, and a 14-in. upcast pipe. It uses 375 in. of water under an effective head of 325 ft. It is set in a sump 10 ft. deep, in bedrock. The sump is six feet square at the collar, tapering to four feet at the bottom. The elevator is set at an inclination of 70°. The height of elevation is 46 ft. vertically from the top of the nozzle to the top of the blocks in the head-blocks, insuring sufficient dump to the river. It may be stated in passing that no trouble is experienced with the tailing after the current of the river is reached.

The following table is made up from daily averages throughout the season of six months during 1912-1913:

Cubic yards of gravel washed per day.....	417.00
Miner's inches of water per day (24 hr.).....	350.00
Cubic yards of gravel washed per miner's inch....	1.19
Cubic feet of water per cubic foot of gravel washed.	67.00
Cubic feet of giant-water to be lifted per minute...	525.00
Cubic feet of seepage water to be lifted per minute.	*45.00
Total flow in elevator upraise-pipe, cu. ft. per min..	†1132.00
Cubic feet of gravel to be lifted per minute.....	7.81
Height of banks, feet	30.00
Grade of sluices, inches	7 to 12

*Estimated.

†Elevator feed-water, 375 miner's inches.

The following table is the average working cost per yard throughout the season, administration charges not included:

	Per day.	Per cu. yd.
Foreman and common labor.....	\$17.50	\$0.041
Freight, supplies, etc.....	1.00	0.002
Boarding-house	5.85	0.014
Maintenance, including all dead work.....	3.22	0.008
Depreciation of plant, ditch, riffles, giants, etc.	6.66	0.015
Total working cost	\$34.23	\$0.080

In the above table is shown the duty of the miners inch of water per 24 hours in the carrying of the gravel from the giants to the elevator only. I have limited the discussion to this in the belief that it is improper to charge the carrying capacity of the total water used with that portion of the work of transportation performed in and beyond the elevator itself: first, because the giant water has a 'carrying duty' only between the giant and the elevator. Thereafter it becomes 'freight' and has to be itself carried as dead weight along with the gravel; second, at the elevator additional 'freight' is presented in the shape of seepage water that enters the cut in large quantities and has to

be carried away. These two bodies of water, giant and seepage water, comprise the real load that consumes the water for the elevator, and we seldom deliver enough gravel at the elevator to reach the carrying capacity of the elevator. Therefore, the duty of the miners inches from the giant to the elevator, is the important consideration and if the elevator carries the water from its giant it will handle any amount of gravel the water contains whether it be large or small, although an excess of sand will choke the elevator.

At the beginning, after setting the elevator, the gravel bank being close, all gold is caught in the upper sluices. As the work progresses and the gravel bank becomes farther away a bedrock flume is necessary. The first box is set so that its end is 3 in. above the nozzle of the elevator. This sluice is 20 in. wide on the bottom, 24 in. deep on the sides, and is set at a grade of 7 inches in 12 ft. To overlap the joints of the bottom boards of the sluice, false bottoms are put in. Upon these rest the riffles, held down on the sides by 2 by 4-in. scantlings. The sluice-boxes are built in 12-ft. lengths of 1¼-in. yellow pine boards. They are riffled longitudinally and also laterally. The longitudinal riffles are 20-lb. rails, flanged down, spaced with slip-blocks, giving a 3½-in. riffle space on top. These rails give an ideal surface over which boulders can travel. The cross riffles are pine blocks 4 in. high, spaced 2 in. apart. In the second box from the head, Hungarian riffles are kept. They are taken up every three days. It is easier and quicker to handle them than the longitudinal or block riffles. Eighty per cent of the gold recovered is caught in the bedrock sluice and the elevator sump.

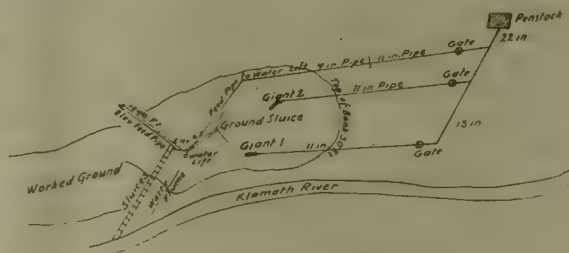
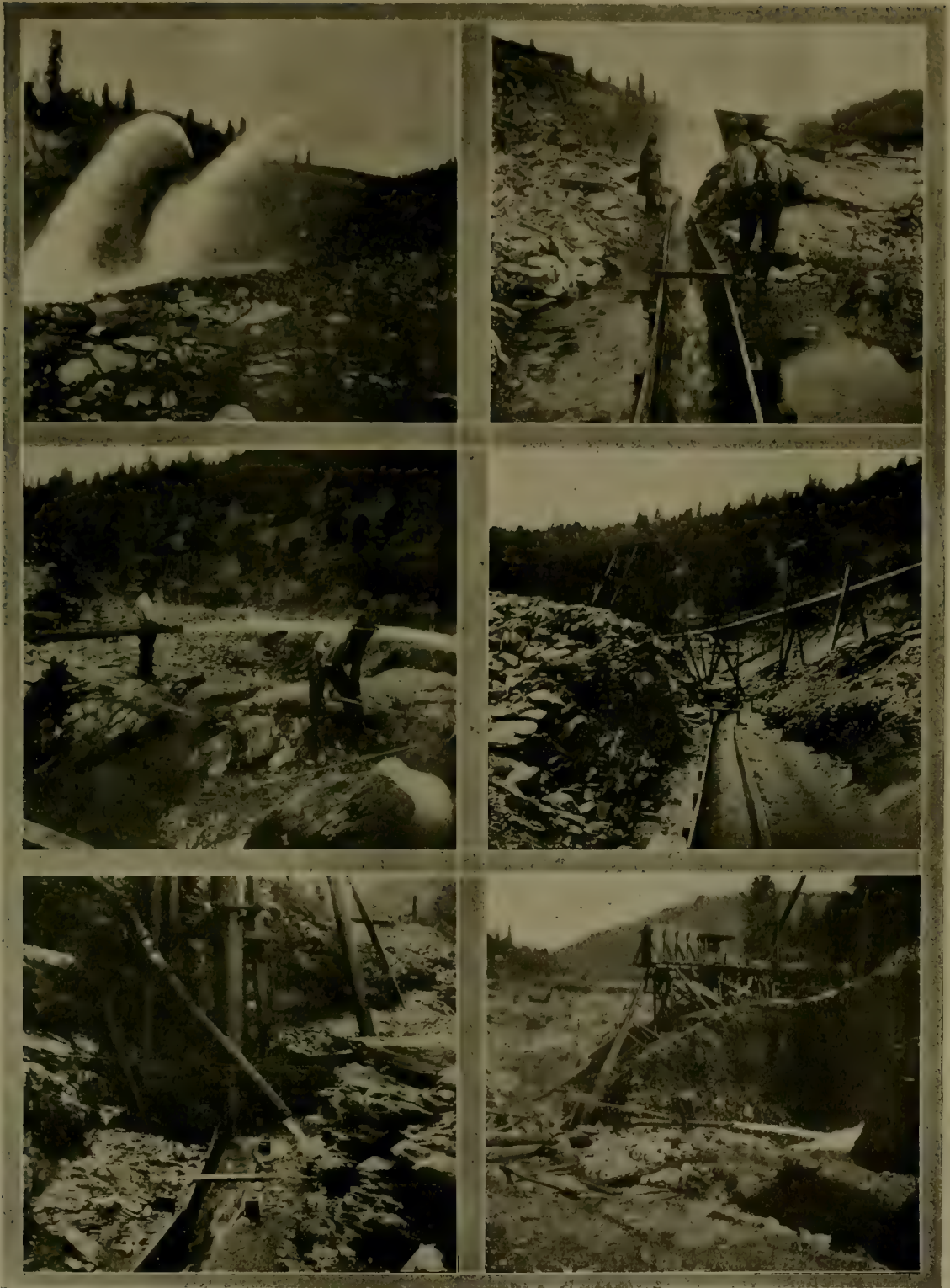


FIG. 1. PLAN OF WORKINGS.

The elevator raises the gravel to the upper sluices and through them it runs to the river. The head box is 6 ft. high, 12 ft. long, tapering from 48 to 32 in. The bottom boards are 1½-in. yellow pine covered with 1¼-in. false bottoms of the same material. In addition, back and top are made of 1¼-in. lumber, lined with ¼-in. steel plates. It is yoked on the sides every three feet with 4 by 4-in. timbers. A slightly curved hood of cast iron, 4 ft. long, 30 in. wide, and 4 in. thick, is bolted to the top of the box. This stops the upward trend of the water and gravel, directing it down the sluiceway.

The sluices are built in separate units. Each box is 12 ft. long, 32 in. wide, and 24 in. high. They are set on a grade of 6 inches in 12 ft., and are built of 1½-in.



GIANTS, SLICES, AND BEDROCK AT RIVER BEND.

yellow pine lumber, yoked every 4 ft. with 3 by 4-in. yokes.

The bottom of each box is covered with a planed false bottom, down to and including the eighth box. The false bottom for the other 12 boxes are of unplanned lumber.

Owing to the wear of the constantly falling boulders on the bottom of the head-box, blocks 12 by 12 by 12 in. were used. These were built close together with no



FIG. 2.

rifle space between the sets (Fig. 2), no attempt being made to save gold in this box. From the head-box to the first box in the sluice there is a drop of 3 in. The blocks in this space, together with the succeeding four boxes are 9 by 9 in. Experiments showed better results by spacing the blocks 1 in. apart in each set and separating each set by 2 in. This gives a longitudinal as well as a lateral riffle. The longitudinal space between the blocks is staggered. This is accomplished by varying the widths of the first block in the set (Fig. 3). This style continues for the next three boxes.



FIG. 3.

There is a drop of 3 in. to the box containing the Hungarian riffles. These are angle-iron sections running laterally across the sluice. They are bolted to iron strips which tie a set of the bars together. Each of these sets is 2 ft. long, and contain eight bars, thus producing a riffle space of 3 in. (Fig. 4).

This type continues for two boxes where a drop of 2 in. brings the material onto the longitudinal rails. These are of the same kind already described in the ground-sluice. The space at the top is 3½ in., nine rails to the box (Fig. 5 and Fig. 6). These continue for two boxes, where again one box of block riffles is placed. This takes us to the tenth box. From here to the end, gold becomes so scarce that it hardly pays to clean up. From the tenth box to the twentieth and last, old rails, scrap iron, and the like, and placed on the bottom of the boxes to save wear. Quicksilver is used from the fourth to the tenth box. It is an interesting fact to note that in a set of boxes, 25% of the gold is caught in the different sudden drops from one riffle to the next lower one.

Most of the gold is caught in the fourth, fifth, and

sixth boxes. From there on the quantity falls off rapidly. Beyond the tenth box it is not economically saved, hence attention and labor may well be directed

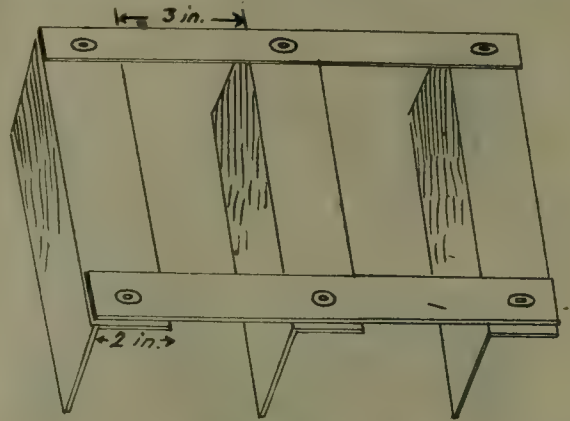


FIG. 4. ARRANGEMENT OF RIFFLES.

elsewhere. The reason more gold is not caught in the first three boxes may be explained by the fact that the gravel is given such momentum by the elevator that two or three boxes are required for the separation



FIG. 5.

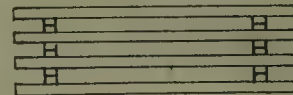


FIG. 6.

of the different particles according to their respective specific gravities, and in order to allow the particles to fall with the riffles.

Costs at the Simmer & Jack Mine

During the past fiscal year there was treated 912,200 tons of ore, yielding 230,644 oz. fine gold at the following cost:

	Per ton.		Per ton.
Development	\$1.60	Sand treatment	\$0.20
Mining	0.04	Slime treatment	0.13
Ore transport, sorting, crushing	0.08	General expenses	0.23
Stamping	0.22	Equipment	0.02
Tube-milling	0.12	Total	\$2.64

Two blast-furnaces are working regularly at Katanga, Tanganyika Concessions, Central Africa, producing 1000 tons of copper per month. It has been decided to erect four more furnaces.

The Brown Patents Decision

The decision in the United States Circuit Court of Appeals for the Third Circuit on appeal from the District Court of the United States for the District of Delaware, of the case of Joseph A. Vincent, owner of patent 781,711, granted to Alden H. Brown, February 7, 1905, for a process of treating precious metal bearing ores, and charging the Tonopah Mining Co. and others with infringing the two claims thereof, was handed down last week. The judges were Messrs. Gray, Buffington, and McPherson, the ones who decided the Moore-Butters controversy, and the following opinion was written by Mr. Justice Buffington.

Specifications of the Patent

Brown's patent, as recited in the specification, "relates to a process for the treatment of precious metal bearing ores, and embraces the treatment of the ore by a solution of cyanide of potassium or of other alkaline cyanide and the subsequent treatment of the ore by concentration." The specification states that: "It has been the practice for many years in plants where the concentration and cyanide processes are used in combination, to treat the ore, first, by concentration, and, secondly, by cyanide. The process which I have invented and which I now have in successful operation is a reversal of this proceeding with the addition of certain special features in connection with the cyanide step."

The second or broad claim is for these two steps in succession, to wit: "2. A process of treating sulphide ore consisting first in subjecting the raw or unroasted ore to the action of a cyanide solution whereby the finer metallic values are dissolved, and second, subjecting the ore or tailings to concentration whereby the coarser values are recovered."

The first claim also includes the two foregoing steps, but "certain special features in connection with the cyanide steps," are detailed in the claim, which is: "1. The herein described process for the treatment of ore consisting in first pulverizing the ore in the presence of cyanide solution; second, subjecting the ore to hydraulic classification by the introduction of cyanide solution at the bottom of an overflow tank to produce an ascending current; third, leaching the ore by the use of cyanide solution whereby the finer values of the ore are dissolved; fourth, removing the dissolved metallic values from the ore in any suitable manner; and finally subjecting the residue of ore to concentration."

The cyanide process, which process is described in *Moore v. Tonopah*, 201 Fed. Rep. 532, a case in this court, consists in subjecting metal-bearing ores to cyanide of potassium dissolved in water. The result is that the metal is disengaged or dissolved and is carried in solution. Such solution is then removed from the residue of the ore by percolation, filtering, or decan-

tation, and is ultimately subjected to electro-chemical action whereby the precious metal is precipitated.

On the other hand, concentration is a mechanical process of removal. It is usually done on concentration tables. Such tables are slightly inclined and have grooves, across which the finely divided ore is slowly carried by a shallow current of water, the table being given a jerky reciprocating motion. The result is that the heavy constituents work along and run over the edge of the table at different places from the lighter ones. It will thus be seen that the two processes of cyaniding and concentrating are distinct, well known, and operatively different, one being chemical, the other mechanical. As noted by the patentee, it was usual to concentrate first and cyanide last, and the patentee advised a reversal of this process. His object in so doing, he states, was because where concentration was used in advance of cyaniding there was a large loss in values by reason of the fact that the necessary water treatment in connection with the reduction of the ores to a fine state of division resulted in a taking up by the water of a large percentage of ore values. As a result it was "difficult, if not impossible, to settle these values for further treatment within the limits of a plant of ordinary construction, for the reason that in the case of many ores these slime values remain in suspension for many hours. It will therefore be understood that in the case of ores of this sort, if amalgamation, concentration, or other process involving the use of water for crushing or treatment is used preliminary to the cyanide process, it will be necessary to have a very extensive system of settling tanks in order to recover these suspended values and hold them in the mill, so that they may be subjected to further treatment. It is a well known fact that the cyanide process recovers only the fine values, and in the treatment that I have devised these fine values are recovered by the cyanide process in the beginning, leaving only the coarser values which are readily recoverable by concentration, the latter being specially adapted for saving this class of values."

No New Principle

It will be noted that no new principle of operation, either in cyaniding or concentrating themselves was disclosed in this patent. It was at most simply a more effective treatment and it will thus be seen that transposition of concentration from initial to final stage, and of cyaniding from final to initial stage is the substantial disclosure of this device. Assuming, for present purposes, that this change was original with Brown, and that it involved invention it must be conceded the field of invention was narrow, and Brown's claims should not by construction be enlarged to include within infringing fences processes which were not within the

field of his inventive disclosure. Now without entering into details, it suffices to say that the second claim embodies the two elements, of, first, cyaniding, viz., "subjecting the raw or unroasted ore to the action of a cyanide solution whereby the finer metallic values are dissolved"—and second, "concentration, whereby the coarser values are recovered." This claim is perfectly clear. A reading of the patent shows precisely what the patentee disclosed, and the claim as precisely claims that disclosure. There is no ambiguity in either disclosure or claim. They are self sufficient and self explanatory. The first element is the use of the well known cyaniding process as the initial and finished first step of the process.

The First Step

The specification thus unmistakably refers to both the initial use and also the completion of cyaniding in this first stage of Brown's process. Thus, "My invention relates to a process for the treatment * * * by a solution of cyanide of potassium * * * and the subsequent treatment of the ore by concentration. * * * It has been the practice * * * to treat the ore first by concentration, and secondly, by cyanide. The process which I have invented * * * is a reversal of this proceeding. * * * If * * * concentration * * * is used preliminary to the cyanide process, it will be necessary to have a very extensive system of settling tanks in order to recover these suspended values and hold them in the mill, so that they may be subjected to further treatment. * * * In the treatment that I have devised these fine values are recovered by the cyanide process in the beginning, leaving only the coarser values, which are readily recoverable by concentration." The drawings illustrate a wet crushing plant. "I will say, however, that so far as the broad idea of employing the cyanide step previous to concentration is concerned, the advantage in this respect would be equally great if dry crushing instead of wet crushing were employed. * * * From the tanks *I I* the gold-bearing solutions pass to the zinc boxes *J, J*, where the values are precipitated. * * * After the cyanide treatment has been completed, the sand tailings from the leaching tank *G* are transferred * * * to the tailings bin *P*. * * * The mixer *K* distributes the tailings to the concentrating table *L*." These extracts show that all steps prior to the sand tailing reaching the concentrating table, concerned cyaniding and cyaniding alone. Indeed the cyaniding of Brown's process had, at this stage, done all that cyaniding was intended to do. In other words, it had resulted, as cyaniding ordinarily did, in "The gold-bearing solutions pass(ing) to the zinc boxes *J J*, where the values are precipitated."

The Second Step

Following this completed process of cyaniding came the second step of the claim, namely, "subjecting ore or tailings to concentration where the coarser values are recovered." Concerning this step there is no ambiguity. It simply takes the sand tailings, which the

finished cyanide process had left in the mixer *K*, and concentrates them. Cyaniding has finished its assigned work and recovered its share of the metal product. The sand tailings were the by-product of cyaniding. It was on this by-product that concentration took up its part of the process. Concentration was so well understood that the patent simply says:

"In regard to the matter of concentration, I will say that any desired system may be used, either the standard practice * * * or any of the more recent oil-concentrating processes, in which the affinity of certain oils for metallic sulphides or other valuable minerals is made use of in order to effect the proper separation."

The first claim is based generally on these two elements, viz., cyaniding and concentration, but embodies in the cyaniding step those "special features in connection with the cyanide step," which the patentee disclosed and thus claimed. As we read that claim the first four elements, viz., "pulverizing the ore in the presence of the cyanide solution: * * * subjecting the ore to hydraulic classification by the introduction of cyanide solution at the bottom of an overflow tank to produce an ascending current: * * * leaching the ore by use of cyanide solution whereby the finer values of the ore are dissolved; * * * and removing the dissolved metallic values from the ore in any suitable manner"—all these are specific sub-steps of cyaniding—those "certain special features in connection with the cyanide step," as the patentee aptly says. They culminate and effect cyaniding. Unitedly they are the same as the first and broader stated first element of the second claim, viz., "subjecting the raw or unroasted ore to the action of the cyanide solution whereby the finer metallic values are dissolved." It follows, therefore, that all the four first elements of the first claim are to be treated as agencies culminating in cyaniding, and so regarding them it follows that however much some other process may utilize one or more of these elements, if they are not made use of in a process that culminates in and completes cyaniding as its first and pre-concentrating step, such element or elements are not employed to infringe the cyaniding initial step of these two claims.

The Third Step

We here note that the discussion of this case seemed to centre on what was meant by the third step, "leaching the ore by the use of cyanide solution whereby the finer values of the ore are dissolved," and the fourth, "removing the dissolved metallic values from the ore in any suitable manner." To us these are plain. Leach is a word of recognized import, namely, to cause a fluid to percolate through. Brown's leaching was by the cyanide process, namely, "leaching the ore by the use of cyanide solution," and the other words, "whereby the finer values of the ore are dissolved," merely state the result of such percolating or leaching. What was meant by leaching was well understood in the art. It was thus described in Moore v. Tonopah, supra,

"The cyanide ore process came into use about 1887 and is the real foundation of the tremendous increase in gold production in the last two decades. It is now the prevalent method of treatment. In it the ore is first crushed and then placed in tanks containing a solution of cyanide of potassium. This solution percolates through the crushed pulverized mass, and, being a solvent of gold, carries off such gold as is subjected to its action. This is called "leaching" and any crushed ore through which percolation took place was termed "leachable." As the term was thus well understood in the art, we are justified in giving it that meaning in this claim. So doing, it follows that the fourth step, which "removes the dissolved metallic values from the ores," merely removes the metallic values which the leaching has dissolved.

No Infringement Shown

This two staged process—first cyaniding, next concentrating—being the only disclosure of Brown and the claims embodying those two separate, individual, completed stages or steps, it follows that any process which makes concentration an intermediate and completed step, one that precedes final and effective cyaniding, is a process different from the one Brown disclosed and claimed. Measuring the defendant's process by these standards, it follows that infringement is not shown, for, without entering into a detailed description of its plant, it suffices to say that a study of its workings has brought us to this conclusion. The defendants, in common with Brown, it may be conceded, are using the cyanide solution in the earlier stage of their process, and to that extent we may say initially utilize the general chemical treatment incident to cyaniding, preparatory to concentrating. But beyond this the resemblance ceases, for by defendant's process concentration—"effective, finished, and final"—is the initial and intermediate step in their process. At such intermediate step the fruits of concentration are withdrawn from the process, and this first completed step of the process, the one "whereby the coarser values are removed," is, as we have seen, the second step of Brown's process.

Differences in the Two Processes

After the defendant's concentration is finished, the by-product goes forward to be subsequently treated by a protracted process of cyaniding. This is at variance with Brown's process in three respects, first, cyaniding follows concentrating; second, it is a system condemned by Brown and one he sought to avoid in that where "concentration * * * is used preliminary to the cyanide process it will be necessary to have a very extensive system of settling tanks in order to recover these suspended values and hold them in the mill so that they may be subjected to further treatment;" third, the defendant's process which physically withdraws from the operation of the process the products of concentration in advance of withdrawing those of cyaniding, makes the process one avoided by Brown, viz.: "It is a well known fact that the cyanide process re-

covers only the fine values, and in the treatment that I have devised these fine values are recovered by the cyanide process in the beginning, leaving only the coarser values, which are readily recoverable by concentrating, the latter being specially adapted for saving this class of values."

It is apparent, therefore, that the defendant's device, which the proofs show has been of great practical worth, owes its worth to the fact that it is built and operated in express disregard to the instructions of Brown's patent. Without passing on the question of the validity of that patent, it suffices to hold defendants do not infringe. The decree below is therefore reversed, and the case remanded with instructions to dismiss the bill for non-infringement.

Treatment of Tailing at Butte Reduction Works

By BANCROFT GORE

Adjacent to the abandoned smelting works of the Colusa-Parrot Mining & Smelting Co. at Butte, Montana, which was one of the W. A. Clark properties purchased by the Anaconda company in 1910, is a large accumulation, estimated at close to a million tons of tailing from the concentrator, containing a gross value in silver and copper of more than \$3,000,000. This valuable dump was retained by the Clark interests pending thorough investigation by a large staff of testing engineers, making use on a large working scale of the latest developments in hydro-metallurgy and ore dressing. One section of the old concentrator not destroyed by fire was remodeled and fitted with every known device that might throw light upon the commercial treatment of this tailing. Preference was finally given to the oil flotation process rather than roasting and leaching as at Anaconda with similar material, and elaborate mill tests were made under supervision of the Minerals Separation American Syndicate Ltd., using a 50-ton agitation unit where a high recovery of the sulphides was demonstrated. One factor in favor of the process was the extreme simplicity of the operations. The raw tailing was fed directly to a Hardinge tube-mill and after crushing to pass 60-mesh screen entered the flotation unit where a remarkably clean high-grade product was removed, dried, sampled, assayed, weighed, and shipped for treatment to the Anaconda smelter. As the tailing has been exposed to weathering, a part of the copper occurs as oxides, sulphates, and basic sulphates, which will be recovered by a preliminary treatment with weak sulphuric acid solutions. The tube-mills are to be lead-lined on this account. A plant with initial daily capacity of 1000 tons has been designed and will be in operation before 1915.

Mining in Norway employed 6508 men and women at 60 properties during 1911.

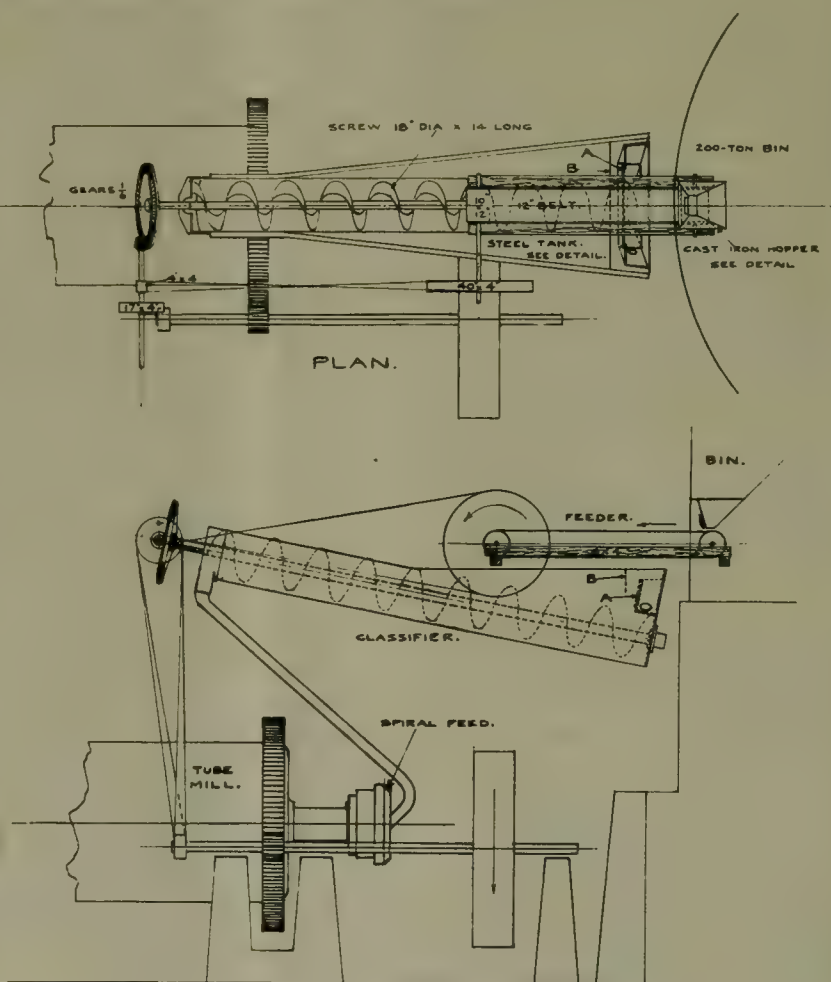
A Screw Classifier and Fine Ore Feeder

By S. A. WORCESTER

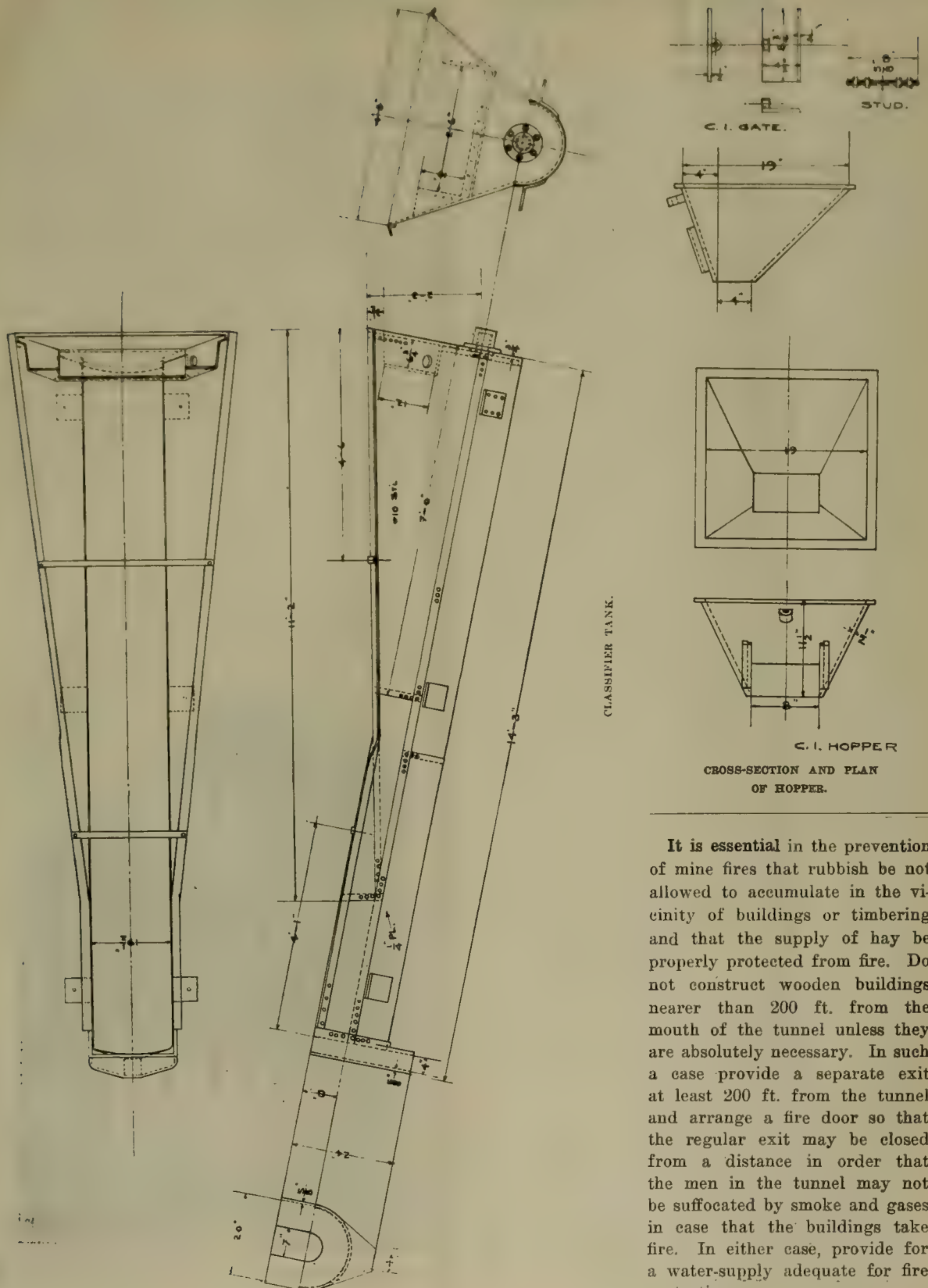
A number of the classifiers here described are in use in a mill of my recent design and construction, and while they develop much larger capacity (about 100 tons each per day), than other machines, their initial cost and space required per unit of capacity are also much less. The screw has more than one-third of its length completely submerged and this feature effects movement of a large volume of pulp in proportion to the diameter of the screw. The screw being in the form of a ribbon, the finer material rises from the sand and follows backward over both the outer and inner edges of the ribbon, while the coarser material remaining nearer the bottom is propelled onward to the discharge. These classifiers operate in closed circuit with tube-mills and the solution necessary for maintaining about 40% moisture in the mill feed is supplied in a number of small streams along the upper end of the screw. This accomplishes active separation of sand from slime and aids rapid classification. The sand is spouted direct to the spiral feed of the tube-mill and the tube-mill discharge is returned by an air-lift to the classifier. The submerged thrust bearing of the classifier screw has a small flow of mill solution passing through it, thus preventing slime from entering and destroying the bearing. The board A, bolted to the front of the cast iron discharge box, determines the height of the slime level in the classifier, and to a large degree the fineness of the slime discharged. Chips floating in the space between the ore feed and the slime discharge are arrested by the screen B, and are skimmed from the surface occasionally with a wire-cloth skimmer.

The feeder conveyor shown delivers material 90% of which will pass 10 mesh, from 200-ton bins to the classifiers, and has proved exceptionally reliable and satisfactory in operation. Features of interest include the combination of the functions of feeder with those of conveyor and ele-

vator, if this should be desired. It can be given an upward inclination of probably 30° when running at very slow speed, thus gaining mill height, whereas most feeders involve loss of mill height and perform but one function. Simplicity and inexpensive construction characterize this feeder, and the ease and accuracy of the screw gate adjustment are important. I regard the constant stream of ore given by this feeder as more desirable than the intermittent feed given by any type of reciprocating or disk feeder, and I believe the constant stream tends to produce more uniform and dependable action in the machines which it feeds. In the arrangement of machines which I show, and which has been very satisfactory, the classifier is driven by a quarter-turn belt from the tube-mill countershaft, and the feeder by a crossed belt from the classifier countershaft.



PLAN AND ELEVATION OF FEEDER, CLASSIFIER, AND TUBE-MILL.



It is essential in the prevention of mine fires that rubbish be not allowed to accumulate in the vicinity of buildings or timbering and that the supply of hay be properly protected from fire. Do not construct wooden buildings nearer than 200 ft. from the mouth of the tunnel unless they are absolutely necessary. In such a case provide a separate exit at least 200 ft. from the tunnel and arrange a fire door so that the regular exit may be closed from a distance in order that the men in the tunnel may not be suffocated by smoke and gases in case that the buildings take fire. In either case, provide for a water-supply adequate for fire protection.

Smelting of Ores and Metals

*With the view of developing more efficient methods in the smelting of ores, the bureau began at its Pittsburgh experiment station a detailed investigation of the practicability of using the electric furnace as a substitute for or adjunct of the blast-furnace, with particular reference to the treatment of low-grade ores. One problem studied is the possibility of using crude oil as a reducing agent. The results of these experiments, which were made by J. F. Cullen under the direction of D. A. Lyon, were incorporated in a report for publication. Another problem, still under investigation, is the possibility of using the electric furnace in the smelting of copper ores, especially sulphides. The experiments incidental to this investigation included work on:

1. The smelting of copper concentrates. Experiments have been made to determine to what degree loss of copper in the slag could be lessened by smelting these concentrates in an electric furnace.

2. The use of the electric furnace in the smelting of non-ferrous ores. The purpose of this investigation is to determine the feasibility of using electricity as a source of heat in smelting copper-iron sulphide ores, lean zinc and lead ores, and in fact all low-grade ores that are not amenable to treatment by wet methods, and especially to ascertain whether the electric furnace may be used profitably for treating ores from deposits that are so far from a smelter that transportation charges exceed the value of the metals in the ores. In some cases it may be possible to use hydro-electric power in an electric furnace, thus removing the necessity of transporting worthless gangue, and enabling the metals of the ores to be transported as matte or crude metal, providing it was not feasible to refine the metal at the smelting plant.

3. The use of the electric furnace as an aid to the ordinary blast-furnace. In the study of this problem the following points have been considered: (a) the possibility of recovering the iron in the slag as metallic iron—at present, as is well known, although the iron content of a gold, silver, copper, or lead ore may be large, it goes to the dump in the slag, either as iron oxide or iron silicate; (b) the possibility of producing ferro-silicon from the slags ordinarily obtained in smelting non-ferrous ores; (c) the recovery of the sulphur as a by-product in the smelting of sulphide ores; (d) the discovery, if possible, of some suitable collector or carrier other than copper and lead for the precious metals in smelting practice.

The purpose of the work has not been to show that the electric furnace should replace reverberatory or the blast-furnaces, but that in some places it may be substituted for them. So far only the possibility of treating copper sulphide ores has been studied. The

results of the work will be published in a bulletin. The electric furnace work for these investigations has been done by R. M. Keeney, under the direction of D. A. Lyon.

New investigations proposed for the coming year include: The electric smelting of zinc ores; the smelting of titaniferous iron ores; the production of 'natural alloys'—that is, the production from complex ores of alloys containing different metals in such proportions as to be of commercial use for structural materials, for tool making, etc.; the use of an electric process for removing moisture from the blast supplied to blast-furnaces; the removal of sulphur from producer gas for metallurgical purposes.

The following reports have been or are being prepared for publication: 'The Use of the Electric Furnace in the Manufacture of Iron and Steel,' by D. A. Lyon and R. M. Keeney; 'The Use of Crude Oil as a Reducing Agent in the Reduction of Iron Ores,' by D. A. Lyon and J. F. Cullen; 'Smelting of Fine Michigan Copper Concentrates in the Electric Furnace,' by R. M. Keeney; 'The Use of the Electric Furnace in Metallurgy,' by D. A. Lyon, R. M. Keeney, and J. F. Cullen; 'The Possibility of Smelting Copper Ores in the Electric Furnace,' by D. A. Lyon and R. M. Keeney.



OFFICE OF BUREAU OF MINES AT WASHINGTON.

*From the forthcoming third annual report of the National Bureau of Mines, Joseph A. Holmes, director.

Suggested Method of Standard Screen Tests

By LLOYD ROBEY

The metallurgist of today is turning his attention more and more to the problem of treating low-grade ores at a profit, and in localities where this problem has been solved, to the unending one of gaining the last possible penny of profit. In the effort to solve these problems he demands of the laboratory, in its tests and experiments, a close approximation to actual field conditions, and a standardization of laboratory processes, so that he may have as fair a basis of comparison as possible.

This demand for methods of laboratory investigation which will give not only exact but comparable tests of the work of different machines under the same conditions, or of the same machine under varying conditions, has not been entirely met as yet. In particular, the general practice in making screen tests is far from uniform. Considering the various investigations in which screen tests are indispensable, as, for example, in comparing the grinding capacities of machines, in controlling concentrator feeds, or in investigating and regulating the fineness of pulps in cyaniding and other wet processes, it is certain that the standardization of screen tests is a matter of some importance.

Method of Investigation

The investigation of screen tests naturally divides itself into two parts: (1) a consideration of the size of wire and aperture in the screen used; (2) a study of the actual method of making the tests after the proper screens have been selected. The first branch has received considerable attention of late, but the second has not been discussed at any great length in the technical press, and therefore it is hoped that the following suggestions may be found to have some slight value.

In the common method of making screen tests, the manner of procedure is about as follows: the pulp is dried and weighed; it is then passed through the coarsest screen of the series, very little precaution being taken against dusting, and the operation ceasing when a casual glance seems to show that no more sand is coming through; the material remaining on the screen is removed and weighed, and the material passing through it put through the next finer screen, and so on through the series, all the dust and finest ore being carried through the entire process. Sometimes a washer is placed in the screen to expedite matters. When the screening is completed, the sum of the various weights is checked against the original dry pulp weight. In this process two factors are undetermined: the loss by dusting of the different screens, and the absorption of the moisture by the fine dust, which is not lost. There is another and oftentimes more serious error in the operator's judgment of the time re-

quired to thoroughly screen the sand. The use of a washer is, of course, inadmissible in any careful work.

Proposed Standard Method

The method proposed is as follows: Dry and weigh the pulp, then immediately wet it again and pass it through the finest screen of the series required. This may be accomplished by allowing a small and slow flowing stream of clear water from the tap to fall on the screen, while shaking the screen gently and feeding the pulp slowly near the stream. On the first trial of this method with a 200-mesh screen, the operator will probably clog his screen, but with a little practice he will learn to use the stream of water to keep the bottom clear and will be able to pass fine pulp through a fine screen without splashing or clogging. Now dry the remaining sand and also the screen. Screen the dry pulp again through the same screen, adopting a regular motion, and screening for a definite period of time. This period of time may be ascertained by experiment, screening until no particles of sand show on a piece of white paper placed underneath the screen.

The time required on the finer screens when 500 grams of dry pulp is taken originally, is from 8 to 15 minutes for each screen. It is sometimes said that there is a grinding action in the screen, and that therefore screening should not be too long continued. This may be true for very soft ores, but with ordinary silicious ores the error is negligible, it being impossible after a certain period of time to get enough material through in several minutes of continued screening to make any impression on an analytical balance. In the case of very soft ores the grinding action will be approximately the same with similar ore in the same length of time, and therefore while there would be an error in the absolute quantity passing the screen, the value of the test for comparative purposes would be unimpaired and greater than in the ordinary procedure, where the time of screening and therefore of grinding action is indeterminate.

The pulp remaining on the screen is now weighed, and the difference between this weight and that of the original pulp gives the weight of material passing through the finest screen, or—in milling parlance—the slime. The dust has now been thoroughly eliminated and credited in its proper place without loss, and the remainder of the operation may be conducted dry, going from the finer screens to the coarser or vice versa at the operator's pleasure, but shaking each screen for the definite ascertained time. If the bulk of the material is very fine it is better to go from fine to coarse, because the weight of material to be screened is more rapidly reduced.

In cases where fine pulp is tested and great accuracy

is not required, as in the daily control of tube-mills and classifiers in the cyanide plant, the preliminary drying is not necessary, the weight of the pulp being ascertained by the specific gravity method. The fine screen should not be used until worn out, but should be discarded after about 100 determinations because the repeated oxidations and scourings wear the wire and enlarge the aperture.

The work of screening in this method is likely to prove burdensome when many tests are to be made,

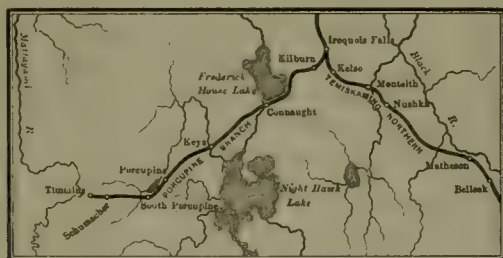
and it will be convenient to fit up a small shaking frame in which the screens may be set, connecting it with the laboratory power-shaft. This also gives the advantage of a steadier and more uniform shaking motion.

I have used and tested this method in mill control work for three years and have found it to give much closer checks than the ordinary method. It may be added that no method of wet screening alone is accurate, though such a method may undoubtedly have its value in approximating mill conditions.

Geological Sketch of the Property of the Hayden Gold Mines, Ltd.

By W. S. DOBBS

The property owned by the Hayden Gold Mines Ltd. consists of three claims partly in Deloro and partly in Ogden townships, Porcupine mining division, Ontario, Canada. These claims are about three and a half miles south of Timmins, Ontario, and can be reached by wagon road from that place. The three claims take in almost all of a rocky ridge which here rises about a hundred feet or so above the surrounding sand plain and muskeg. As these claims have been burned over at least twice, there is no green timber of any sort. In fact, all of claim No. 939 and the greater part of No. 938 have been cleaned bare of all vegetation, thus affording a splendid chance to study the various rocks on this group. Claim 937, on the other hand, especially the eastern portion, is covered by a burden of boulders and drift, glacial and otherwise, to known depths of 10 to 15 ft. in places.



THE PORCUPINE DISTRICT.

The oldest rock is an altered amygdaloidal basalt, called for convenience 'greenstone,' a member of the Keewatin igneous complex. The amygdules are filled with calcite, dolomite, and certain ferromagnesian minerals which have been re-deposited in stringers and veinlets where the shearing and metasomatic action have been pronounced in the schist. This rock (greenstone) along a certain well defined direction and over a considerable area has been subjected to considerable stress and shearing, which has developed a series of channels of passage for the solutions which have precipitated the minerals now found in the shear zone. At least two intrusions have occurred in the greenstone,

and these have exerted tremendous influences on the shear zone and the resulting mineralization and impregnation thereof. The Keewatin greenstone has been intruded first by a granoporphry, which is a quartz or a feldspar porphyry, according to the order in which the various silicates segregated and crystallized in the molten magma. This magmatic intrusion has exerted the most profound influence on the mineralized zone. Secondly, the greenstone has been intruded by a basic distinctly crystalline rock which has been classified by the geologists of the Bureau of Mines as an olivine diabase of post-Huronian origin. In form it is more nearly the dike than the laccolith. This dike has metamorphosed the greenstone, though to a much lesser degree than has the granite porphyry. It is chiefly interesting here as affording an excellent example of the way in which a molten magma erodes, corrodes, and absorbs the adjacent rock in proportion to the distance from the intrusion. Several small barite veins have been found in the zone of metamorphism of the diabase intrusion and these contain from two to six ounces of silver. The veins vary from 2 to 15 inches in width and are about 400 or 500 ft. in length. This diabase dike runs in a southeast by east direction. On claim 937 it cuts the shear zone of schist, which is one of the salient points of evidence to show that the diabase is younger than the porphyry. Nowhere in the vicinity have I been able to find the porphyry and diabase adjacent or in contact, though all known facts point to the existence of such a contact near the southeast corner of 937.

The granite-porphry intrusion probably came from the southwest, and it can be traced the entire length of the three claims. The porphyry appears as an island on the west claim wherever the contact is visible. In various places near the contact is a series of small quartz veins, from a few inches to three or four feet in width, which are apparently the result of the segregation in the molten magma referred to above. The quartz veins along the contact are connected with a series of lateral stringers in the porphyry, and the edges of these veins gradually merge

into the porphyry itself. The zone of mineralization lies roughly parallel to the porphyritic intrusion and ranges in width from 100 ft. in the extreme east to several hundred feet in the west. This possible ore-body and mineral zone has been traced across this entire group into the McDonald claim, southeast of 937. This zone consists of schist very much sheared and partly impregnated with copper and iron pyrite, with a little galena and blende, and is interspersed with and cut by numerous quartz stringers and veins ranging all the way from a fraction of an inch to the big quartz vein lying near the south edge of the zone of mineralization. I have noticed several veins in the shear zone which were three feet and upward in width. Parallel to the contact and within 50 ft. of it lies the large quartz vein, 10 to 50 ft. in width, rising dome-like in place and traced for over 2000 ft. The quartz shows the result of shearing; and the fracture planes are filled with fine black mineral, possibly tourmaline or siderite.

The shear zone was formed as a result of the magmatic intrusion of the granoporphry. The large quartz veins and larger stringers were apparently formed during the period of metasomatic action, as we find copper and ore pyrite in well formed crystals as a result of this intrusion. Thanks to the prospectors' eager desire to stake and sample the porphyries in this district, fairly accurate data with respect to the precious metals contained in the porphyry are available. The porphyry contains from 90c. to \$3.40 per ton in gold. In my opinion it is the 'mother-rock' of the gold. When the post-Huronian diabase intrusion came, the shear zone and porphyry were subjected to further shearing, fracturing, and metamorphism. As a result of this metamorphism gold has migrated out of the porphyry into the fracture planes in the shear zone, which provided a series of channels for the mineral-bearing solutions. In support of this, free gold almost always occurs in the secondary quartz, although two or three instances have been known of its occurrence in the schist out of contact with the quarts.

The larger quartz veins show evidences of shearing and fracture, and minerals have been deposited in the fracture planes, notably siderite, tourmaline, and possibly hornblende. Siderite has been found in the barite veins and in the quartz stringers near the diabase. Galena in places, iron pyrite, and pyrrhotite in a fine state of division have been deposited contemporaneously with the secondary quartz. Free gold and good ore have been found along certain well defined zones, but not in the large quartz veins. Judging by the surface, this vein is very low grade, averaging about \$1 per ton.

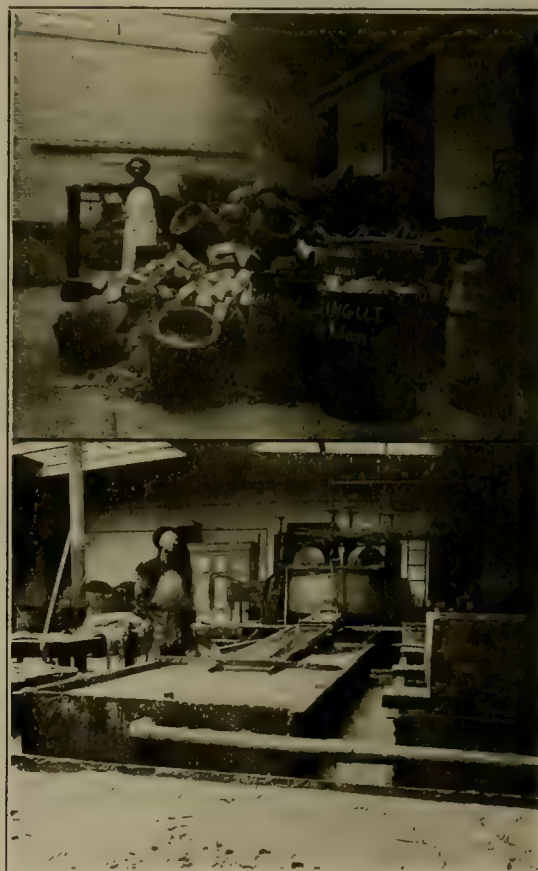
The best and most uniform ore has been found where the quartz and schist are very much intermingled, and also where the sulphides are in a fine state of division. My reasons for stating that the porphyry is the 'mother-rock' of the gold are that the porphyry generally

contains small amounts of gold and that the zones of higher gold content are found in those parts of the shear zone which are nearer to the porphyry than to the diabase. The small amount of work done has produced very interesting results and the development work will, I am sure, produce results well worthy of attention from a purely scientific point of view.

Gold Recovery From Mint Residue

By HAROLD FRENCH

During each year, the San Francisco Mint receives up to 2,400,000 fine ounces of gold for refining and minting. From these operations there is collected thousands of worn-out crucibles and corroded furnace



IN THE TOP PICTURE IS SHOWN THE VARIETY OF MATERIAL COLLECTED; AND IN THE LOWER ONE IS THE MILL, SLUICE-BOX, AND TAILING DUMPS.

bricks, a large quantity of slag, ash, and sweepings. These products are taken to the treatment plant in the basement of the building. Most of the sweepings are panned first. Combustible materials are reduced by burning as much as possible. Soot from the stacks is rich in gold, and they are periodically cleaned.

For reducing the various materials to be treated, bricks and crucibles are broken by hammers and then

fed into an Elspass mill. This consists of a horizontal die pan seven feet diameter, on which rests four vertical rolls four feet high, and weighing about 1600 lb. These are adjusted by strong springs in accordance with the material milled. A 20-hp. motor causes the die pan to revolve, and the rolls start working at the same time. Water is fed into the mill and stationary steel plows in the middle feed the coarse material under the rolls and divert the pulp against the 40-mesh screens at the side of the mill. The fine material flows into a Pierce amalgamator, then through a 12-ft. sluice-box with burlap-lined riffles to a tailing sump. When the feed contains coarse metal, mercury is seldom used in the mill, as the plows concentrate it near the centre of the die pan, and from 80 to 85% of the gold is recovered in this way. When mercury is added, an extraction of 90 to 95% is obtained in the mill and amalgam traps. The tailing is dried by steam in a pipe under the last settling pan, shoveled into sacks containing 90 lb. net each, assayed, and sold to the Selby Smelting & Lead Co. The tailing averages about 12½¢. per pound. Together with the gold from 'rotting iron,' the yearly output is worth from \$100,000 to \$125,000, from about 50 tons of mint by-products.

Whistle Signals*

1. Steam-shovel engineers must be conversant with all warning signals, and it is made the responsibility and duty of each engineer to give warning of all blasting in the vicinity of his steam-shovel.

2. Sound of the whistle must be distinct, with intensity and duration proportionate to the distance signal is to be conveyed.

3. Each shovel must be equipped with a distinctive toned steam whistle. All shovels are numbered plainly, with a number in full view from all parts of the workings. Employees must familiarize themselves with the distinguishing sound of the different shovel whistles in order that they may readily locate blasting operations and be prepared to safeguard themselves from possible danger of flying rock and débris.

4. Powdermen and blasters must not 'spit' or light a fuse or fire a charge until after the alarm and warning signal has been sounded by the shovel engineer.

5. Signal for blasting shall be a series or succession of short, sharp, quick blasts of whistles, continued for brief period, to be followed immediately by as many long sounds of whistle as there are shots to be fired. To illustrate: if there are 10 shots to be fired, the nearest shovel will sound the alarm series of short, quick 'toots' of the whistle, followed after a brief interval by 10 long sounds, indicating 10 rounds or shots to be exploded.

6. The signals prescribed and herewith set out are illustrated by the word 'short' for short sounds, and the word 'long' for long sounds or blasts of the whistle:

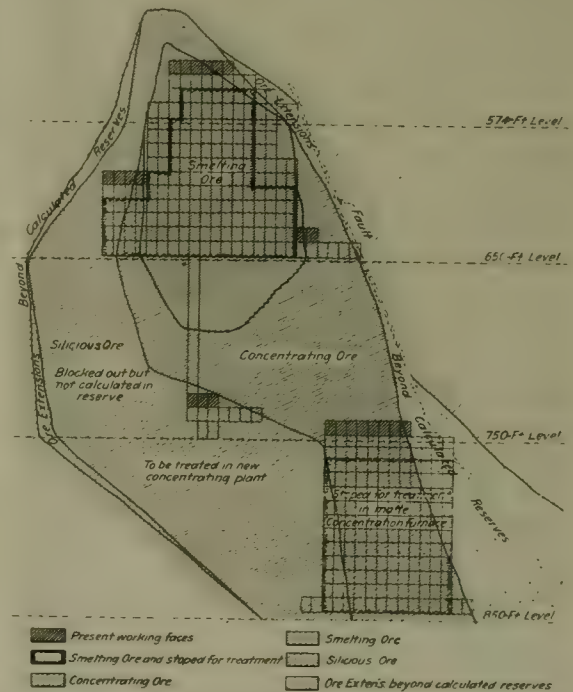
*From the book of 'Rules and Regulations' of the Nevada Consolidated Copper Company.

SOUND.	INDICATION OF WARNING.
1 long, 1 short	Beginning and end of shift.
2 short	Move up shovel.
3 short	Calls waterman, pipemen, and lighters.
4 short	Calls powderman.
5 short	Calls foreman.
Series short, quick	Warning signal—blasting.
Followed by number of long	Indicates number of shots to be fired.
2 long	Round or charge of blasting completed.

The signal for 'seam' shots, distinguished from bore-hole shots, top blasting, or bull-dozing, will be the regular alarm signal followed by whistle sound of longer duration than the long signal indicating number of shots to be fired. While a seam shot may not be more dangerous than other blasting, the shattering effect of such a shot may cause the throwing of small pieces or particles of rock a greater distance than a top blast would. Employees are, therefore, urged to heed this signal and to seek shelter with all possible dispatch.

The Mt. Morgan Orebody

The origin of this gold and copper producing deposit has been frequently discussed. In the last half-yearly report of the general manager, B. Magnus, are some



notes on its present condition. Ore reserves are as follows:

High grade, tons	1,285,000
Medium grade, tons	1,960,000
Concentrating, tons	3,000,000

The ore smelted from the mine during the period was 123,247 tons averaging 3.125% copper and 8.516

oz. gold per ton. The Mt. Morgan orebody is one which contains higher metal contents in the centre, surrounding which is ore lower in metals but higher in silica. This lower-grade ore is to be treated in the concentrating mill now being erected. To prepare these blocks of concentrating ore for mining, it is necessary to drive drifts, cross-cuts, winzes, and opening out stope sets through them. Some of this ore is first-class smelting ore. All the ore produced from these workings, with the exception of that which goes to the experimental concentrating plant, is at present being smelted, as, to store it until the permanent concentrator is working, would oxidize it too much to handle in the flotation plant. Further quantities of concentrating ore were also mined in raising to reach the copper ore; this also had to be smelted. In addition to this, a certain amount of ore, outside of the reserves, had to be mined in the course of the usual work, and also had to be smelted. The smelting of this low-grade ore, high in silica, not alone materially increases the cost due to the extra flux necessary, but the low copper content of this silicious ore materially reduces the copper output.

The plan of the 750-ft. level, and a section through one part of it, accompanying the report, shows why the Company had to handle during the period both concentrating ore and silicious ore outside the reserves. While the section herewith reproduced is of only one part of the mine, it is fairly representative. It will be noticed that immediately below the 650-ft. level there is a large block of first-grade smelting ore. The most economical method of mining this, and the one adopted, is to sink the winze from the 650 to the 750-ft. level, then stope up in the usual way. This, of course, as will be seen on reference to the section, involves breaking a considerable quantity of concentrating ore, also some outside the reserves before the first-grade smelting ore is reached. Consideration was given to starting work at the bottom of the first-grade smelting ore. Due to the attending disadvantages this course was not followed, as it would have necessitated cutting double sills, picking up double bottoms, handling some of the ore twice in the top lift, and possibly twice filling in the lower lift. On floor 14, above the 650-ft. level, it will be noticed that stoping has got into the concentrating ore. If this ore was left until the concentrator was running, it would either be lost or could only be regained at considerable cost. For similar reasons stoping outside the first-grade smelting ore on the 650-ft. level is being done.

Rutile production in 1913 amounted to 305 tons, containing 94 to 96% of titanium dioxide. This came from the American Rutile Co.'s property in Nelson county, Virginia. The plant consists of a 10-stamp mill, concentrators, and Wetherell magnetic separator.

The American rotary drilling system for oil wells is being introduced to the Caucasus fields, Russia.

Gold Output of Bendigo in 1913

This old mining district of Victoria, Australia, has produced approximately 19,000,000 oz. gold since 1851. During the past year the output from the dividend-paying mines was 266,942 tons, yielding 104,445 oz. gold and £136,081 in dividends. Assessments totaled £100,152, leaving a net profit of £35,928. The output of the whole district in 1913 was 168,172 oz. Details of the producers are as follows, according to the *Australian Mining Standard*:

Mines.	Tons.	Ounces.	Dividends.	Per. share.
Central Red, White & Blue.	28,232	14,626	£38,400	\$5.36
Golden Pyke	13,999	10,649	23,415	4.08
Carlisle	21,564	7,076	12,565	1.68
Great Northern	9,830	4,989	9,750	1.56
South New Moon.....	18,631	5,869	9,600	1.44
Virginia	19,265	6,430	8,775	1.56
North Bendigo	9,813	3,969	7,200	1.44
Ironbark	14,715	6,355	4,959	0.96
New Chum Goldfields.....	11,535	3,704	4,000	0.60
Princess Dagmar	4,284	2,761	3,386	0.48
Windmill Hill	3,037	2,508	3,175	0.48
United Hustlers & Redan..	6,871	3,448	2,156	0.24
Nell Gwynne	17,236	4,953	1,750	0.60
Williams' United	8,199	2,228	2,100	0.24
Johnson's Reef	19,456	6,691	1,450	0.24
New Golden Fleece	5,945	1,280	1,000	0.12
New Nil	5,880	1,249	1,000	0.12
South Prince of Wales.....	2,510	779	750	0.12
Totals	220,912	89,555	£136,081	
The Lansell Proprietary Mines:		Tons.	Ounces.	
Little No. 180.....		26,105	8,713	
North Red, White & Blue.....		12,792	4,298	
Comet		3,635	965	
South Red, White & Blue.....		1,820	504	
Sandhurst		1,678	408	
Total		46,030	14,889	

Mining was interfered with for several months by a number of men striking, as they agreed not to work with non-union men.

Operating Time in the Klondike

The Canadian Klondyke Mining Co.'s manager, J. W. Boyle, gives the following information regarding the 1913 season:

Canadian No. 2 dredge started operations on March 30, has been digging 268 days, has operated over 92% of the time, and has dredged over 2,400,000 cubic yards. Canadian No. 3 started its first operations on May 10, worked 210 days, closed down December 6, operated 89% of the time, and dredged over 1,850,000 cubic yards. Canadian No. 4 started its first operations on May 20, worked 234 days, closed down December 20, operated 88% of elapsed time, and dredged 1,900,000 cubic yards. This gives a total for the three dredges of nearly 6,000,000 cubic yards.

Ore reserves in the Braden mine, Chile, are estimated at 78,000,000 tons of copper ore.

Discussion

Readers of the MINING AND SCIENTIFIC PRESS are invited to send their comments for the discussion of technical matters pertaining to mining and metallurgy to the Editor. The Editor reserves the right to publish or withhold the expression of views contrary to the policy of the Press. The Editor reserves the right to publish or withhold the expression of views contrary to the policy of the Press. The Editor reserves the right to publish or withhold the expression of views contrary to the policy of the Press.

The Rand Banket

The Editor:

Sir—Students of the geology and mineralogy of the Rand will no doubt have followed Mr. Horwood's articles with great interest, and will agree with me in according him great credit for his patient and laborious investigations in a field that presents many complicated and interesting problems, but it is doubtful whether even the enormous amount of evidence he has succeeded in marshaling will be sufficient to convert those opposed to his theory regarding the origin of the bold contents of the banket beds, when they find that his geological deductions are by no means in accordance with the evidence of the rocks themselves.

Mr. Horwood's description of the causes that led to the formation of the Witwatersrand syncline are as follows:

"It is, however, significant that the southern and western outcrops of the syncline are missing," and that the contours suggest that the so-called basin really consists of an ancient synclinal valley, formed by the Ventersdorp diabase having broken through, poured over, and flooded the strata of the Witwatersrand beds, which, in consequence of the weight of enormous superimposed masses of volcanic rock and the removal of them from below, sank, dipping inward toward the region whence the material had been withdrawn."

With regard to the first portion of this extract, Mr. Horwood appears completely to ignore the great outcrop of Witwatersrand beds, Ventersdorp diabase, and Pretoria beds that encircle the granite area on the southern side of the Vaal river. These are generally recognized by South African geologists as the opposite extreme of the Witwatersrand syncline.

The beds in the area are generally vertical and occasionally over-tilted—then dipping toward the granite—and both the Ventersdorp diabase and the overlying Black Reef series, dolomite, and Pretoria beds, encircle the granite so regularly, both in strike and dip, that there is no sign of the unconformity known to exist in other parts of the country between the Black Reef series and the beds underlying it.

The evidence both on the Witwatersrand and in the Vaal river area points distinctly to great earth-movements, resulting in the formation of a synclinal trough after the Ventersdorp diabbases had solidified. Consequently the sinking of the strata, as suggested

by Mr. Horwood, could not have been influenced by the outpouring of volcanic matter, which was a rigid mass when the sinking occurred. This point is further strengthened by the well known fact that the Witwatersrand beds flatten in dip toward the Ventersdorp diabase beds, whereas the reverse would have happened if the volcanic matter had been removed from below them.

Nor will it be generally conceded that "this intense volcanic activity could have also produced numerous lateral fractures." No doubt there are evidences of great fracturing in the Witwatersrand beds, and of the intrusion of many igneous dikes, but they cannot be connected in any way with the Ventersdorp diabase, which is remarkably free from veins or dikes. That the Ventersdorp diabbases represent lava flows, which emanated from some source, probably many miles distant from the Witwatersrand, can be assumed from their amygdaloidal character, combined with the vast area over which these flows are known to extend. I have not come across a single instance of a dike emanating from, or connected with, the Ventersdorp diabase, although I have made many investigations at the junction of the igneous and sedimentary beds for the purpose of determining the relationship to each other.

These investigations led me to the conclusion that the lava flows, now forming the Ventersdorp diabbases, had passed over a comparatively undisturbed area of sedimentary rocks, which presented no evidence of serious disturbance at the time. This being the case, Mr. Horwood's assumption that the longitudinal dikes so frequently occurring in the Witwatersrand area are connected with the Ventersdorp diabase cannot be substantiated by any direct evidence of such relationship. Surely there would have been numerous dikes crossing the strike of the beds when such a gigantic volcanic outburst, producing sheets of over 5000 ft. thickness, broke through the sedimentary beds.

Early investigators of the banket came to the conclusion that the beds were tilted into their present position after their solidification. Strain phenomena was such a marked feature in every microscopic slide that they could not overlook it. Even the minutest grain of quartzite had been influenced by movement. They, therefore, assumed that the metalliferous contents of the banket beds had been introduced previous to their disturbance and solidification, or conversion into quartzite. Mr. Horwood, on the other hand, assigns the cause principally to the intrusion of basic igneous rocks in the form of dikes.

Fig. 4, on page 567, is an illustration of a dike crossing a gold-bearing conglomerate in the Nourse Deep mines. Here it will be seen that the conglomerate bed is cut off sharply against the dike, whereas in the fault, to the left of the dike, the conglomerate is somewhat crumpled. From this evidence it may be

Mining and Scientific Press, December 27, 1913, p. 1909.

Mining and Scientific Press, October 11, 1913.

assumed that the dike intersected a rigid bed, whereas the fault may have occurred at some previous period, when the beds were more plastic. In the ascension theory, it is necessary that there were channels of communication between the beds and the source from whence the gold-bearing solutions were derived. Why, then, has Mr. Horwood preferred the dikes that intersected the strata after its solidification, as shown in this illustration, to the pre-existing faults? He has shown conclusively in Fig. 28A, on page 808, and Fig. 28B and 28C, on page 809,⁴ that there is a decided rise in the gold contents as the line of faulting is approached, but he does not show a similar occurrence in the neighborhood of a dike, except in the Crown Reef where an upthrow fault occurred as well.

That basic igneous dikes form channels for the ascension of other than molten mineral matter will not be generally accepted by geologists, and the fact that these dikes contain an infinitesimal quantity of gold, as stated by Mr. Horwood, may be accounted for by their having robbed the gold-bearing beds which they intersected. Metamorphosis by basic dikes has rarely been recorded, and then only in a slight degree. Basic igneous dikes when intersecting coal beds, do not change the nature of the coal for more than a few feet on either side, and in quartzites their influence is almost imperceptible.

Mr. Horwood's comparison between ordinary mineral veins and blanket beds (footnote No. 44, on page 604⁵) is certainly far-fetched. On page 723 Mr. Horwood states that in 1905 he came to the conclusion that "traces of gold could be found in every series, and in much of the intervening quartzite, showing that the whole of the Witwatersrand beds had been, to some extent, permeated by mineralizing solutions"; and this is perfectly correct. I have crushed quartzite from the Venterskroon area that yielded 12 dwt. (free gold) per ton, and I have had assays of over an ounce from the silicious beds of the Hospital Hill slate.

Further, my experience goes to prove that gold exists in the Witwatersrand beds where uninfluenced by either dikes or faults, and I have been informed by a geologist of high standing and long South African experience that in the West African mines, now yielding gold from strata identical with the Witwatersrand, there is absolutely no evidence of the existence of igneous intrusions in connection with the gold-bearing conglomerates in that country.

My own investigations have led me to the conclusion that the gold and other mineral-bearing solutions were introduced into the Witwatersrand beds while the latter were in a porous condition, whether by means of fissures or directly from the aqueous solutions in which the beds were formed, as originally proposed by De Launay, is an open question, and, in conclusion, I would ask Mr. Horwood to explain whether every

characteristic of the gold-bearing Witwatersrand beds which he has taken such pains to collect and describe, could not be equally as readily accounted for if the gold had been derived from other sources than the igneous dikes, granting that time and pressure were given credit for the metamorphism and crystallization of the contents of the conglomerate. Mr. Horwood will no doubt be interested to learn that when the Rietfontein reef was being opened up, a number of nuggets of gold were taken from the mortar-box, and some were found in handling the ore. One of these nuggets weighed over two ounces, and several were over an ounce in weight. There were about 20 in all. They were handed to me for exhibition in the Chamber of Mines' museum, of which I was curator for a number of years, but at the outbreak of the war they were returned to the late Harold Strange, managing director of the Rietfontein company, and they are now probably in the possession of his executors. They were ordinary nuggets such as are found in alluvial gold-bearing deposits.

London, February 18.

DAVID DRAPER.

How Close Can You Estimate Heights?

The Editor:

Sir—The accompanying photos were taken at the Quartette tailing pond during a recent examination at that property. They illustrate an interesting case, where nature shows in a 'laboratory' way the cause and effect of cañon and gorge topography. The miniature gorge illustrated was formed by a very small overflow stream from the tailing pond, which cut quickly



HOW HIGH ARE THESE CLIFFS?

through a series of sand and slime strata which had been previously caked and dried into layers under desert conditions. The walls are about four feet high and the individual layers are fractions of an inch in thickness only. It has been interesting to note various estimates as to the height of the walls on casual inspection of the photos. These have ranged from 20 to 2000 feet.

San Francisco, March 10.

A. W. GEIGER.

⁴*Mining and Scientific Press*, November 22, 1913.

⁵*Mining and Scientific Press*, October 18, 1913.

Concentrates

Most of these are in reply to questions received by mail. Our readers are invited to ask questions and give information dealing with the practice of mining, milling, and smelting.

Moisture in ores from the Rochester Weaver leases, Nevada, averaged 3.6% in 1913.

Copper ore smelted at Mt. Morgan assayed 55.6% silica, at a cost of 13c. per unit to flux the silica.

An endless-rope haulage 2400 ft. long is working satisfactorily on No. 42 level, south of No. 6 shaft, of the Osceola mine, Michigan.

Mine drainage at the Brunswick property, Grass Valley, California, is done by a Dow pump, which is on the lowest level, 1250 ft., and lifts the water to the drainage adit, 128 ft. under the collar of the old incline shaft. Costs have been reduced since its installation.

The danger of killing mosquitoes with the hands has been drawn attention to by the Liverpool School of Tropical Medicine. The mosquitoes are liable to carry parasites which cause *elephantiasis*, so that especial care should be observed in districts where the latter disease is known to exist.

A carat is 1/24th part. The term has been generally adopted to indicate the gold fineness of alloys used for industrial purposes. The carat, or fineness, represents the parts of gold per twenty-four parts. The remainder is generally silver or copper used for hardening and cheapening purposes.

Where a person wilfully trespasses on the patented land of another in Arizona, and digs shafts thereon which may become a pitfall for stock belonging to that other, he is guilty of a misdemeanor under the provision of Section 532 of the Penal Code, and upon complaint properly sworn to before the nearest justice of the peace, can be criminally prosecuted.

Demand for molybdenite is growing, and supplies are irregular, so that at the present time as high as \$1500 per ton has been paid for clean molybdenite. It is possible that better prices could be obtained, unless these high prices call forth a large supply and again depress the market. For a number of years the average price has been about \$500 per ton, but owing to the growing demand and the decrease in supply, the prices indicated above have been reached. This condition will only be permanent if the supply remains limited. From an operator's point of view, it would not be profitable to undertake work unless it was justified by the prices of about \$500 per ton for clean concentrate, in spite of the high prices at present indicated.

Matte from cyanide clean-up is easier to treat when it contains more gold than silver. If it is rich in gold, with some silver, the gold will be reduced at once and the silver remains in the matte, especially when treating it with iron shaving, according to G. Simpson, of the Ketahoen mine, Sumatra. For every 100 oz. of silver in a silver matte he collects, 2.2 lb. of turnings is added in melting. Cast iron is not as good as steel for this purpose. The matte is run down first with 1.1 lb. of iron, then a second time with a similar quantity, it being found better to do this than to melt hot at once. After refining gold and silver bullion in a crucible, it is found that matte sticks hard to it when poured into a mold. The higher the value of the matte, the tighter it adheres to the bullion. If a little cyanide salt is added during melting, this makes the matte of lower value, and it separates easily from the bullion. The addition of a little iron shaving during melting acts in a similar way, is cheaper, and there is no danger from fume.

Treatment at the Grand Junction mill, Waihi, New Zealand, shown in the accompanying cut, is as follows: The ore consists of a gangue of quartz and calcite, with 8 to 10% sulphide, in a country rock of highly altered dacite. Metals average \$8 and \$1 silver per ton. The 40 stamps, having been increased to 60, crush an average of 8400 tons per month, yielding bullion worth about \$80,000. Cyanide solution



GRAND JUNCTION MILL, WAIHI, NEW ZEALAND.

and lead acetate are added to the batteries. The pulp flows to three elevator wheels and then to a series of spitzkasten. The underflow passes to Wilfley tables and the overflow to eight tube-mills, two being 19¼ by 4¾ ft., and the others 16¼ by 4¼ ft., revolving at 27 r.p.m. All the ground pulp goes to thickeners, from which it is pumped to one of a series of 12 flat agitators revolving at 4 r.p.m., which act as storage tanks. It is then pumped to Pachuca tanks for agitation for 18 hours. Filtration is done by a Moore type of plant. All solutions are precipitated on zinc shaving. Melting the fluxed precipitate is done in Ballack tilting furnaces, and the bullion refined in a kerosene-fired furnace. Costs of milling and treatment are about \$1.50 per ton.

Special Correspondence

TORONTO, CANADA

KIRKLAND LAKE MINES.—NIPISSING PROFITS AND FUTURE.—INTERNATIONAL NICKEL PROFIT SHARING.—BLACK LAKE ASBESTOS CO.—MINERAL RIGHTS ON LANDS IN ALBERTA.

Kirkland Lake flotations are still creating considerable excitement in London, notwithstanding the severe criticism the methods employed by the interested parties have undergone. From the Kirkland Lake Proprietary, the original flotation, which appears to be an outgrowth of the Union and Rhodesian Trust, C. A. Foster, of Haileybury, received £25,000 in cash for which he gave to the Company the benefit of those contracts and negotiations which he had entered into for properties in the Kirkland Lake district. According to the prospectus of the Kirkland Lake Proprietary, after the original issue of 75,000 £1 shares for every two shares issued up to an additional 50,000 shares, Mr. Foster was to receive either £1 in cash or one fully paid-up share of stock. It is understood that upon receipt of this £25,000 in cash, Mr. Foster purchased 25,000 shares of stock, also obtaining, as per the original agreement, an additional 12,500 shares, giving him a total of 37,500 shares, which is the largest individual holding in the Company. Mr. Foster then sold to the Kirkland Lake Proprietary a 99½% interest in the Tough-Oakes mine in Kirkland Lake, in which he is also the largest shareholder. It is understood that the price paid was \$3 per share for the 450,000 shares outstanding. For the purpose of taking over this property, a London company called the Tough-Oakes, Limited, was formed with a capital of £500,000, shares of which were issued at par. When this Company has been successfully launched, Kirkland Lake Proprietary will receive back all the money which it has spent on the property, and in addition 100,000 shares of Tough-Oakes stock. It is understood that the other properties which the Kirkland Lake Proprietary has under option will be handled in a similar manner. Reports on these various properties, the Tough-Oakes, Burnside, Sylvanite, and Teck-Hughes, have been made by H. H. Johnson. These reports leave much to be desired. Mr. Johnson, notwithstanding the fact that the Tough-Oakes mine has only been opened at the 250-ft. level and has a comparatively small amount of driving done, estimates, with insufficient data, developed and prospective ore to the value of £220,000. From this, however, must be deducted the cost of further development and the expenditures necessary to equip the property with a mill and plant. Mr. Johnson further estimates that the annual net earnings will be £150,000 per year. These figures are based on the returns from a mill having a capacity of 30,000 tons per year, and, with only 19,000 tons of ore actually developed, the estimate of annual profits is certainly open to criticism. The necessity for caution by prospective investors in the securities of any of these Companies is evident, and while the properties under consideration have considerable merit, the possibilities are that greater profits will accrue to the promoters than to the stockholders.

The recent activity in the stock of the Nipissing Mining Co., which dropped from about \$9 to \$6.40 per share, is believed to be preliminary to a cut in the dividend. This Company at present is paying dividends at the rate of 30% per year on a capital of \$6,000,000, quarterly dividends being 5% regular and a 2½% bonus. In the event of action being taken, it is believed that the bonus will be dropped. In this connection, a recent circular sent out under the signature of E. P. Earle, president, is of interest. Mr. Earle states that the report for the year 1913 will be sent to the share-

holders in April, and will contain full particulars of operations for the year ended January 31, 1913. Inasmuch as there has been of late a falling off in the net earnings due to the lower average grade of the ore produced, and as it is impossible for the management to state whether this condition will prove temporary or permanent, it was considered advisable to submit a brief statement to the stockholders. The nature of the orebodies in the Cobalt district is such that it is impossible to predict earnings far in advance. The earnings of the Company will in the future, as they have in the past, depend upon the continuation of the known veins which are now being operated and the discovery of new orebodies. There have been periods in the past when earnings have fallen off because of conditions similar to those now existing. The Company owns a large area of undeveloped territory which presumably contains orebodies of value. Mr. Earle states further that during the past three months five new veins have been found in partly developed ground which will aggregate about 8 in. of 2000-oz. ore. On January 1 the Company's ore reserves were practically the same as were estimated for December 31, 1912, when they stood at 9,643,338 oz. The Nipissing, in common with the majority of the Cobalt mines, is depleting its high-grade ore reserves at a faster rate than they are being supplemented by the discovery of new orebodies. The high-grade veins have been responsible for the large dividends paid by Cobalt mines, and, notwithstanding the large tonnage of low-grade ore available, a cut in the dividend is inevitable, as the high-grade ore becomes less. Statements for the last few months showed that the net value of the ore mined varied between \$165,000 and \$185,000 per month. As the present dividend requirements call for \$150,000 per month, and working expenses are between \$50,000 and \$60,000, it is easily seen that unless a decided change for the better takes place, a reduction in the dividend rate is only to be expected.

Of the 3000 shares of International Nickel common stock which employees of the Company were recently permitted to subscribe for at \$110, practically all has been taken up. Of the 4000 persons on the payroll, 40% subscribed for their allotment of shares. The minimum subscription was one share to any employee of under five years' service receiving up to \$825 per year, while the maximum subscription was 10 shares to anyone receiving over \$4000 per year who has been in the employ of the Company for over 10 years. This stock will be paid for in monthly installments, and the employees will receive dividends as soon as the first installment is paid. An additional bonus, equal to 5% of the stock so paid for, will be distributed equally to such employees as retain their stock and remain in the employ of the Company. The success of this innovation, which is the first of its kind among any of the large mining companies in Canada, has been very gratifying to the management.

The statement of the Black Lake Asbestos Co. for 1913 is not likely to prove a very pleasing document to the shareholders, as it shows a loss of \$20,939 on the year's operations. From the available figures, it does not appear that the Company sold any asbestos in 1913, as the only receipts given in the profit and loss statement are \$1617 for rents and \$4796 for interest, against an expenditure of \$27,352. The directors state that the results of the past year's operations have been unfavorable owing to a decline in the percentage of asbestos obtained from the rock, due to a change in formation in one of the largest pits. The asbestos fibre was 3.8% for the last six months of the year, as against 5.1% for the preceding half-year. It is, however, stated that new pits are being opened which will furnish asbestos rock equal in quality to the best now being mined. The Company is in a better financial position than the profit and loss statement would indicate, as it has \$73,000 loaned on col-

lateral security. Current assets, including this loan, amount to \$150,881, while current liabilities, including a bank overdraft of \$23,366, total \$29,616. The entire estimated output of the Company has been contracted for up to next October at advanced prices, and indications are that a still higher price will be obtained for the balance of the output. The Black Lake company was one of the several large consolidations for which a bright future was predicted. On account of the condition of the asbestos market, and exceedingly ill-advised financing on the part of the promoters, the Company was forced into liquidation. After it was reorganized, the capital was decreased and fixed charges largely eliminated; but notwithstanding this, the Company does not seem to be making much headway.

On account of the right of the Dominion Government to grant mineral rights on lands in the vicinity of Calgary being questioned, an interesting situation has arisen in connection with the oil and gas leases in that field. This threatens to lead to a great amount of litigation which may possibly invalidate the securities of those who invested either in oil leases or in the stock of oil companies. It has been generally understood that land filed on for homestead purposes prior to 1889, carried with it the mineral rights, and that all homestead lands taken up since that date were without such rights. In 1889 an order-in-council was passed which provided that, under patents issued by the Crown, all mineral rights should be reserved. This condition prevailed until 1908, when a new act was passed which expressly provided that mineral rights should be excluded from homestead entries. It is on this understanding that leases have been applied for, and during the recent oil excitement in the field southwest of Calgary, about 50% of the leases in the district are for oil and gas rights under lands that were homesteaded between 1890 and 1908. It is now stated on good legal authority that during these years the Government had no right under the law to take these reservations of mineral rights from the homesteaders, and that these rights belong to the owners of the surface rights or to anyone to whom the surface rights may have been assigned. Should this contention be upheld, a large part of the leases recently applied for would be valueless; but on the other hand, it is pointed out that homesteaders who have entered on their lands and ultimately accepted a patent with the knowledge of the regulations supposed to be in force, now have no grounds for complaint.

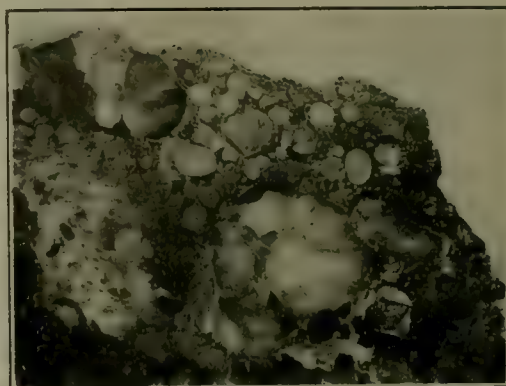
JOHANNESBURG, TRANSVAAL

ESTIMATE OF THE LIFE OF THE RAND BY THE CHAMBER OF MINES.

— OTHER AREAS LIKELY TO BE PROFITABLE. — PROBABLE DEPTH OF MINING. — RESULTS IN 1913.

A mild sensation has been caused in mining circles by the appearance of a statement, prepared by the Chamber of Mines for the Government Economic Commission, showing the probable life of the Witwatersrand goldfields. The exact length of the life of the Rand was not estimated, because so many factors enter into the question, but the probable life of the Rand as it is known today is, according to the Chamber of Mines, so much shorter than anticipated, that it may not be out of place to give the principal features contained in this official statement. First, it is pointed out that the Rand goldfield has been proved to extend from Randfontein on the west to Holfontein on the east, a distance of over 60 miles. The limit to deep mining throughout this length was taken at 7500 ft. vertical, because the government has actually refused to proclaim any ground for mining purposes where the 'reef' is supposed to exist below that depth. To arrive at the probable gold contents of this deep unproved ground, this has been taken as equal to the gold contained in the last 1000 ft. of the developed reef, no

allowance being made for the flattening or decline in gold content in depth, both of which are known to exist. If working costs continue as at present, the Chamber of Mines estimates that in 42 of the mines, the other mines not included, there are 550,000,000 tons of profitable ore, which, at the present rate of crushing by the 42 mines, will maintain the Rand with only sufficient ore to keep the mills running for about five years. It must be admitted that the method of arriving at this conclusion is only an approximate one; but coming from such an authority as the Transvaal Chamber of Mines, it has attracted considerable attention. It was further estimated by this institution that under existing conditions the tonnage crushed in the year 1930 will probably fall to one-half its present quantity, an estimate which in most quarters seems difficult to believe. The sting contained in the above estimate of the future of the Rand is, however, to some extent removed by subsequent statements, one being to the effect that outside this official estimate there are three properties in the East Rand now in



A SAMPLE BASKET FROM THE NEW REEFONTEIN.

course of development, comprising 4140 claims and capable of yielding 1,800,000 tons of profitable ore per year, while there are eight other properties closed down in the same neighborhood, owning 6420 claims, whose milling capabilities may be assumed to be 2,500,000 tons per year, not taken into consideration. Then it is pointed out that there are no less than 86,000 other gold claims in the Far East Rand, where boring operations have proved the reef, also excluded from the official estimate; so that it will be seen that the estimate made by the Chamber of Mines is a conservative one. The Kimberley Reef series, and the probable westerly extension of the Main Reef series, are lightly considered; but it seems clear that the Chamber of Mines does not look for much extension in the central and western Rand, the Far East Rand being best able to add to the present gold production of the Witwatersrand.

If this statement of the Rand's future be studied, it will be seen that, while it may be a broad and general statement, there is much in it with which most engineers will agree. At the same time, any attempt to fix the life of the Rand by years must necessarily be an approximate one only, on account of the many varying factors and difficulties surrounding the question. There is, for instance, the question of the limit to deep mining on the Rand which the Mines Department seems to have fixed at 7500 ft. vertical. The present deepest mine on the Rand has attained a depth of over 5000 ft., without adding materially to the cost of working, and on the basis of working costs, an ultimate depth of 7500 ft. vertical seems quite within reach. As for mining difficulties due to depth, these are not particularly noticeable, and with the excellent underground conditions the depth

limit assumed seems attainable. The real difficulty surrounding 'ultra-deep' mining on the Rand seems to be that of the gold content of the reef, because, taking the Rand as a whole, quite one-half of its entire length seems to have depreciated to such an extent as to make the task of deep mining one of working at a profit a reef at a depth of over 5000 ft. yielding only \$5 gold per ton.

This depth has not yet been attained on the western Rand, but it is doubtful whether at such a depth the average value will exceed \$5 or \$6. In the central Rand the prospects of deep mining are good, but it is doubtful whether the output from the western and central Rand will improve in the future, while that from the east Rand can only expect at least to be maintained. The only section of the Rand affording scope for an increased output is that known as the Far East Rand, beyond the town of Boksburg, but this opening for new mines was fully dealt with in the Chamber of Mines statement submitted to the Economic Commission. There can be no doubt, however, that the Rand production of gold has reached a point scarcely likely to be exceeded, and one that only with difficulty will be maintained after the next ten years.

It has been the rule on the Rand for the output of gold to steadily increase, month by month and year by year, for the last 20 years, and to be told by no less an authority than the Chamber of Mines that these increases were coming to an end, came as a shock to the Rand. Last year's figures show, however, that this is the case, for while in 1912 the value of the Transvaal gold output was £38,686,250, the total value of last year's output was only £37,372,952, being the first time since the Rand was discovered that the output of gold registered under normal conditions a decline. [The strike during the past year helped to reduce the output.—EDITOR.] It seems evident that increases in the future will become more difficult, but the present output ought to be maintained for more than five years, and probably when the permanent decline sets in it will be more gradual than the statement made by the Chamber of Mines would lead us to expect.

During 1913 all the mines treated 25,628,432 tons, as against 25,486,361 in 1912. The average yield declined from \$6.96 to \$6.66 per ton, the lowest yet recorded. Costs fell from \$4.48 to \$4.30, and working profit from \$2.40 to \$2.28. Aggregate profits were £12,189,105, as against £12,678,095. There were 9337 stamps and 278 tube-mills working, compared with 9449 and 262, respectively, and the stamp-duty rose from 8.39 to 8.82 tons per day. Sorting fell from 12.57 to 10.74%. Dividends increased from £7,952,994 to £8,194,099.

The output in January 1914 was worth £2,768,470, the lowest for many years. The tonnage treated was 1,902,433, averaging \$6.56 with a profit of \$2.22 per ton.

LONDON

THE INSTITUTION OF PETROLEUM TECHNOLOGISTS INAUGURAL MEETING.—FLOTATION LITIGATION, ELMORES *v.* THE SULPHIDE CORPORATION DECISION.

It is not only the engineer interested in metalliferous mining who finds it expedient to have a professional society to protect the public against impostors. Those connected with petroleum have also been stirred to form such a society. I recently attended the inaugural meeting of the Institution of Petroleum Technologists, and, to judge by the large attendance and the character of the men present, the new society appears to have a destiny. Sir Boverton Redwood is the first president, and supporting him on the platform were such well known men as Vivian Lewes, Sir Thomas Holland, Cunningham Craig, and John Cadman. The president made a statement formulating the aims and objects of the Institution. The commercial element does not come within its scope. There is no desire to push the advantages of petroleum and

its products in their applications as producers of power and light or as lubricants. The sole aim is to advance the scientific treatment of petroleum problems in their geological, chemical, and mining aspects, and to promote the better training of the future leaders of the petroleum industry. After Sir Boverton's inaugural statement, three short addresses were delivered by Sir Thomas Holland, Cunningham Craig, and Vivian Lewes, the first being strictly technological, and the other two being in the nature of amplifications of the presidential address. Sir Thomas Holland's lecture was devoted to the geometry of the various types of asymmetrical anticlines, and gave mathematical directions for tapping the crests of the successive oil-bearing beds. In his address, Cunningham Craig said that the public and the financiers had to be taught the elements of petroleum geology, and petroleum mining must be put on a strictly business footing. Mr. Craig has already earned the thanks of his professional friends by his refusal to be talked into giving favorable reports either by governments or promoters. In this connection, his views on the chances of finding oil in South Africa are well known. He is the author of that excellent book, 'Oil Finding.' He was also eloquent on the lack of opportunities in England for specialized training in connection with petroleum, and he commended the action of John Cadman, professor of mining in the University of Birmingham, for his enterprise in establishing a course where geology, chemistry, and mining are taught from the point of view of the petroleum technologist. By means of this school, it is hoped that native talent will be trained, fitted for the multitude of posts now offered. At the present time, chemical advice is sought on the Continent, and engineers and drillers are brought from America or Galicia. The concluding address, by Vivian Lewes, called attention to the chemical side of the subject, as affording the possibility of even greater prizes than the geology and engineering. The removal of troublesome sulphur compounds affords an important field for research, and the production of petrol products from petroleum by cracking or otherwise is an equally attractive subject.

Three weeks ago I gave particulars of the hearing of the appeal from the New South Wales court, by the Judicial Committee of the Privy Council, in connection with the suit by the Elmore's against the Sulphide Corporation, alleging that the Minerals Separation process as used by the Corporation was an infringement of the Elmore patent of 1901, which claims the use of acid for aiding the selective action of oil for metallic or sulphide particles. The five judges appeared to be inclined to restrict the arguments to this narrow scope, and for that reason there was a general impression here that the Elmore's would win. It comes as a surprise, therefore, to find that the judgment sustains the Australian court and dismisses the appeal, leaving Minerals Separation the victor. Unfortunately, the practice of the Judicial Committee does not indicate whether the judges are unanimous. In the purely English courts each judge delivers his individual opinion. It is probable that the five were divided and that the majority was a case of three to two. Though the arguments before the court appeared to be in favor of narrowing the issue to the 1901 claim, the judgment rambled over much wider ground, and finally the judges said that Elmore used oil as the concentration and flotation agent, while Minerals Separation depended for the same effect on the principle of surface tension. The case was presented differently by the Elmore's in this litigation on the New South Wales patent from the form in which the lawsuit was fought in England. In the earlier case both patents, that for oil in 1898, and that for acid in 1901, were cited. As all the judges pronounced against the 1898 patent, the Elmore's decided to rely solely on the 1901 patent in the New South Wales case. On the other side, the defenders of Minerals Separation were, in the interval between the House of Lords and Judicial Committee hearings, placed in a more favorable position by the

consolidation of interests with the De Bavay company which owns the Potter patents. In the old days, Minerals Separation was 'between the devil and the deep sea,' being attacked by oil on one side and buoyant bubbles on the other. When peace was made with bubbles, greater stress could be laid on the surface tension principle, and the oil could be relegated to a more obscure position. This presentation of the surface tension proposition appears to have formed the basis of the Judicial Committee's decision. The flotation question bristles with so many details and apparent contradictions that it is well nigh impossible to arrive at any concise view. Moreover, the whole of the facts are not known to the public and to journalists, so it is easy for us outsiders to fall into error. I may be committing an egregious blunder, therefore, in wondering why the Elmore vacuum patent was not cited in the case. It indicates the use of surface tension and small amounts of oil and acid, and it antedated by a year the main Minerals Separation patent of 1905. Probably the reason is that the vacuum process runs against the Potter surface-tension process patented in 1902, and this was the enemy's territory by purchase.

NEW YORK

COPPER EXPORTS AND TRADE IN EUROPE.—FEDERAL MINING & SMELTING CO.'S SMELTING CONTRACT.—CALUMET & ARIZONA MINING CO.'S REPORT.—MEXICAN NOTES.

Curiosity as to how exports of copper to Europe can continue at record-breaking figures in spite of dullness in business there as well as in this country, seems to be becoming more general. From 1909 to 1912 exports increased yearly at the rate of about 6% per year, but during 1912 there was a slight decrease. But the 1913 exports increased nearly 40% over the preceding year, while the exports of the past four months have averaged nearly 10% larger than during 1913. Exports in February were \$3,899,183 lb., and are estimated at \$5,000,000 lb. in March. C. W. Morse, who has just returned from Europe, has made the following statement: "I was impressed with the general falling off in business, which at this particular time is more than normal. In Germany, France, and England every line of business is showing a marked decrease." In putting these two facts side by side, the state of mind of the copper consumer can be best shown by a large question mark. Following the Democratic victory in 1912, and the knowledge that the tariff would certainly be reduced, high exports of copper to European manufacturers were perfectly natural last year. The copper consumed during the Balkan war helped out through the necessity of restocking arsenals with ammunition; but what basis exists for the present unprecedented flood of copper to Europe is hard to see.

The suit of the minority stockholders of the Federal Mining & Smelting Co. to annul its smelting contract with the American Smelting & Refining Co. is now being heard, and the facts brought out make interesting reading for everyone. It will be remembered that, in 1905, Charles Sweeny sold the control of the Federal, held by himself, J. D. Rockefeller, and George J. Gould, to the Guggenheim organization. Guggenheim representatives went on the Federal board, and the smelting contract with the American Smelting & Refining Co. was extended for 25 years. It soon developed that the ore reserves in the Federal were not nearly so rich as supposed. Meanwhile a change in the smelting situation caused an unexpected marked decrease in the smelting charges on the ores of the district. As a result, the Federal was soon making almost no profit out of mining its ores, while the American Smelting & Refining Co. was making a good profit at smelting them at a rate much above the prevailing one for competitive ores. This state of affairs has been worrying the minority shareholders, and they are trying to break the smelting contract. A contract is a contract, however, and,

unless not entered into in good faith, usually has to stand even if it proves a losing one.

The Calumet & Arizona Mining Co., which operates mines and a smelter in Cochise county, Arizona, has published its report for 1913, containing the following information: Development covered 15,635 ft. at the Irish Mag, Oliver, and Powell shafts of the C. & A. mine. Little work is being done at the first-named just now. No new orebodies were opened in the Oliver, but a good tonnage of ore from small shoots at 1150 and 1250 ft. was mined. This area has several small rich sulphide shoots. A large reserve was developed between the 1250 and 1350-ft. levels. Prospecting is under way at the Powell shaft. At the Courtland mine, development totaled 3591 ft. Until November 30, ore shipments averaged 600 tons per week. In July, the Germania shaft started to move and prevented hoisting ore. By arrangements with the Leadville Mining Co., its Maid shaft was used for this purpose. The mine is now leased. These two properties produced 135,979 tons of ore averaging 4.93 and 5.40% copper.

At the Superior & Pittsburg mine the total work was 47,201 ft., at the Hoatson, Junction, Briggs, and Cole shafts. Results to 1000 ft. in oxidized ore at the Cole have been satisfactory. The Junction shaft was concreted, being finished on February 8, 1914. At 1300 ft. south from the shaft, ore was opened nearly to the 1200-ft. level. Along the Copper Queen side-line a fair-sized body of good sulphide ore was opened. At 1400 ft., in the southwest corner of the Ormond claim, a shoot 40 ft. wide and 60 ft. long was developed. Steady shipments were made from 1300 ft. at the Briggs area. The shaft was sunk to the 1500-ft. level of the Junction. A motor line at 1400 ft. will haul Briggs ore to the Junction. Considerable ore was opened at the Hoatson shaft down to 1400 ft. Ore mined totaled 393,941 tons, averaging 6.27% copper. Shipments to the smelter were 376,452 tons. The new smelter is in full operation. It cost \$2,218,218. Total earnings from copper, gold, and silver were \$9,160,975, and sundry revenue, \$21,020. The net income was \$4,074,637. Expenses on outside properties were \$146,830, covering work at the Daggs-Newman and Copper Giant claims in Pinal county, and the Amole and New Cornelia in Pima county, the latter at Ajo. Work at the latter has been the proving of ore reserves, water development, and surveying a railway from Ajo to Tucson. Estimates of the ore are as follows: available by steam-shovel, carbonate ore, 11,954,400 tons averaging 1.54% copper; sulphide ore, 20,526,800 tons averaging 1.54%; underground mining, sulphide ore, 7,776,800 tons averaging 1.40%; and rock stripping, 3,308,400 tons containing 0.60% copper. The carbonate ore will be leached, and a good recovery by flotation of the sulphide ore is shown by tests.

Work is to be resumed by the Amajac Mines Co., whose property is in the state of Jalisco, Mexico. A 50-ton mill is in course of construction. Walter J. Pentland is general manager. Nearly 300 tons of ore per day is being treated in the new Cinco Minas mill. The recovery is up to 96%. The Company is marketing its bullion through the Sociedad Afincadora de Metales, the French refining concern of Mexico City. Arrangements for the marketing of the concentrate have not yet been closed, but these products probably will be shipped to Wales. Mine development has been resumed and plans have been made for extensive work. The main working shaft is to be sunk to a depth of 1000 feet.

From the Amparo Mining Co., 150 tons of concentrate has been sent to the Selby smelter in California. The average value is \$500 per ton. This is the second shipment to this smelter. Much interest has been attracted locally by an interview with Emeterio de la Garza, published in the *Sun*. Sr. Garza has served under Diaz, de la Barra, Madero, and Huerta, having been the confidential envoy of the last at Washington. He advocates a peace conference.

General Mining News

ALASKA

The annual report of J. R. Willis, collector of customs for the territory, at Juneau, shows the following results for 1913:

Total commerce, domestic and foreign.....	\$67,422,307
Decrease compared with 1912, due to lower gold yield	5,318,753
Gold and silver exports to United States.....	12,959,266
Copper ore and matte	3,765,132
Tin ore and concentrate	72,734
All fish products	15,803,073
Gypsum	129,375
Marble	92,588
Shipping, foreign and domestic, total, tons.....	1,389,306
Population, decrease	1,126

CODROVA

Heavy snowstorms have interrupted traffic on the Copper River railroad, and trains have been stalled.

FAIRBANKS

It is proposed to hold an exposition here in 1917, to commemorate the fiftieth anniversary of the acquisition of Alaska by the United States from Russia, and the probable completion of the authorized railroads from one of the southeastern ports to Fairbanks. A company with 15 directors and a capital of \$1,000,000 is to be formed.

JUNEAU

The 1913 returns of the mines was as follows:

	Alaska	Alaska	Alaska United.	
	Mexican.	Treadwell.	Bullion.	700-Ft. Claim.
Tons	227,112	886,057	222,992	225,435
Gold output	\$489,697	\$2,358,422	\$511,391	\$532,152
Profit	171,797	1,223,437	323,602	325,669
Dividends	180,000	1,000,000	\$414,460	

ARIZONA

According to official statements at Globe, Gila county, the Tucson, Phoenix & Tidewater is to be constructed from Tucson, in Pima county to Phoenix in Maricopa county. The line will be 120 miles long and will probably run through Florence in Pinal county.

COCHISE COUNTY

The Shattuck-Arizona company paid 50c. per share on April 20, amounting to \$175,000, and \$1,925,000 to date.

GILA COUNTY

It is probable that an electric tramway will be constructed to operate between Globe and Miami.

Shipments of ore from the London-Arizona Consolidated Copper Co.'s mines to the smelter are now proceeding regularly. A recent shipment of 50 tons averaged 6.2% copper and 3 oz. silver per ton. The net smelter returns on this carload were \$414. Four more cars are now in transit.

SANTA CRUZ COUNTY

Smelter returns from ore sent from the Patagonia Mining & Development mine, gave 30 oz. silver and 13.72% copper, the net value being \$46.28 per ton.

CALIFORNIA

Oil statistics for February are as follows: Rigs completed during month, 17; wells drilling, 225; wells completed, 44; wells abandoned, 23; producing wells, 5787; net output, 7,943,638 bbl.; shipments, 7,384,406 bbl.; and stocks, 51,180,067 barrels.

AMADOR COUNTY

Dividends paid by the South Eureka, Bunker Hill, and Fremont companies during the first three months of 1914 are \$62,997, \$15,000, and \$12,000 respectively. The Lone Coal & Iron Co. has received an offer for the output of its coal mine at Lone. The Central Eureka mill is again in operation. The Plymouth Consolidated Gold Mines, Limited, has a capital of 240,000 £1 shares, of which 127,000 are issued fully paid, and 113,000 were offered to the public at par on January 26 to 28, 1914, according to the prospectus. These shares were over subscribed for in short time. The directors are John Barry, David Richards, and Cyril Wanklyn, all on the board of the Sons of Gwalia, Limited, operating a profitable mine in Western Australia. Ore reserves in the Plymouth are 110,113 tons worth \$150,667, with a profit of \$72,858. Working costs will be about \$2.72 per ton, and 90% recovery is allowed for. A 300-ton mill is now being erected, and should be working in September next.

BUTTE COUNTY

During 1913, the Oro Water Light & Power Co.'s dredges recovered gold worth \$542,240, at a cost of \$255,538, and with a net return of \$275,579. Profits of the whole concern were \$349,455.

Five dredgemen have gone, and nine others are leaving Oroville for Dawson, Yukon, where they will be employed by the Guggenheim company. Fire destroyed property valued at \$100,000 at Oroville on March 19. Two boats of the Oroville Dredging Co. recovered \$4791 during the first week in February.

IMPERIAL COUNTY

(Special Correspondence.)—The Imperial Reduction Co.'s mill and cyanide plant is now in its second month, with good results. It consists of three Gates dry-crushing rolls, three 8-ft. Hardinge tube-mills, fifteen Deister tables, one Dorr thickener, two Trent agitators followed by two Trent replacers. The ore reserves are extensive and of a profitable grade.

Ogilby, March 13.

NEVADA COUNTY

It is reported that San Francisco people have acquired the Golden Gate mine, a promising property near Grass Valley. Three men had their right hands injured in various ways at the Champion mine. At the Empire 3800-ft. level, W. Allen, an old Grass Valley miner, was killed by a descending skip, through some unaccountable cause. On May 13, 1913, Guiseppe Domiano fell down a chute in the Birchville mine. He is now suing for \$31,247.50. Five claims in the Meadow Lake district are in dispute as to ownership.

PLACER COUNTY

C. H. Dunton, collector of minerals for the Sacramento Valley Expositions Commission, has been making inquiries in this county for samples of gold, copper, asbestos ores, and clay and marble. Several men were injured on March 20, by a gravel bank at the Goggin placer mine, forty miles from Forest Hill, caving on one and the nozzle striking others.

PLUMAS COUNTY

The California Mines Co. has been organized to work a large mine on the Mother Lode and developing the Oakland and Osborne claims in the southern part of this county. The officials are D. C. Demarest, W. de Varila, L. H. Fordham, and H. C. Bocchio of San Francisco, and two Minneapolis people.

SIESTA COUNTY

The new 100-ton decantation slime plant at the Midas mine, at Harrison Gulch, is in operation. It cost \$30,000 and is similar to the Globe mill in Trinity county. The 20-stamp mill of the Midas is running full time. Rich ore is being extracted by C. C. McDonald from his claim on Mule mountain, near Redding. He is erecting a 5-stamp mill.

SIERRA COUNTY

A gravel channel under a capping of lava has been opened by an adit driven from an old hydraulic mining area at the Mountain House property.

SISKIYOU COUNTY

A dredge is to be moved from the Oroville district to operate between Montague and Yreka. L. N. Parks will be in charge.

YUBA COUNTY

Probably the Pennsylvania and Bessie mines at Browns Valley will be unwatered and reopened.

COLORADO

CONEJOS COUNTY

(Special Correspondence).—There is nothing much doing



PART OF CONEJOS, RIO GRANDE, MINERAL, AND ARCHULETA COUNTIES, COLORADO.

at Platoro, but it is said that the Golden Cycle people have taken hold of the Mammoth property there and will shortly start men working.

Platoro, February 27.

MINERAL COUNTY

(Special Correspondence).—Conditions at Creede have not changed much. The Humphreys Creede United Mines Co. mill is not yet started on account of the low price of lead, and will not for some time, probably not before next summer. There is more snow here this winter than ever before in the history of the camp, but even at that there is not enough to bother working except temporarily.

The fluor spar mine at Wagon Wheel Gap is not shipping at present, as the steel mill at Pueblo is overstocked. The company is going ahead with development work and seems to think there is a lot of mineral there. It is trying to develop other markets than the steel works, and may ship to various glass works in Kansas and Texas. This deposit is remarkably pure, running well over 90% CaF without any washing or sorting, while that from Illinois and Kentucky is only about 85% or less.

Creede, February 27.

MONTROSE COUNTY

(Special Correspondence).—The recent discovery was in Happy cañon, about 7 miles south of Montrose. As soon as news of it leaked out, everybody in that town made a break, and you could not get even a horse, much less a rig at Montrose, as they were all strung out along the road to Happy cañon. The ore occurs in a flat stratum of sandstone and gold content as high as \$60 are reported. The first car of ore was to be shipped today, and they expected it to run \$60 per ton. The American Nettle, and possibly some of the other mines just below Ouray, were in quartzite, and possibly this may be a similar deposit. Of course, there is no telling

yet whether it amounts to anything or not. There are said to be about 200 tents out there, so it is quite a boom camp. Montrose, February 27.

TELLER COUNTY (CRIPPLE CREEK)

On No. 12 level of the Isabella Mines Co.'s main shaft, a shoot 5 ft. wide has been opened by a raise, containing tellurides and averaging from \$200 to \$300 per ton. Thirty sets of lessees are working at the property. The total number of people engaged about mines in the district is 3200, of whom 2476 are miners. Lessees operating blocks of ground of the Stratton estate, under lease from the Stratton Cripple Creek Mining & Development Co., paid a total of \$61,121 in royalties during the year 1913.

IDAHO

The annual report of Robert N. Bell, state inspector of mines, has been submitted to Governor Haines, and includes the following information: There were 4000 men employed in all mines. There were 26 fatal accidents, 25 of which were in Shoshone county; also 45 serious and 75 slight mishaps. These occurred in mining 2,000,000 tons of ore and an equal amount of waste. The gross value of ore and bullion produced was about \$24,000,000 and \$4,500,000 was paid in dividends. The state again assumed first place in the list of lead producers. The coal deposits in the new county of Madison are described in the report.

BONNER COUNTY

A raise in the Idaho-Continental mine, 26 miles from Port-hill, is opening ore assaying 71.3% lead and 38 oz. silver per ton. Shipments will be made in July.

SHOSHONE COUNTY

Around Murray the snow is melting and a busy season is looked for in mining. Machinery at the National mill will be ready for a run by April 1, although that for the flotation plant is somewhat behind.

MICHIGAN

HOUGHTON COUNTY

In his testimony before the committee of inquiry into the strike, James MacNaughton, of the Calumet & Hecla, gave the following information: Probably half of the opened ground was worked out, and the other half would not be so rich in copper; the proportion of copper per ton of 'rock' in the district was about 20 lb., the Calumet conglomerate yielding 28 lb.; in Butte this was 62, Arizona 74, and the Arizona and Utah porphyrites 22 lb.; to mine conglomerate is 50 to 75% more expensive than the amygdaloid; Calumet & Hecla normally hoists 20,500 tons of 'rock' per day; from mining to marketing of copper, a period of about six weeks elapses; 300 shaftmen are employed at the Calumet & Hecla; 80% of its 70 miles of drifts are used; hoisting engineers in the district are not licensed; the contract system of mining was based on the cubic fathom, 6 by 6 ft., measured by the mine 'captain'; prices of contracts are cut down at times, but there are 750 to 800 bosses, and some may not be square with the men, this is not by the Company's orders; a bonus system of 10c. per ton exists for mining over 900 tons per month; men were required to work not more than 150 ft. apart; before the strike the Calumet & Hecla companies employed 419 one-man and 177 two-men drills; in 1912, miners with the former machine earned \$3.34, and with the latter \$2.82 per shift; trammers in 11 mines moved from 1200 to 1948 tons each per day over distances of 171 to 900 ft.; the Calumet & Hecla has had no labor troubles since 1871; Mr. MacNaughton started work in 1877 carrying water for coal shovelers.

A timberman, trammer, and finally a contract miner named Joseph Ram, gave interesting evidence before the Commission. He kept his monthly pay dockets for 17 years, and they were exhibited. From 1897 to 1902 he averaged \$2.32.

and from 1902 to 1914 \$3.41 per shift, the latter term being on contract. He worked an average of 297 days per year.

The strike in the district has been practically called off by Charles H. Moyer, president of the Western Federation of Miners.

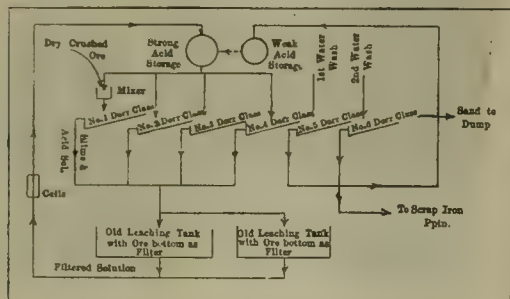
MONTANA

SILVERBOW COUNTY

(Special Correspondence.) Estimates for the construction of a 2000-ton unit of the new leaching plant of the Anaconda Copper Mining Co. total about \$1,250,000. The ultimate capacity is to be 3000 tons per day. The plant will consist of five main sections, namely, the dewatering, roasting, acid manufacture, leaching, and precipitation of the copper. The silver is also to be saved, and salt will be added during leaching. There will be 28 6-hearth, 18-ft. diameter McDougall roasting furnaces, and ten 50 by 14-ft. tanks for the first unit. The slime plant consists of 160 28-ft. diameter Dorr thickeners, 20 20-deck 16-ft. diameter buddies, three 50-ft. diameter by 14 ft. high settling tanks, and three Oliver filters. Half of the buddies are working, and the remainder will soon be ready. The 20-ft. diameter Great Falls converter is treating 105 tons of matte at a single blow, which lasts about six hours. A second one is to be constructed.

Anaconda, March 21.

At 2200 ft. the Middle vein has been cut in the Pilot-Butte, but is low grade. The Anaconda company will have a large exhibit at the Panama-Pacific Exposition in 1915. Fifty feet



FLOW-SHEET OF BUTTE-DULUTH PLANT.

within the Four Johns claim of the Butte & Superior, 35 ft. of high-grade ore has been opened. During February the Butte-Duluth leaching plant treated 3200 tons of ore with 89% extraction. The copper output was 65,000 lb. of electrolytic and 40,000 lb. of precipitate.

NEVADA

CHURCHILL COUNTY

During February the Nevada Hills mine produced 4070 tons averaging \$9.99 per ton, from which was recovered \$33,273 at a cost of \$27,810. Development covered 558 ft. at a cost of 80c. per ton. Total resources are worth \$197,341.

EUREKA COUNTY

The following description of the Buckhorn orebodies is from an interview of Fred J. Siebert, consulting engineer for the Buckhorn Mines Co., by the *Reno Gazette*: The property is 28 miles south of Beowawe on the Southern Pacific railroad, where the Company's power-plant is operated. The mine was discovered in the winter of 1908-09 by Joe Lynn, whose partners were W. S. McCrea, William Ebert, James Dwyer, and John Swan. Eventually, April 1910, George Wingfield bought 14 claims and several fractions for \$90,000. Since then 20,000 ft. of work has been covered, and a large tonnage of low-grade ore opened. There is no other mine with the same characteristics. The central core of the orebody is an intruded porphyry, augite andesite, intruded through many

different alternating sheets of basalt and volcanic scoria. This central core has been the solution channel, and the gold and silver has been deposited over great widths in the beds of basalt and scoria, which have been favorable to ore deposition. These beds of scoria have been most favorable on account of their porous nature, but some of the softer basalt flows have also formed large deposits. So far as the work has progressed, it shows nine different basalt flows and a similar number of scoria beds. From the central core of the augite andesite the metal content decreases each way, and tonnage depends, therefore, upon the cost of production, but the commercial ore is in places at least 150 ft. wide. The ore zone, so far as proved, is about 1600 ft. long. The first 100 ft. in depth in the deposit includes practically all of the oxidized ore, which will be mined and milled first. The deposit to that point is almost vertical. It will be mined by the glory-hole system. Below this depth the deposit turns off rather flat and will be mined by the top-slice system, which is in effect the most up-to-date system of caving. No machine-drills are used, as the ore is so soft. The main haulage level from the mine is 2600 ft. long, 1750 ft. of which is underground. Transportation is by electric locomotives. The 350-ton mill is now in full operation, and was briefly described in the *Mining and Scientific Press* of September 20, 1913.

HUMBOLDT COUNTY

A 5½-cu. ft. dredge at Unionville, owned by the Federal Mines Co., is the only dredge in Nevada. It handles 1500 to 1600 cu. yd. per day. Gasoline engines are used.

Judge Farrington, in the United States District Court, on March 12 gave his decision in the Rochester mine case, wherein Dr. George and Stevens Bros. sued J. F. Nenzel, discoverer of the Rochester mine, and the Rochester Mines Co., for a block of stock which they alleged had been secured through fraud. The plaintiffs were awarded \$210,000 worth of shares.

The narrow-gage line built by the Rochester Hills Mining Co. is to be extended right into the camp.

LANDER COUNTY

The placer deposits in the Battle Mountain district are yielding good returns to the claimholders, and are attracting considerable notice. According to Will C. Higgins, editor of *The Salt Lake Mining Review*, who has inspected the place, considers it of importance. The gravel is shallow, and every facility exists for cheap transport of supplies.

LINCOLN COUNTY

A station is being cut at 1400 ft. at No. 1 shaft of the Amalgamated Pioche. A brecciated quartzite zone was entered at the bottom of the shaft, and contains enough gold and silver to warrant prospecting. Mr. Van Wagenen is superintendent.

LYON COUNTY

From August 1913 to January 1914 the Nevada-Douglas ore has averaged 6.5% copper, containing 3,002,516 lb. of metal, worth \$435,365.

The statement of the Mason Valley Mines Co. for the last quarter of 1913 contains the following:

Ore smelted, company and custom, tons	50,197
Matte produced, tons	3,610
Copper content, pounds	3,694,227
Operating profit	\$53,561
Depreciation, deferred charges, bond interest	38,272
Net profit	15,289

MINERAL COUNTY

The Goldfield Consolidated Mines Co. has secured an option on the property of the Aurora Consolidated Mines Co. at Aurora. The latter Company is building a 500-ton mill, which is well on toward completion. This mine was examined by the Tonopah Mining Co. prior to Jesse Knight and associates buying it and building the new plant.

NYE COUNTY

Owing to some good gold and silver ore being opened about four miles north of Tonopah, a rush, among which were a number of well known local people, set in to stake claims. During the week ended March 21, ten mines at Tonopah produced 11,248 tons of ore worth \$274,610. In February the Tonopah company's yield was \$187,945 from 11,492 tons, with a profit of \$80,550. At 1640 ft., in trachyte, in the Belmont, the Belmont vein was cut. West End profits were \$36,381 from 4357 tons in February. The Extension mill is treating 157 tons per day. Net earnings of the Montana in February were \$12,000. A tube-mill, capable of preparing 15 to 18 tons per day of chalcidony for use in the mills in Nevada plants, is being erected at the quarry of O. Maris, six miles from Manhattan. The Tonopah Mining Co. will compare the local and Danish pebbles for grinding. Three mills are working at Manhattan, and with considerable development under way the camp is busier than for some time.

WHITE PINE COUNTY

The Consolidated Copper Mines Co. will probably erect an experimental mill near East Ely.

NEW MEXICO

SOCORRO COUNTY

(Special Correspondence.)—At 900 ft. the Socorro company's drift has cut 8 ft. of \$50 ore. The monthly mill production is about two tons of gold-silver bullion, in addition to a considerable tonnage of high-grade concentrate. The Company recently retired its \$200,000 issue of preferred stock, from earnings. A good cash reserve is being accumulated. In the Pacific, the stope below 250 ft. is from 10 to 15 ft. wide, worth from \$60 to \$135 per ton. The Socorro company has an option on the property. The Oaks Co. is surveying and sampling the Eberle mine. Ore assaying \$34.80 gold and \$16.77 silver per ton has been opened in a vein off the main vein near the portal of adit 'A.'

Mogollon, March 9.

OREGON

Mining in this state has been described in 'Mineral Resources of Oregon,' Vol. I, No. 1, published by the Oregon Bureau of Mines and Geology, H. M. Parkes, director. This serial will be published regularly. The total value of all minerals in 1913 was \$3,650,000, of which \$1,925,000 was from gold, silver, lead, and copper. Josephine, Jackson, Lane, Douglas, Curry, and Coos counties, in the southern district, produced gold and silver worth \$225,000. The ratio between placer and deep mining is over 2 to 1. In eastern Oregon the output was \$1,700,000, 75% from deep mines, from Baker, Malheur, Grant, Wheeler, and Crook counties. The volume also deals with the necessity for a mineral survey, work of the bureau, 'What is the Matter With the Mining Industry?' by A. M. Swartley, coal in Oregon, and other matter.

UTAH

SALT LAKE COUNTY

Underground work at the Utah Copper Co.'s mine at Bingham has been almost discontinued, and within a few weeks will be entirely abandoned. D. C. Jackling said recently that this is a result of the advanced stage reached in the stripping operations, which makes it possible for the steam-shovels to provide even more ore than the combined capacity of the two mills require.

WASHINGTON

FERRY COUNTY

(Special Correspondence.)—The Ben Hur Leasing Co., in the Ben Hur mine, is working on two shifts, entirely in ore, north and south of the shaft, on No. 2, 3, and 4 levels. Recent shipments have been low grade, but the ore is improving at present. The Rathfon Reduction Co. has paid

\$5000 to Ferry county on its option for the purchase of the Republic mine. This leaves a balance of \$18,000 of deferred payments to be paid when due.

Republic, March 20.

Bids for the assets of the Republic Mines Corporation were submitted at Spokane on March 10. The property included the Lone Pine, Pearl, and Surprise mines. Robert Sterling, of Wallace, Idaho, bid \$230,000, on the understanding that he could get an option on the Quilp mine; E. R. Davidson, of Spokane, bid \$250,000, exclusive of the Quilp; Henry Kehoe, of Spokane, bid \$150,000, provided he could get the Quilp option, and certain other arrangements; Sidney Norman, representing New York people, offered \$150,000, part in cash and part in stock in a company to be formed to acquire all the producing mines at Republic, and also to erect a 50-ton concentrating plant; and E. L. Tate, of the Quilp company, offered \$150,000 under certain conditions. It is said that Mr. Sterling has under option 760,000 of the 1,000,000 shares in the Corporation. The Corporation's property was eventually sold to Mr. Sterling for \$260,000. He was acting for a New York syndicate.

The Hope and Knob Hill mining companies, operating at Republic, have purchased the mine and mill of the San Poil



SAN POIL MILL, REPUBLIC.

Mining Co., also at Republic, for \$170,000. The payments are to be made from ore from the former mines. The daily capacity of the plant is 100 tons.

STEVENS COUNTY

Foundations are being prepared for a 100-ton smelter for the Copper King Mining Co. at Chewelah. Oil will be used as fuel.

CANADA

BRITISH COLUMBIA

An option on the Yellowstone group of claims, 17 miles from tidewater up the Salmon river, has been taken by the Canadian Mining, Exploration & Development Co. W. J. Rolf is the Company's engineer.

The Granby Consolidated company's new smelter at Anyox was blown in on March 16.

ONTARIO

During February, the Dome mine's gold yield was 12,010 tons of ore for \$69,000, or \$5.74 per ton. Since April 1913 the total is 130,240 tons, yielding \$1,116,606.

A new hoist has been installed at Beaver Consolidated, Cobalt, and extensive development will be done on 10 levels. Thirteen machines are working underground at present. The La Rose company is prospecting in the Fisher-Eplett mine, north of the Beaver Consolidated, and at 300 ft. has opened a large body of quartz assaying 40c. per ton in gold. The McKinley-Darragh-Savage company, of Cobalt, has taken a six months' working option on the Jupiter mine at Porcupine.

Personal

W. DELA BENEDICT is in California.
 THOMAS T. READ is in Washington.
 F. B. LAWSON is here from London.
 A. D. SPIGAT is at Guadalupe, Mexico.
 E. H. LESLIE was at Denver this week.
 WILLIAM D. PEREGRINE is at Denver, Colorado.
 G. L. SHELTON was in Salt Lake City last week.
 JOHN RANDALL is now at Placerville, California.
 A. W. STICKNEY sailed for England on March 12.
 CHARLES JANIN has returned from Russia to London.
 ALBERT BURCH was in San Francisco for the week-end.
 WHITMAN SYMMES was in San Francisco over Sunday.
 RALPH ARNOLD passed through San Francisco last week.
 ERNEST G. LOCKE is temporarily at Hollywood, California.
 GEORGE T. COFFEY has gone back to Dawson for the season.
 H. M. WOLFELIN is visiting the mines of southern California.
 EUGENE CALLENS has gone to Johannesburg from Paris, France.

B. N. JACKSON has removed from Cibola, Arizona, to Los Angeles.

W. FOOTSON WONG has been visiting the Inspiration mine, in Arizona.

WALLACE LEE has left Los Angeles and is now at Washington, D. C.

A. B. EMERY, manager of the La Fe mine, Zacatecas, is in New York.

EDGAR COLLINS passed through San Francisco, returning to Arizona, Monday.

EDMUND JUESSEN was at Manhattan last week and is now in Plumas county.

JAMES S. DOUGLAS and WALTER DOUGLAS are inspecting the Phelps-Dodge properties in Arizona.

ELWOOD MEAD has been granted permission by the regents of the University of California to return to Australia.

H. W. MOORE has been made general superintendent of the Tropic Mining & Milling Co., at Rosamond, California.

I. F. LAUCKS is at Silverton, British Columbia, on professional business for the Standard Silver Lead Mining Company.

Paul M. Paine has been appointed general superintendent of the Honolulu Con. Oil Co. properties with headquarters at Taft, California.

HYMAN HERMAN, director of the Geological Survey of Victoria, has been elected president of the Australasian Institute of Mining Engineers.

W. G. ANDERSON has been appointed general manager for the Ore Chimney Mining Co., Ltd., at Northbrook, Frontenac county, Ontario, Canada.

GARDNER F. WILLIAMS will address the San Francisco section of the A. I. M. E. on 'Modern View of the Origin of the Diamond,' at the Engineers' Club, Tuesday evening, March 31.

MORTON WEBBER has been engaged in examination work in Idaho and Montana for the past three months. He recently returned to New York for a few days, and has left again for the West to be absent about two months.

A. HOUSMAN, who died at Alameda, March 1, was best known as having been connected for some time with the State Mining Bureau. While in that office he did much of the work upon which the bulletin upon copper resources of California was based. He has also much other good work to his credit, being a well educated engineer of experience and attainments. His death is regretted by a wide circle of friends.

Society Meetings

MARCH	
Name.	Date.
American Institute Mining Engineers, San Francisco..	31
APRIL	
American Chemical Society	8-11
American Institute of Electrical Engineers	10
American Electro-Chemical Society	16-18
Institution of Mining and Metallurgy.....London....	16
MAY	
Mining and Metallurgical Society...San Francisco....	4
National Fire Protection Association	5-7
American Iron and Steel Institute	22
Institution of Mining and Metallurgy.....London....	21
JUNE	
American Institute of Electrical Engineers	22 or 26
American Society for Testing Materials	23-27
Society for the Promotion of Engineering Education	29 to July 2
American Society of Mechanical Engineers.....	end of June
Franklin Institute	Philadelphia....end of June
AUGUST	
American Inst. Mining Engineers..Salt Lake City....	10-14
SEPTEMBER	
American Institute of Electrical Engineers.....	not fixed
American Chemical Society	9-12
OCTOBER	
American Institute of Electrical Engineers.....	9
American Iron and Steel Institute	23-24
NOVEMBER	
American Institute of Electrical Engineers	13
DECEMBER	
American Society of Mechanical Engineers	7-8
Society of Gas Lighting (annual meeting).....	10
Society of Naval Architects	11-12
American Institute of Electrical Engineers	11
American Museum of Safety	11-20
Geological Society of America, Philadelphia.....	29-31

Schools and Societies

MASSACHUSETTS 'TECH' has a student registration of 1687, a gain of 74 over the last year.

COLUMBIA UNIVERSITY will spend \$3,721,215 in operating all of its departments from July 1, 1914, to June 30, 1915. For the work of the university proper, \$2,925,597 is appropriated, of which \$2,131,655 is for educational administration and instruction. The balance is for buildings, grounds, library, and redemption fund.

THE INSTITUTE OF PETROLEUM TECHNOLOGISTS held its inaugural meeting in London on March 3. The president, Sir Boverton Redwood, was in the chair. 'The Geology of the Anticline' was discussed by Sir Thomas Holland; 'The Educational Aims of the Institution,' by Cunningham Craig; and 'Petroleum Technology as a Profession,' by Vivian B. Lewes.

THE COLORADO SCHOOL OF MINES senior class trip includes the following itinerary: Leave Denver on April 20; at Midvale, Bingham, Tootoe, and Salt Lake City, Utah, from April 28 to May 4, inclusive; the metallurgists' division will be at Butte and Anaconda from May 5 to 11; and the miners' division at these places to May 13. The tour will end at Denver on May 18.

The Metal Markets

LOCAL METAL PRICES

San Francisco, March 26.

Antimony	9 — 9½c
Electrolytic copper	15½—15¾c
Pig lead	4.15— 5.10
Quicksilver (flask)	\$39.00
Tin	40½—42 c
Spelter	6½— 6¾c
Zinc dust, 100 kg. zinc-lined cases, 7½ to 8c. per pound	

EASTERN METAL MARKET

(By wire from New York.)

New York, March 26.—More business is doing in copper for domestic trade and exports, and prices have advanced from 14.05 to 14.35c. per pound. Producers' agencies in London are quoting 14.67 to 14.72c. for electrolytic, according to delivery. Lead and spelter show no change and are both flat. Tin is steady at 38.55 to 38.75 cents. Bar silver in New York and London are 58c. and 26¼d. per ounce respectively. Net earnings on the common stock of the American Smelting & Refining Co. were equal to 7.47% in 1913, compared with 11.47% in 1912.

SILVER

Below are given the average New York quotations in cents per ounce, of fine silver.

Date.	Average week ending.
Mch. 19.....	58.00
" 20.....	58.00
" 21.....	58.12
" 22 Sunday.....	58.12
" 23.....	58.12
" 24.....	58.00
" 25.....	58.00
Monthly averages.	
Jan. 1913.	1914.
Jan. 63.01	57.58
Feb. 61.25	57.53
Mch. 57.87	57.53
Apr. 59.26	57.53
May 60.21	57.53
June 59.03	57.53
July 58.70	57.53
Aug. 60.53	57.53
Sept. 60.88	57.53
Oct. 58.76	57.53
Nov. 57.73	57.53
Dec. 57.73	57.53

The report of the Royal Commission on Indian Finance and Currency has been published, according to The Mining Journal, London. The Commission reports that the currency most suitable for the internal needs of India is silver and notes. On the other hand, the system can only be satisfactory if the gold standard reserve is maintained at an adequate figure. The reserve exists to secure the conversion into sterling of so much of the internal currency as may at any moment seek export. The Commission consequently suggests a rearrangement of the assets at present at the disposal of the gold standard reserve and the paper currency reserve. The gold specie, amounting to six crores of rupees, or say £4,000,000, at present to the credit of the paper currency reserve, should be transferred to the gold standard reserve in exchange for sterling securities to the same amount now held by the gold standard reserve. The silver holding of the gold standard reserve, valued at about £4,000,000, should similarly be exchanged with the paper currency reserve, which, with the total amount of gold held by the gold standard reserve, would raise that fund to about £9,500,000 in specie. This sum, however, is considered insufficient, and a minimum of £15,000,000, it is suggested, should be accumulated as rapidly as possible. This gold reserve would, of course, be kept in London. There can be no question that one of the most important financial questions of the time, especially in view of the present declining tendency of the world's gold output, is to secure that every ounce of gold is made to support as much credit as possible. In English banking circles there is a general recognition that present reserves of gold should be gradually increased, and so long as it is possible to satisfy commercial opinion that the reserves held are adequate, there seems no reason why gold should be wasted through attrition, hoarding, casual loss, or distribution into channels by which it passes out of the immediate control of central organizations, when the actual functions of currency can be discharged by notes, bills, and token coins.

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending	Mch. 12.	1913.	1914.
Feb. 26.....	39.00	39.50	39.50
Mch. 5.....	39.00	39.00	39.00
Monthly averages.			
Jan. 1913.	1914.	July	1913.
Jan. 39.37	39.25	July	41.00
Feb. 41.00	39.00	Aug.	40.50
Mch. 40.20	39.00	Sept.	39.70
Apr. 41.00	39.00	Oct.	39.37
May 40.25	39.00	Nov.	39.40
June 41.00	39.00	Dec.	40.00

COPPER

Quotations on copper as published in this column represent average wholesale transactions on the New York market and refer to electrolytic copper. Lake copper commands normally 1-5 to 1-4c. per lb. more. Prices are in cents per pound.

Date.	Average week ending
Mch. 19.....	14.05
" 20.....	14.10
" 21.....	14.15
" 22 Sunday.....	14.20
" 23.....	14.25
" 24.....	14.35
" 25.....	14.35
Monthly averages.	
Jan. 1913.	1914.
Jan. 16.54	14.21
Feb. 14.93	14.46
Mch. 14.72	14.46
Apr. 15.22	14.46
May 15.42	14.46
June 14.71	14.46
July	1913.
July	14.21
Aug.	15.42
Sept.	16.23
Oct.	16.31
Nov.	15.08
Dec.	14.25

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.	Average week ending
Mch. 19.....	4.00
" 20.....	4.00
" 21.....	4.00
" 22 Sunday.....	4.00
" 23.....	4.00
" 24.....	4.00
" 25.....	4.00
Monthly averages.	
Jan. 1913.	1914.
Jan. 4.28	4.11
Feb. 4.33	4.02
Mch. 4.32	4.02
Apr. 4.36	4.02
May 4.34	4.02
June 4.33	4.02
July	1913.
July	4.35
Aug.	4.60
Sept.	4.70
Oct.	4.37
Nov.	4.16
Dec.	4.02

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date.	Average week ending
Mch. 19.....	5.10
" 20.....	5.10
" 21.....	5.10
" 22 Sunday.....	5.10
" 23.....	5.10
" 24.....	5.10
" 25.....	5.10
Monthly averages.	
Jan. 1913.	1914.
Jan. 6.88	5.14
Feb. 6.13	5.22
Mch. 5.94	5.22
Apr. 5.52	5.22
May 5.23	5.09
June 5.00	5.07
July	1913.
July	5.11
Aug.	5.51
Sept.	5.55
Oct.	5.22
Nov.	5.09
Dec.	5.07

Zincblende at Joplin is selling for \$38 to \$41, basis of 60% metallic zinc, compared with \$49 to \$52, basis, for the corresponding week of 1913. Lead ore brings \$50, basis of 80% metallic lead, compared with \$57 per ton, basis, a year ago.

TIN

New York prices control in the American market for tin, since the metal is almost entirely imported. San Francisco quotations average about 5c. per lb. higher. Below are given average monthly New York quotations, in cents per pound:

Monthly averages.					
1913.		1914.		1914	
Jan.	50.45	37.85	July	40.70	
Feb.	49.07	39.76	Aug.	41.75	
Mch.	46.95		Sept.	42.45	
Apr.	49.00		Oct.	40.61	
May	49.10		Nov.	39.77	
June	45.10		Dec.	37.57	

Billion tin sold at public auction in 1913 at Batavia, Java, totaled 66,000 slabs averaging 74.8 lb. each, or 4,938,800 lb., at an average price of 42.61c. per pound.

Imports of aluminum, crude, ingots, scrap, etc., in December 1913 were 1,351,803 lb., valued at \$224,278; in December 1912, 3,803,469 lb., valued at \$653,401; in the year 1913, 23,185,776 lb., valued at \$3,905,977; and in the year 1912, 22,159,937 lb., valued at \$3,092,889.

The Stock Markets

SAN FRANCISCO STOCKS AND BONDS

(San Francisco Stock and Bond Exchange.)

March 25.

BONDS					
Listed.	Bid	Ask	Unlisted.	Bid	Ask
Associated Oil Co.	\$ 87½	99½	Natomas Consol. Co.	—	28
Unlisted.			Pac. Port. Cement Co.	100	—
Ass. Oil Co.	—	81	Santa Cruz Cement Co.	43½	—
General Petroleum Co.	35	38	Union Oil	61½	61½

STOCKS

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Amalgamated Oil	—	82½	General Petroleum	3	4½
Associated Oil	41	41½	Noble Electric Steel	5	—
E. I. du Pont pfd.	—	90	Natomas Consol.	50c	—
Glant	81	86	Pac. Port. Cement	—	62½
Pac. Mt. Horax, com.	—	57½	Riverside Cement	—	63
Pacific Crude Oil	—	30c	Santa Cruz Cement	47	—
Sterling O. & D.	1½	1½	Stand. Port. Cement	29½	—

NEVADA STOCKS

(By courtesy of San Francisco Stock Exchange.)

March 26.

Atlanta	\$.35	Montana-Tonopah	\$.99
Belcher	.41	Nevada Hills	.31
Belmont	.762	North Star	.37
Con. Virginia	.17	Opfir	.45
Florence	.67	Pittsburg Silver Peak	.34
Goldfield Con.	1.77	Round Mountain	.35
Goldfield Oro	.14	Sierra Nevada	.19
Halifax	.80	Tonopah Extension	2.00
Jim Butler	1.05	Tonopah Merger	.51
Jumbo Extension	.37	Tonopah of Nevada	7.00
MacNamara	.09	Union	.14
Mexican	1.10	Victor	.27
Midway	.35	West End	.88
Mizpah Extension	.47	Yellow Jacket	.45

CALIFORNIA STOCKS

(Latest Quotations.)

	Bid	Ask		Bid	Ask
Argonaut	\$2.75	—	Central Eureka	\$.60	\$0.69
Brunswick Con.	\$1.05	—	Mountain King	—	0.50
Bunker Hill	1.90	—	South Eureka	1.50	—

COPPER SHARES—BOSTON

(By courtesy of J. C. Wilson, Mills Building.)

March 26.

	Bid	Ask		Bid	Ask
Allouez	\$ 41	42	Mohawk	\$ 44	44½
Ariz. Commercial	43	5	Nevada Con.	16½	16½
Butte & Superior	35½	35½	North Butte	27½	28
Calumet & Arizona	68½	68½	Old Dominion	49	49½
Calumet & Hecla	415	416	Osceola	77½	78
Copper Range	37½	38½	Quincy	59	60
Daly West	2½	2½	Shannon	6½	6½
East Butte	11½	11½	Superior & Boston	2½	2½
Franklin	6½	6½	Tamarack	35½	35
Granby	88	88½	U. S. Smelting, com.	39½	40
Greene Cananea	37	37½	Utah Con.	10½	10½
Isle-Royale	19	19½	Winona	3½	3½
Mass Copper	2½	2½	Wolverine	—	47

NEW YORK CURB QUOTATIONS

(By courtesy of E. F. Hutton & Co., Kohl Building.)

March 26.

	Bid	Ask		Bid	Ask
Braden Copper	8½	8½	La Rose	1½	1½
Braden Co.	165	170	Mason Valley	3	3½
B. C. Copper	1½	1½	McKinley-Dar.	70c.	75c.
Con. Cop. Mines	2½	2½	Mines Co. Am.	2½	2½
Davis-Daly	1½	1½	Nipissing	5½	6½
Ely Con.	4	6	Ohio Copper	¼	½
First National	2½	3	Stand. Oil of Cal.	315	348
Giroux	1	1½	Tri Bullion	¼	¼
Hollinger	16	17	Tuolumne	5½	1
Iron Blossom	1½	1½	United Cop. com.	¼	¾
Kerr Lake	4	4½	Yukon Gold	2½	3

NEW YORK STOCK EXCHANGE

(By courtesy of J. C. Wilson, Mills Building.)

March 26.

	Bid	Ask		Bid	Ask
Amalgamated	—	75½	Miami	—	24
Anaconda	—	38½	Nevada Con.	16½	16½
A. S. & R. com.	—	69½	Quicksilver, com.	1½	2½
Calif. Pet., com.	27	27½	Itay Con.	21½	21½
Chino	42½	42½	Tenn. Copper	35	35½
Guggenheim Ex.	56	56½	U. S. Steel, pfd.	110	110½
Inspiration	17½	18	U. S. Steel, com.	63½	63½
Mexican Pet., com.	67½	68	Utah Copper	66½	66½

LONDON QUOTATIONS

(By cable, through the courtesy of Cullin & Powell Co., New York.)

March 26.

	£	s.	d.		£	s.	d.
Alaska Mexican	1	7	6	Mexican Eagle, com.	2	1	3
Alaska Treadwell	8	5	0	Mexico Miners	5	6	0
Alaska United	3	2	6	Messina	1	11	3
Arizona	2	0	0	Oroville	0	13	9
Camp Bird	0	12	6	Pacific Oilfields	0	2	6
Cobalt Townsite	2	17	6	Rio Tinto	71	16	0
El Oro	0	13	9	Santa Gertrudis	0	16	0
Esperanza	0	17	6	Tanganyika	2	6	0
Granville	0	10	0	Tomboy	1	3	9
Kern River Oilfields	0	8	9				

AUSTRALASIAN

March 26.

	£	s.	d.		£	s.	d.
British Broken Hill	2	1	3	Mount Elliott	3	17	6
Broken Hill Prop.	2	0	0	Mount Lyell	1	6	0
Golden Horse-Shoe	2	12	6	Mount Morgan	3	8	9
Great Boulder Prop.	0	15	0	Walbi	2	6	3
Ivanhoe	2	13	9	Walhi Grand Junction	1	6	3
Kalgurli	1	17	6	Zinc Corporation, Ord.	1	2	6
Mount Boppy	0	12	6				

COAL AND IRON IN RUSSIA

Coal production of the Donetz Basin of Russia, which provides 55.5% of the coal consumption of the country, amounted to 28,000,000 tons in 1913. At a recent conference of coal men at Kharkof, estimates were made of the output and consumption of Donetz coal for the next five years as follows: output, 34,217,000, 37,828,000, 41,132,000, 43,787,000, and 44,274,000; consumption, 33,567,000, 36,149,000, 38,280,000, 39,742,000, and 41,295,000 short tons, respectively.

The metallurgical industry of Russia, which has its principal centre in the consular district of Odessa, is showing increased activity. The output of pig iron in the country last year was 4,660,000 long tons, against 4,050,000 tons in 1912. Imports were about 50,000 tons. Orders received by the Russian Iron & Steel Syndicate in 1913 were 2,435,000 tons.—Daily Consular Report.

GERMAN MACHINERY TRADE

Machinery exports from Germany in 1913 amounted to 593,969 metric tons, against 536,636 tons in 1912. The average value was \$276.29 per ton. Imports were 87,902 tons, against 77,937 in the previous year. These were worth \$222.77 per ton. The exportation of machines from Germany in 1913 was divided as follows: to Russia, 19%; Austria-Hungary, 11; France, 10; Great Britain, 7; Belgium, The Netherlands, and Italy, each 5; Spain, 3.5; Rumania, Brazil, and Argentina, each 3; Switzerland, 2.5; Denmark, United States, South America (except Brazil and Argentina), and Japan, each 1.5%. The remaining 17% went to Norway, Sweden, Canada, China, India, etc. According to official data, the United States supplied 40%, Great Britain 34, Switzerland 6, Canada 7, Belgium 2, and Austria-Hungary 1.6% of Germany's machine imports in 1913.—Daily Consular Report.

INDUSTRIAL ESTABLISHMENTS in Italy, according to the 1911 census, totaled 243,985, employing 2,305,698 people, and 1,573,774 hp. Of these, mining and metal-working industries were 63,667, employing 799,345 people and 257,776 hp. There were 495 chemical works, employing 10,165 people and 3867 horse-power.

Company Reports

BROKEN HILL PROPRIETARY MINING CO., LIMITED

During the six months ended November 30, 1913, this well known concern had the following results:

Ore treated, tons	158,863
Refinery output:	
Silver, ounces	2,750,671
Lead, tons	49,723
Tailing treated by flotation, tons	181,463
Zinc concentrate produced, tons	43,914
Profit	\$691,000

Good progress has been made with the foundations for the iron and steel plant at Newcastle, and the work is being pushed on as fast as possible with a view to starting work early in 1915.

MACNAMARA MINING COMPANY

This Company operates a mine, 10-stamp mill, and cyanide plant at Tonopah, Nevada. The report for the past year includes the following information: Development is being done on the 500, 600, 625, and 700-ft. levels on the Lower Contact vein, and will be started soon at 800 ft. During the year, 2103 ft. of work was accomplished on this vein. Good widths of ore with good bullion contents have been opened, but the occurrences were rather irregular. In places the vein is 40 ft. wide, but averages 30 ft. High-grade ore was cut on the 500-ft. level.

Development, feet	3,284
Ore treated, tons	28,098
Average value, per ton	\$8.41
Gold yield, ounces	2,842
Silver ounces	266,772
Recovery, per cent	92.7
Gross value	\$219,002
Cost per ton:	
Mining, including development, taxes, insurance, etc.	\$4.349
Mining, including management, interest on debt, etc.	3.523
Bullion expenses	0.136
Cash at November 30, 1913.....	\$4,444

GOLDFIELD CONSOLIDATED MINES COMPANY

From a total of 330,217 tons of \$14.88 ore milled, and 19,248 tons of \$27.39 ore shipped, the different mines of this Nevada company produced as follows: Combination, \$1,332,957; Mohawk, \$1,765,345; Red Top Laguna, \$336,496; Clermont-Jumbo, No. 2, \$1,422,271; dumps, \$54,496; and Clermont, \$527,284. The gross value was \$5,438,853, and the revenue from ore was \$4,942,828, according to the president, George Wingfield. The expenses of mining, transport, milling, construction, taxation, and general were \$2,210,883, leaving net \$2,731,945. Two dividends, 30 and 40c. per share, amounted to \$2,491,404. Cash balances at the end of the year were \$1,074,372, with other outstanding settlements of \$161,217. The uncertainty of the Nevada bullion has been settled, and the transportation company controlled by the Goldfield Consolidated, will merely continue to work at actual operating cost. According to Albert Burch, the general manager, development covered 38,696 ft. at a cost of \$8.42 per foot. Operating conditions are becoming increasingly more difficult, as 90% of the present ore is from pillars, ends, and sides of old stopes from which the best ore was mined some years ago. Mining costs are \$3.41 per ton. Measurable ore reserves consist of 136,000 tons of average grade, and are larger than at the beginning of 1913. The mines contain large quantities of low-grade ore, which will be treated if some means of doing so is devised.

The mill costs were 17c. below those of 1912. All mill residue has been impounded since the start, and experiments show that there is a profit of a few cents per ton in them. Total costs were \$6.38 per ton, against \$6.92 in 1912. The gross output to date is 1,778,304 tons yielding \$59,475,201, and \$26,330,470 in dividends.

ASSOCIATED NORTHERN BLOCKS (W. A.), LIMITED

This Company owns 48 acres of property at Kalgoorlie, and 93 acres at Ora Banda, 40 miles from Kalgoorlie, Western Australia; and 112 acres at El Refugio, Mexico. The first-named area has produced \$1,728,043 from 365,555 tons of ore to date; the Victorious, \$115,263 from 102,797 tons; while owing to the revolution in Mexico, little has been done, and the mine is to be leased. Dividends, including \$35,000 paid in the year ended September 30, 1913, total £726,250. The Iron Duke claim, at Kalgoorlie, is practically worked out, although tributaries mined 17,963 tons of ore, yielding gold worth £68,671. The sulphide mill treated, in all, 25,047 tons of ore, including 5923 tons of purchased ore, also 32,276 tons of residue, yielding £102,348. Royalties amounting to £16,417 were collected from tributaries. A profit of about £17,479 was made on this property. Developments at the Victorious mine have been noted in the Special Correspondence pages of this journal from time to time. Development covered 6688 ft. at a cost of \$7.96 per foot. Shaft-sinking 168 ft. cost \$84.60 per foot. Stations cut amounted to 9477 cu. ft. Three lodes produced 97,639 tons of ore worth £124,043. The country around the ore is very decomposed, causing great strain on timbers by creeps. The estimation of ore reserves is difficult, and work in the sulphide zone is not sufficiently advanced to make estimates. The mill produced bullion worth £108,370 at a cost of \$1.23 per ton. Detailed costs will be given in another issue of this journal. The report includes one made by Edward H. Liveing on the two properties in Western Australia. He gives little hope for the Iron Duke mine, and advises postponing the erection of a sulphide plant at the Victorious until No. 6 level is well developed. The year's work left a surplus of £23,867, while investments are worth £37,210. W. Martin is superintendent of the Victorious mine, and George M. Roberts general manager for the Company.

ASHANTI GOLDFIELDS CORPORATION, LIMITED.

This Company controls a large concession, and operates mines and treatment plants in the Gold Coast Colony, West Africa. The directors' report under review covers the year ended June 30, 1913. The reduction works treated 148,447 short tons of ore, yielding 107,977 oz. gold, and 7296 oz. silver, realizing a total of £476,800, with the bullion from 14,661 tons of old tailing. The working profit was £253,116, but on adding sundry receipts and deducting government royalty, depreciation, development, etc., the net profit was £175,147. The balance from the previous year was £76,169, which gave a total of £251,315. Three dividends, amounting to £187,507, were paid out of this total. Ore reserves at September 30 were estimated as 365,300 tons, worth £1,505,000, with a profit of £573,600. These are 27,540 tons less, but worth £24,000 and £21,300 profit respectively above those of the previous estimates. Working costs in West Africa averaged \$6.24; bullion charges, 19c.; London expenses, 28c.; government royalty, 74c.; development, \$1.29; and depreciation 66c.; a total of \$9.40 per ton. Gas-engines have been installed at the mines in place of steam power. The directors considered the present state of the mines to be highly encouraging, the profit in sight shows no decrease, and the metallurgical methods have improved.

The consulting engineer's, W. R. Feldtmann, report, covers the year ended September 30, 1913. Development at all mines covered 18,278 ft. The Ayernm mine produced

25,782 tons of ore, yielding £47,500. This came from No. 5 level stopes, and a little from No. 6 level. The lode below No. 4 level has been dangerous to mine. The main shaft is down 565 ft., and drifts at this depth have opened the vein, which is quartz in irregular lenses of a low grade. There is 105,000 tons of ore in this mine. The Ashanti mine produced 77,207 tons, yielding £318,000. Ore reserves are 182,300 tons, averaging \$28.60 per ton. The Obuasi shoot on No. 10 and 11 levels has opened excellent ore. The Justice claims produced 16,720 and 6170 tons of oxidized and sulphide ore, respectively, returning £31,000 and £10,900. Blackie's mine yielded 12,897 tons and £33,500 in gold. A considerable amount of work was done on outside properties with varying results. There was a large shortage of labor during the year, hampering work generally. Mr. Feldt-mann's report gives great detail of mining and future profits. Treatment of the different ores produced consists of roasting and direct cyaniding, and a filter-press plant, showing recoveries of 92.6 and 80.14%, respectively. Some of the Ashanti ore contains graphite.

YUKON GOLD COMPANY

This Company operates dredges and hydraulic plants near Dawson, Klondike, dredges at Iditarod, Alaska, and a boat on the American river, California. The report of O. B. Perry for the year 1913 gives the following information: No. 4 and No. 6 boats in the Klondike were dismantled, and are being rebuilt on other areas. The cost of moving them and constructing power-lines was \$164,484. The eight Dawson boats worked from May 1 to October 31, a season of 164 days. The average recovery and cost was 65.13c. and 29.53c. per cubic yard, respectively. Owing to power troubles with the Granville Power Co., the boats were idle 20 days, or 11% of the possible time. The power contract is to be canceled, and power will be obtained from the Yukon Gold Co.'s own plant. Of the area mined at Dawson, 445,624 sq. yd., or 68.4%, was frozen and had to be thawed by steam. The Iditarod dredge worked from May 8 to November 25, a season of 203 days. The average recovery and cost was \$1.67 and 64.33c. per cubic yard, respectively. The two California boats, two at Oroville for a time, and later one at that place and one near Auburn, worked satisfactorily. The latter has a capacity of 120,000 cu. yd. per month. Hydraulicking at Dawson resulted in a loss, due to stripping the top gravel before the 'pay' could be mined. The water-supply fell from 524,249 miner's inches in 1912 to 406,135 in 1913. The area blocked out and stripped could not be completely mined and the gold recovered. About 50% remains to be cleaned to bed-rock, so the gross value is not representative of the area mined, or of the gold content of the gravel. The cost was 9.7c. per cubic yard, and duty of the water 6.6. Drought, using water for generating power, and a bad break in the ditch system were responsible for unsatisfactory hydraulic work. Scattered claims leased to individuals gave a good profit. Results may be summarized as follows:

Work done.	Cubic yards.	Gold yield.	Cost.	Profit.
Dawson dredging...	5,133,575	\$3,343,667	\$1,515,872	\$1,827,795
Dawson hydraulick-				
ing	2,875,952	256,491	278,917	*22,426
Iditarod dredging...	496,756	827,420	319,560	507,860
California dredging...	2,550,271	176,023	103,849	72,174
Miscellaneous .....	.....	185,800	33,756	152,044
Total .....	.....	\$4,789,403	\$2,251,955	\$2,537,449

*Loss due to causes explained.

Royalties paid were \$787,278; amortization, \$520,886; interest, general, \$145,373; a total of \$1,453,536. A dividend of 6% was paid. The indebtedness to the Guggenheim Exploration Co. was reduced by \$425,000. The surplus at December 31, 1913, was \$489,576.

HOMESTAKE MINING COMPANY

In point of dividends paid, this Company stands fourth in the list of the world's gold mines, being exceeded by the Crown Mines, and East Rand Proprietary group in the Transvaal, and the Goldfield Consolidated of Nevada; but when its scale of operations and future is considered, it probably occupies first place.

The report of T. J. Grier, superintendent, covers the calendar year 1913, and contains the following information: Development covered 16,313 ft. of drifts and 686 ft. of raises. The depths of the shafts remain as they were a year ago, namely: Ellison, 1850 ft.; B. and M., 1550; Golden Prospect, 1100; Golden Star, 1400; Old Brig, 800; and Golden Gate, 800 ft. Broken ore in the stopes amounts to 2,206,671 tons, an increase of 176,000 tons. The property is in fine physical condition, and prospects point to a long and profitable life. A modern change-house was erected for the miners, and Recreation Building at Lead was built and is now ready for all of the Company's employees. Assets of the Company are worth \$23,811,776, which includes all equipment, cash, and bullion. Liabilities include capital stock, \$21,840,000; accounts payable, \$2942; outstanding drafts, \$492,713; unclaimed dividends, \$5660; and profit and loss balance, \$1,470,460.

Results may be summarized as follows:

Ore treated, tons	1,540,961
Average value realized, per ton.....	\$4.0148
Gold output	\$6,186,652
Balance from 1912	1,455,958
Other revenue	132,716
Total revenue	7,775,326
Costs:	Per ton.
Mining and 'dead work'.....	\$1.480
Milling	0.254
Cyaniding sand, direct cost	0.104
Regrinding	0.009
Cyaniding slime	0.086
Assay office	0.021
Foundry and shops	0.061
Shafts	0.137
Hydro-electric plant and electric operation.....	0.028
Hospital, Recreation Building, etc.....	0.106
General, including property purchase, taxes, timber, water, salary, survey, etc.....	0.434
Total cost	\$2.720

Dividends totaled \$2,146,224, equivalent to \$1.39 per ton, and total realizable value per ton was \$4.0148. The discrepancy is due to other sources of income. It is also to be noted that these figures are based upon tons milled, which does not agree with tons mined. It is impossible with the figures at hand to state separately the actual cost of milling and mining per ton, nor is there any information given as to total ore reserves or recovery. Both are known to be satisfactory, since the reserve is sufficient for many years, and the tailing loss is understood to be about 24c. per ton. It is to be noted that at the Homestake much construction is charged into cost and not capitalized, although recently new capital was issued against the cyanide plants, water system, hydro-electric plant, and other work that has been under way for some years back. As we noted at the time, the excess profits, above regular dividends, are divided between stockholders and workers, the latter receiving a 7% dividend on each man's pay for the year. The Homestake is a great mine, and the management is doing excellent work. It is to be regretted that the accounts as published are somewhat inadequate, and we should like to see them classified more in detail. However, we believe this is not due to any indisposition to give stockholders and public all proper information.

Book Reviews

IGNEOUS ROCKS; COMPOSITION, TEXTURE, AND CLASSIFICATION; DESCRIPTION AND OCCURRENCE. By Joseph P. Iddings, Vol. II. Svo, xi + 685 pages. New York, John Wiley & Sons, Inc.; London, Chapman & Hall, Ltd., 1913. For sale by the *Mining and Scientific Press*. Price \$6.

Volume II is a worthy successor to the earlier volume of Mr. Iddings' 'Igneous Rocks,' and to the mining man, interested in the broad relations of ore occurrence, is of greater interest. Volume I, which appeared in 1909, describes successively the chemical composition of igneous rocks and the minerals which compose them; the physical chemistry of magmas; the crystallization and the texture of igneous rocks; their mode of occurrence; the process of magmatic differentiation, and the classification of igneous rocks.

Volume II is devoted to a description of the composition of igneous rocks, both chemical and mineral; their texture and their genetic relations. The latter entails a knowledge of the mode of occurrence; their relation to other rock masses; their geographical distribution, and a determination of the period of the earth's history when they solidified. The treatise is separated into two parts: "one dealing chiefly with the description of the material features and their modes of occurrence as rock masses, petrography in its narrower sense; the other part treating of the occurrence of groups of igneous rocks in all regions of the earth." The first chapter is devoted to a resume of the character of igneous rocks as solidified liquid solutions, the presence of gradational facies between all rock types, and the advance in petrography due to the introduction of the quantitative system of classification. As to date the latter system has not been in sufficiently long or general use by petrographers to serve as the foundation of a description of the igneous rocks of the world, Mr. Iddings introduces a qualitative classification.

Descriptions of the various igneous rocks follow, arranged according to this classification, in which Iddings recognizes rocks composed of (1) quartz preponderant; (2) quartz and feldspar; (3) feldspar; (4) feldspar and feldspathoids (nepheline, leucite, and sodalite); (5) feldspathoids; (6) mafic minerals (amphibole, pyroxene, olivine, iron ores, etc.). Under each are described first the phaneritic (crystalline) rocks, and then their aphanitic (porphyritic and glassy rock) equivalents. The numberless names which have been applied to various rocks as described by previous petrographers of each division are defined, and the origin of the name explained. Notwithstanding the advantage in the quantitative classification of rocks in the treatment of certain petrographic problems, the mining engineer must depend on a selected few of these old fashioned and to him practical rock names. Class No. 2, for example, includes granite, quartz-monzonite, granodiorite, quartz-diorite, and quartz-gabbro. Mr. Iddings, in attempting to give to each name a definite rock significance, introduces certain quantitative limits which can be followed with advantage even in petrographic work of a roughness such as suffices for most economic work. He places in division No. 6, for instance, gabbros, in which the feldspar minerals (pyroxenes, hornblendes, olivines, etc.) exceed the feldspar (feldspar, etc.) by more than 5 to 3. More feldspar-rich gabbros belong to Division No. 3. Under each division the characteristics of the minerals composing the rock members thereof are described, as are the rock textures. A discussion of the chemical composition then follows, the volume containing over 2000 rock analyses.

Part II begins with the description of the distribution of igneous rocks in the world with generalizations particularly upon petrographical provinces. The difficulties partly inher-

ent to the problem itself and partly due to the absence to date of sufficient data, are emphasized. The major structural and petrographic features of each continental land mass and the principal island groups are then discussed. After the description of the igneous rocks, that of the petrographical provinces of each land unit follows. Maps, on a small scale to be sure, of the Americas, Europe, Asia, Africa, Japan and the East Indies, Australia, and the islands of the Pacific, show the world distribution of igneous rocks. Naturally, because of the author's nationality, and because of the wealth of American petrographic data, America is particularly fully described. No matter, however, what continent or what political division thereof may be for the moment of interest to the mining engineer, he will find a digest (with citations to the most valuable literature) of our knowledge concerning the local igneous rocks. It is this regional description of igneous rocks which the mining world will find of most interest and value. Certain ores and non-metallic products are known to be confined to certain igneous rocks; each of us in addition has a distinct impression that still other useful substances are prone to be associated with certain classes of igneous rocks. Nowhere else, to the reviewer's knowledge, is there so much material by which such associations, some of which have become axiomatic can be applied, while others still hypothetical, can be tested.

S. H. B.

AMERICAN RED CROSS ABRIDGED TEXT-BOOK ON FIRST AID. Miners' Edition. By Charles Lynch and M. J. Shields. P. 186. Ill., Index. P. Blakiston's Son & Co., Philadelphia, 1913. For sale by the *Mining and Scientific Press*. Price, 30c.

This useful and practical text-book is similar to the earlier editions of the Red Cross first-aid books, but contains much additional information and instruction. It is designed to be a manual for miners and for the use of instructors of miners. The first 132 pages of the book are devoted to physiology and explanations of the symptoms and treatment of all kinds of injuries that may be caused by accidents, such as sprains, dislocations, fractures, wounds, bleeding, and electric shocks. Such subjects as freezing, drowning, gas poisoning, artificial respiration, and bites of insects or reptiles are also covered. The subject of 'Miners First-Aid' is confined to one chapter of 42 pages, of which 28 pages are photographs showing how mine accidents may be caused by carelessness or negligence. Although this book does not treat extensively of mine accidents, it gives simple and efficient instructions for the treatment of persons who have met with injuries from any source.

FIRST AID IN MINING. By Louis G. Irvine. P. 114. Ill. South African Red Cross Society. Johannesburg, 1913. For sale by the *Mining and Scientific Press*. Price, 60c.

This valuable little hand-book is supplementary to the regular series of First-Aid Manuals, and contains specific information regarding accidents occurring in mines. It is not intended to be a complete text-book, but rather as a series of notes and additional information which will be of service in the treatment of injuries sustained in and about mining properties. The book contains specifications for emergency stations and first aid equipment; rules for the treatment of wounds, bleeding, burns, sprains, and fractures; and methods for the transport of injured men underground. There are also important chapters treating of accidents due to poisonous gases, electricity, and cyanide poisoning. The explanations, directions, and illustrations dealing with the treatment of wounds and fractures, and the transportation of the injured, are especially clear and simple. The working drawings of the Red Cross plank stretcher should be of great value to every mine superintendent. The various methods of artificial respiration are excellently described and illustrated. The book should be in the hands of all of our mine operators, for a practical knowledge of the treatment of injuries can only be acquired by means of a thorough study of the subject.

Decisions Relating to Mining

ORE ON DUMP—PART OF REALTY

Where purchasers worked a mine under an option, and, after making the required payments to the owner up to the date of expiration, allowed their option to expire and forthwith entered into a new agreement with the owner it was held that ore which had been extracted and left on the mine dumps while working under the first option, became a part of the soil and subject to the provisions of the second option.

Savage v. Nixon (California), 209 Federal, 122. October 9, 1913.

OIL AND GAS LEASE—FORFEITURE

Plaintiff's grantor executed an oil and gas lease to defendant to run for 40 years under which defendant was only bound to pay 1% of the net proceeds derived from oil or gas obtained, should he see fit to develop the land, and in so doing obtain oil or gas. Held that an unexplained delay for a period of 18 months on the part of the lessee in commencing development operations was sufficient to work a forfeiture of the lease, there being no consideration for the lessor's agreement either in the way of money paid or work done by the lessee.

Davis v. Riddle (Colorado), 136 Pacific, 551. November 10, 1913.

RIGHT OF SUBJACENT SUPPORT—HOW WAIVED

Where the owner of land retains the surface estate and conveys the estate in minerals thereunder, he may convey or waive the right of subjacent support for the surface, but such conveyance or waiver should not be implied unless the language of the instrument is appropriate therefore and clearly indicates such to be the intention of the parties to the conveyance. Damages allowed to a lessor of coal lands whose lessee under a mining lease had removed so much coal as to cause the surface to cave and fall in.

Walsh v. Kansas Fuel Co. (Kansas) 137 Pacific, 941. January 10, 1914.

MINERAL RIGHTS—TAXATION

The assessment for taxing purposes of mineral rights where they have been separately conveyed and are owned by persons other than the owners of the surface, without any corresponding deduction from the assessments against the surface owners does not violate U. S. Constitution, 14th Amendment, as discriminating against the owners of mineral rights so assessed, where it does not appear that mineral rights known to exist were consciously relieves from taxation if they belonged to the owners of the surface.

Downman v. Texas (U. S. Supreme Court). Dec. 1, 1913.

Brown Bear Coal Association, 42 Land Decisions, 320. August 13, 1913.

MINING LICENSE—FORFEITURE SET ASIDE

Where landowners granted a mining license to other persons to mine upon their property for a period of five years, and the licensees entered into possession, and expended some money in sinking a shaft and extracted a small quantity of ore, and where said licensees suspended their operations for a period of several months thereafter and then renewed them for a further period, the licensors will not be permitted after acquiescing in all these operations to arbitrarily terminate the mining license on the grounds that there had been a suspension of work at one time during the period, nor to exact a higher royalty than was originally agreed upon as a condition for allowing the licensees to continue work.

Gates v. Steckel (Missouri) 161 Southwestern, 1185. December 11, 1913.

Recent Publications

RUSSIA. A handbook on commercial and industrial conditions. By John H. Snodgrass and other consular officers. Special consular report, No. 61. P. 255. Maps. Department of Commerce. Washington, 1913. As its name implies, this publication covers everything of interest connected with Russian enterprises in Europe and Asia.

STATISTICS ON COPPER AND COPPER MINES. Compiled by J. C. Wilson & Co., Mills building, San Francisco, 1914. P. 16. This is a handy little booklet and contains details of copper production of the world, the principal producing states of America, consumption of the metal, new uses, average prices, and dividends paid by American copper companies in 1913.

WATER SUPPLY, SEWERAGE, AND DRAINAGE DEPARTMENT OF WESTERN AUSTRALIA. First annual report, 1912-13. H. C. Trethowan, under-secretary. P. 101. Ill., maps, charts, plans, index. Perth, 1913. In 1912, the goldfields water supply, metropolitan water supply, agricultural water supply, country towns, irrigation drainage, artesian boring, water supplies, and stock routes in mining districts, and other state organizations for similar purposes, were consolidated under the name of the above department. The combined capital expenditure of these important undertakings is \$32,000,000, employing 771 people. The report under review contains the past year's work and present position, and extracts, especially of the goldfields water scheme, which cost \$15,800,000, will be published in other issues of this journal.

United States Geological Survey publications, Washington, 1913:

INTERPRETATION OF ANOMALIES OF GRAVITY. By Grove Karl Gilbert. Professional paper 85-C. P. 9. Map.

MINERAL RESOURCES OF THE UNITED STATES, 1912. Part II. Non-metals. P. 1218. Maps. The different chapters in this valuable compilation have already been extensively covered in this journal during 1913, as they were published in pamphlet form by the U. S. Geological Survey. Authors on the various subjects were as follows: E. W. Parker, B. Hill, David T. Day, Charles A. Davis, E. F. Burchard, Jefferson Middleton, J. H. Hance, Ralph W. Stone, A. T. Coons, T. Nelson Dale, Frank J. Katz, Frank L. Hess, Charles G. Yale, Hoyt S. Gale, W. C. Phalen, James M. Hill, J. S. Diller, Douglas B. Sterrett, Edson S. Bastin, and George C. Matson.

GEOLOGICAL ATLAS OF THE UNITED STATES. U. S. Geol. Surv., Folios 185. Murphysboro-Herrin; 187, Ellinjay; 188, Talula-Springfield; 189, Barnesboro-Patton; 190, Niagara. Washington, 1912-1913. The geological atlas that is being published by the U. S. Geological Survey is issued in the form of elaborate folios, one for each quadrangle or group of quadrangles as they are surveyed. Each includes topographic and geological maps and a brief text. The maps illustrate the great refinement that has been attained by the Survey in its cartographic work, and the folios constitute the standard source of information for the areas they cover. The Murphysboro-Herrin and the Talula-Springfield folios were prepared in cooperation with the Illinois Geological Survey, and the Barnesboro-Patton with that of Pennsylvania. In each case the mapping has included platting structural contours which, in connection with the topographic sheet, are of the greatest value in opening and developing the various coal beds and other mineral deposits. The Illinois folios are especially interesting because they represent the extension of this method into a flat area where the surface is heavily drift covered. The results are highly creditable to both the state and national surveys concerned.

Recent Patents

1,080,721.—METHOD OF TREATING MATERIALS WITH SOLUTIONS OF TITANOUS SALTS. Christian M. Edward Schroeder, Rutherford, N. J., assignor to The Titanum Alloy Manufacturing Co., New York, N. Y., a corporation of Maine.

The method of bleaching materials which comprises immersing them in a bath containing metallic titanium and an acid solvent of titanium.

1,080,606.—CONVERTER PROCESS. Otto Thiel, Landstuhl, Germany.

Introducing a portion of the pig metal into the converter, then subjecting the charge to the blast and allowing it to remain in the converter, then introducing more of the charge into the converter and then subjecting the combined charge to the blast to the end, until finished.

1,080,573.—STEAM TURBINE. John F. Metten, Philadelphia, Pa., assignor to the Wm. Cramp & Sons Ship & Engine Building Co., a corporation of Pennsylvania.

The combination in a turbine with a rotor, a casing having a removable segment, and a dished diaphragm having a packing around the axis of the rotor, of a separate nozzle carrying element, and means whereby the nozzle carrying element engages the casing and the diaphragm to lock the latter against longitudinal movement.

1,080,656.—CENTRIFUGAL PUMP. William K. Richardson, Leavenworth, Kansas.

In a centrifugal machine, the combination with a rotor adapted to subject fluid to pressure due to centrifugal force, of a plurality of blades in position to deliver fluid into the eye of said rotor and revolve therewith, said blades being inclined toward the rotor in a direction opposite to the direction of rotation, and having a calculated translatory displacement approximately twice the rated volume designed to pass the screw.

1,080,707.—ROCK DRILL. Edwin M. Mackie and Percival F. Doyle, Franklin, Pa., assignor to Chicago Pneumatic Tool Co., Chicago, Ill., a corporation of New Jersey.

In combination with a rock drill, an air feed device cooperating therewith, a valve for admitting pressure fluid to the air feed, and a fluid pressure actuated governor for controlling the degree of pressure admitted to such device, said governor having provision for releasing such pressure therefrom.

1,074,150.—PROCESS OF TREATING MATERIALS. Frederick W. Yost, Chicago, Illinois.

Treating finely divided metal-bearing material capable of undergoing propagative reaction, which comprises initiating a reaction in a mass of the material, conducting a current of reaction-supporting gas through the mass in one direction, conducting another current of reaction supporting gas through the mass in another direction and controlling conditions so as to cause propagative reaction between components of the currents of gas and of the mass.

1,080,586.—ROASTING FURNACE. Charles W. Renwick, Isabella, Tenn., and Nicholas L. Heinz, LaSalle, Ill.

One roasting furnace of the class described, the combination with a hollow rabble-shaft and hollow rabble-arms of L shaped tubular ports vertically extended in the shaft and arranged in different radial planes, connections for the arms with the shaft comprising slotted coupling pieces on the shaft in conjunction with rods extended through the arms, and means at the outer ends of the arms for putting the rods under tension in said coupling pieces and for releasing the same.

Industrial Progress

The NATIONAL TUBE Co. announces publication of bulletin 15A, dealing with National pipe for drilling purposes.

THE WM. POWELL Co. has for distribution a 'Powell White Star Valve Booklet,' which contains full descriptions of this well known line of valves.

THE HARDINGE CONICAL MILL Co. announces that it has received an order from the Beatson Copper Co., at Latouche, Alaska, for five of the largest sized Hardinge conical mills.

ARTHUR G. MCKEE is distributing a catalogue describing and illustrating in detail the 'Baker' suspension type storage bin as built by him in wood, steel, or concrete for any one of many uses.

THE LAIDLAW-DUNN-GORDON Co. has issued under date of January 1914, Bulletin L 523-A, containing complete descriptions of 'Cincinnati' gear duplex Corliss steam driven air-compressors classes WA and XA, made by that company.

THE FRED M. PRESCOTT STEAM PUMP Co. has published in the form of bulletin 106 the record of a duty test made on a 'Prescott, Duplex Missabe Waterworks Power Pump' at Dubuque, Iowa, which showed an overall efficiency of 83.5 per cent.

IN LESCHEN'S HERCULES for February is a well illustrated account of coaling United States warships at sea, as also of how wire rope enters into rapid steel frame construction, logging, handling gravel and sand from a pit, and various other uses.

The copper smelting and converting plant of the Yampa Smelting Co. at Bingham Canyon, Utah, which was of 1000 tons daily capacity has been purchased by the MORSE BROS. MACHINERY & SUPPLY Co., which will dismantle the entire plant and all of the material is offered for sale.

SAUERMAN BROS. are supplementing their regular and well illustrated catalogue of the 'Shearer & Mayer' drag-line cable way excavator with individual leaflets of 4 by 7 in. size punched for convenient filing in standard loose-leaf note books and illustrating various situations in which the excavator is being used to advantage.

THE SWEETLAND FILTER PRESS Co. is now ready to send inquirers copies of catalog No. 10, containing a complete account of the new 'Sweetland Self-Dumping Filter' of the clam-shell type. In this filter the leaves are enclosed in a horizontal steel cylinder of which the lower half is hinged and so arranged as to drop back out of the way when the filter is to be discharged.

THE ARIZONA ENGINEERING Co. has just been incorporated for the purpose of doing a general engineering business and handling mining supplies in Mohave county, Arizona. The incorporators are E. F. Thompson; J. E. White, former manager at the Quartette mine; G. R. Franklin, purchasing agent for the U. S. Stores Co.; and R. P. Wheelock, county engineer. The principal place of business will be at Kingman.

THE SPRAGUE ELECTRIC WORKS has issued catalog 329 dealing with electric fans and Bulletin 49,000 describing the portable ozonators made by that Company. Fans are widely used for ventilating purposes nowadays. The ozonators are designed for use in situations where for any reason a ventilating system is impossible. They act upon the principle that ozone, an unstable form of oxygen, readily unites with organic matter in the air and so purifies it.

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EDITORIAL

IRON as well as petroleum are to be developed in China through American enterprise. It now develops that the Bethlehem Steel Company participates in the concession recently granted to the Standard Oil Company and acquires rights as to iron ore lands. Following the incursion of this Company into Chile, this indicates a far seeing policy designed to acquire raw materials for a world-wide manufacturing and selling industry.

MEXICAN bank notes are being put out that rest on the security given by rubber stamp signature and a gaudy official seal, according to reports from the Mexican capital. This new brand of currency is being turned out by the print shops of Mexico City and its validity secured by an edict, making a refusal to accept it punishable by fine and imprisonment. If the presses do not break down under the strain, a happy solution of Don Victoriano's financial difficulties has at last been found.

DEPRECIATION for exhaustion of orebodies as mined at "a reasonable rate not to exceed 5 per cent," allowed under the United States income tax law, does not predicate complete amortization in 20 years, as a little reflection shows. Assume an orebody of which one-twentieth is mined each year. On each twentieth as mined, a 5 per cent depreciation is allowed. At the end of 20 years all the ore is gone, and only 5 per cent in all has been allowed for amortization. It is difficult to see how mining companies are to be taught proper accounting and shareholders brought to regard dividends from mines as in part return of capital, if the United States continues to set such an example.

QUESTIONS as to the persistence of ore in depth are among the most vital that come up in connection with any mining proposal. It is rarely that a mine can be bought for the ore in sight, and estimation of the value of most mines, as all prospects, must be based upon the judgment as to the depth to which the ore may be safely assumed to persist. We have published numerous articles upon this subject, and this week we present a general summary by Mr. Malcolm MacLaren that appeals to us, particularly since it is not a generalization based upon all ores, but a careful consideration of the effect of depth upon particular

types of gold ores. This, we believe, is the right way to approach the problem. Mr. Maclaren's paper was presented to the International Congress of Geologists at Toronto. It rounds out nicely various contributions made by him earlier to our own columns, and will, we are sure, be read with interest.

JAPANESE newspapers are protesting at the terms of the contract recently entered into between the Standard Oil Company and the Chinese Government; it is considered that the provision that in event that the fields first to be prospected prove barren, other territory is to be opened to the Company, practically creates a monopoly and violates the 'open door' principle. Not having the terms of the agreement before us, we are unable to judge as to the merits of this criticism, but we do believe profoundly that development of the oil resources of China under present conditions can only be safely undertaken by a large and experienced organization working under monopoly or near monopoly conditions. Any other plan is certain to be wasteful of capital and oil; and in the long run somebody pays for the waste.

WALKING down a city street is one of the most dangerous occupations if one may judge from the number of accidents and deaths reported. For example, there were 2,099 killed and 42,544 injured in street accidents in Great Britain in 1913. Of these, 579 were killed and 18,365 injured in the metropolitan district of London alone. These figures may be compared with the 2360 killed in the coal mines and 661 killed in the metal mines of the United States in the same year. Exact comparisons are impossible, since the total number exposed to accident in the streets is unknown. It does seem clear, however, that the accident rate in the mines is decreasing while the reverse is true of street accidents. Motor cars are responsible for a marked increase in the death and accident rate in the cities, though in the city of London proper the number of deaths from this cause has begun to decrease. Apparently nature is working in the usual way; the clumsy have been killed and the survivors have learned to dodge.

JUST to let our friends in other states and lands know that the supposed protest of the Pacific coast cities against the repeal of the Panama canal free tolls provision for coastwise ships is not unanimous, we want to say that the straight forward, plain spoken message of the President has received the approval of a large part of the more thoughtful citizens resident on the west coast. A loud protest is being made in certain quarters, but it should not be taken too seriously. There would be much political gain to many now in sorry plight if the President could be 'put in a hole.' Without unduly discounting the honest, but as we believe mistaken, convictions of others, we think this the prime impelling force back of the furore. When the free passage of coasting vessels was proposed, senti-

ment was naturally for it. California was still smarting from the inflictions of the ancient railway monopoly aided by the pretended competition of the Pacific Mail Steamship Company. It was hard to believe that the day for such things had passed, and the cry for absolute freedom of the water route had not only sentiment but business to commend it. In the interval since the power of the Interstate Commerce Commission and of the various state commissions to regulate rates and prevent abuses has been placed upon a wholly unexpectedly secure basis. The power of the courts to dissolve a monopoly has been shown, and there is much less reason to fear a return to oppressive tactics by transportation agencies. No one was more surprised than the Westerners when England and other countries took the ground that the new law violated treaty rights. It had seemed, and still seems, to relate to a matter that is entirely one of domestic concern. However, the whole world apparently thinks us wrong in this, and Californians no more than other Americans relish being considered treaty violators, whether the charge be just or unjust. Conditions having changed and the economic argument being now unimportant, there is strong sentiment in favor of giving up as a courtesy what might, if necessary, be defended as a right.

METALLURGY is really chemistry applied to the business of making dollars out of ore, and the art owes much to the chemists who have contributed so much to its advancement. Not long ago we chronicled the advance which Mr. W. A. Hall has made toward the solution of the vexing fume problem, and this week we print the specifications of the patent taken out by Mr. E. R. Weidlein covering the process which he has devised for the recovery of copper from its ores by leaching. The research work on which this is based having been done in the Mellon Research Laboratories of the University of Pittsburgh, which have been widely exploited in the popular magazines. Too much may perhaps be expected of it, just as the son of a famous father is at some disadvantage. Substantially this same process is covered by United States Patents 723,949 (1903), and 930,967 (1909), and Mr. Weidlein's hope is therefore to succeed where others have failed. To carry out the suggested process of precipitating the copper from CuSO_4 solution by passing SO_2 into the warm solution under pressure, it is necessary to first neutralize the excess of acid present and this is not only an appreciable item of cost, but presents great difficulty. It is suggested that this can be done with limestone, but anyone who has had practical experience in the neutralization of sulphate solutions with lime or limestone is painfully aware that the resulting hydrated sulphates of calcium precipitate go back into solution and re-precipitate with slight changes of temperature and pressure in a most annoying and disconcerting manner. This is only one of the difficulties, and while the process does not involve the consumption of sulphuric acid, it must not

be overlooked that the collection and compression of SO_2 , followed by passing it through the solution, involves an appreciable cost. The management of the Mason Valley plant has always had the best reason for giving out details of practice—well directed and successful work—and it is greatly to be desired that, even if the proposed process shall not prove as successful as is hoped, yet a full record of the results attained will be made public for the guidance of others. Nothing is more futile than the laborious re-acquiring of other people's fruitless experience. We recently mentioned that a European company is about to abandon a process after two years' work upon it and take up another which has similarly been tried and abandoned by an American company, which is about to take up the first process. It is quite possible that, under the different conditions, this is exactly the right thing to do, but what an amount of profitless labor could be avoided if each company were possessed of a full record of the results attained by the other. Success is not the only praiseworthy thing; well directed effort is equally honorable; and their duty toward their fellows should impel metallurgists to make public, in so far as they reasonably and honorably can, the fruits of their experience.

Diamonds and Diamond Mining

Diamonds are a luxury, and while the world is prosperous, the mining of this form of carbon is profitable, according to Mr. Gardner F. Williams, who gave a most interesting illustrated lecture on the subject before the San Francisco section of the American Institute of Mining Engineers on March 31. Before the financial depression in the United States in 1908, the Kimberley group of diamond mines employed 4000 whites and 27,000 kaffirs; but during this period these numbers were reduced by 2000 and 10,000 respectively. After many years of careful study of diamonds, Mr. Williams has no definite theories regarding their origin. Peculiar combinations of diamonds and other minerals have been found, and were shown on the screen during the lecture. An early theory of their formation advocated especially by the late H. Carvel Lewis was that the carbon came from the shales around part of the diamond 'pipe' or blue ground; but this theory has difficulties to meet. Previous to the discovery of the Kimberley deposits, all diamonds had been found in rivers, and river diamonds differ from those mined at Kimberley.

A large percentage of the Kimberley stones are broken, and those from each mine have distinctive characteristics; but so expert are the valuers that they can identify them at once. Open-cut mining was continued to a depth of 1000 feet, but it then became dangerous, and underground work is now being done to 3520 feet. Hoisting at one shaft is done at the rate of 1000 'loads', of 1600 pounds each, per hour. It was found that the hoisting ropes whipped about in the shaft and cut the timbers, but steel is now being used

in place of them, and to prevent this cutting the ropes, hoisting is done at a great speed, the ropes thereby being kept taut as a rod. The blue ground is spread out on large areas of 'floors' to a depth of 10 inches, and after over a year or two it disintegrates so much that 66 per cent will pass a 16-mesh screen. During the washing and concentration of the blue ground, the diamonds are recovered on grease tables. Why they are caught, and practically nothing else, is explained by Mr. Gardner by the fact that diamonds are not wet by water, and therefore stick to the vaseline used. On Page 597 of this issue, will be found an abstract of the annual report of the Premier Diamond Mining Company, Limited, showing the scale of operations at this other great South African mine, and its low costs.

The Mining Code Commission

The Smoot bill proposing a commission to codify and suggest amendments to the United States mining laws, has been reported to the Senate. In revised form it provides for a commission of three "two of whom shall be lawyers of large experience in the practice of mining law and one a mining engineer who shall have had practical experience in the operation of mines." This commission is to hold hearings in the principal mining centres in the Western United States and Alaska, to consider the experience and laws of other countries, and to submit within a year a tentative code applying to mineral lands of all classes. The members are to be paid \$500 per month and expenses and an appropriation of \$25,000 is made to cover the expense involved.

We believe that the amendments made by the Senate committee materially improve the bill. There is a widespread feeling that it is still capable of betterment, principally in that provision should be made for a larger participation by mining men. The final law will necessarily be written by some member or members of Congress, and there are so many capable lawyers in that body, including a number who have had extended experience in practice of mining law, that it may be safely assumed that the proposed code will be put in good form before it becomes a law. The main duty of the commission will be to determine what are the real defects of the present system and how far it is wise to go in attempting to correct them. This calls for experience in mining, and now that the bill has been broadened to cover coal, oil, gas, phosphate rock, and similar materials, it would seem especially important to have the commission so constituted as to draw upon experience in both the main branches of mining, that relating to metals and the non-metallics. It would be a grave responsibility for one mining engineer to represent the whole mining industry in such a work. A commission of five is not too large in view of the work to be done, the short time allowed, and the fact that it is not expected that the whole time will be devoted to the task. We believe that the real sentiment and experience of the mining world can be felt out better by mine

operators and engineers than by lawyers. After it has been determined what to do, the lawyer will have the very important task of determining how it can be done with the minimum of disturbance of our present legal fabric. It will be no easy task, and the phrasing of the law should be left wholly to those who are expert in that art. By the same rule, the determination of the wants and experience of the mining men may appropriately be left to those who feel the wants and have the experience.

The change in the phrasing of the bill, so as to charge the commission with the duty of studying the laws governing non-metallic mineral lands, renders it inappropriate that the legislation now before Congress and designed to establish a leasing system for coal, oil, and phosphate lands, be passed in advance of the report of the commission. Public sentiment is rapidly coming to favor, or at least to acquiesce in, legislation such as that proposed, but there are important difficulties yet to be met. Contrary to the implication of the press reports, the Ferris bill now before Congress, proposes not to deal with the withdrawn lands. In the case of petroleum, at least, the real difficulties are now with lands that have been reserved, but are actually developed, or are being claimed, by locators. It would seem better to work out the lines of general policy first and then provide for its application as rapidly as possible, to the cases where there is already trouble.

What is the Matter with the Rand?

South Africans have been much disturbed at the decrease in the gold yield of the Rand and are holding many a solemn inquest. The *South African Mining Journal* has been running a series of articles on 'What is Wrong with South African Mining?' In the issue of February 21 it is urged that the Government should offer more liberal terms on leases so as to induce the opening of more mines. At this distance it would seem to us a poor policy to open more mines when stamps are hung up and plants are already idle because of lack of labor, and when one, at least, of the difficulties is that capital has been too easily obtained in the past. All mining districts, even the largest, come to a time when decreasing grade of ore requires lower operating costs. The easy way to meet the situation is to increase the plant and distribute fixed charges over a larger tonnage, at the same time that by shortening the life of the property the total sum spent in annual salaries is decreased. It requires, however, nice judgment to do this without disaster. The need ordinarily arises when the mine or district is doing well and when it is easy to obtain money. If the new money be charged to capital account, satisfactory operating costs are obtained and these last long enough, in many cases, to allow those chiefly concerned to sell their holdings, but not much longer. Such at least has been the history of many a good mine. The production of metal, however, must go on regardless of changes in stock ownership, and the engineer

on the ground has then the very practical problem to face of how to reduce the real costs. It is this situation that the Rand engineers must face. They have further a peculiar difficulty in that the enormous scale of operations, in proportion to the population, calls for a labor supply that simply does not exist; taking into account racial prejudices that, rightly or wrongly, forbid opening the field freely to the labor market of the world. The mines of the Rand must have more labor or more efficient labor. The former is, at present, out of the domain of practical politics; the latter points the way to long years of effort and raises troublesome questions as to what would be the future relations of the white and black races in South Africa, if the black men were trained and educated to real efficiency.

The American way of meeting the situation would be to train some black men and use more white men. We are by no means prepared to say that that plan would meet the situation in South Africa. Our race problem, even in the southern states, is no such problem as exists on the Rand, and we have by no means made such a success in solving our problems as to warrant preaching to others. At the same time, we may be permitted to point out that in proportion to the work accomplished in the past century, the United States has been chronically short of labor. Our captains of industry have had to develop machinery and relatively efficient workmen because men of any sort were scarce. Despite the large investment, immense scale of operations, and the use of 'cheap' labor, Rand costs, while low, are not too low. Making allowance for the 'phantom profits' of which Mr. T. A. Rickard has written effectively in *The Mining Magazine*, the cost is at least 20 shillings per ton. At the North Star mine in California, a gold-quartz vein is worked which in thickness, dip, and depth of workings resembles greatly the Rand bankets. The ore is mined, hoisted, crushed, and treated by amalgamation and cyanidation, as on the Rand. A trifle over 100,000 tons per year is handled and the cost is just about 20 shillings. At the Empire mine nearby, Mr. George W. Starr, who formerly operated on the Rand, manages a similar mine, and, while detailed figures are not made public, it is known that the cost is at least as low as at the North Star. This work is all done with white labor, working 8-hour shifts, under union conditions, for \$3 per shift and above. Comparisons of cost made also with thin vein coal mining in various European countries, as well as with metal mines in general, raise grave questions as to whether the 'cheap' labor of the Rand is really cheap.

It is to be anticipated that the output of the Rand will decline in any event. To open more mines would be simply to rob the others of workmen. To increase the units of output from existing mines seems hardly possible save by the old fashioned plan of increasing the input of labor, and an American may be permitted to 'guess' that this will only be done by increasing the efficiency of the workmen in one way or another.

The Incaoro Gold Mine and Mill, Pallaya, Bolivia

By FRANCIS CHURCH LINCOLN

The Incaoro Mines Company of Delaware is operating a gold quartz mine and mill at Pallaya, near Yari, district of Larecajas, department of La Paz, Bolivia. Horace G. Knowles, formerly American minister to Bolivia, is president of the Company, and David G. Bricker, once of Butte, is general manager.

Pallaya is 117 miles from the city of La Paz, and the trip to the mine ordinarily consumes three days. One day in the saddle may be saved by taking advantage of the weekly stage to Achacache. After ascending rapidly from La Paz at an elevation of 11,800 ft. to Alto with one of 13,200 ft., the stage crosses the tableland of the Alto descending slowly to the shores of Lake Titicaca, 12,500 ft. above sea level, and skirts the lake to Achacache where the first night's stop is

made. The remaining two days of the trip must be made on muleback. On the second day, the continental divide is crossed into Amazonian drainage territory, and the descent made to the town of Sorata nestling in the valley of the San Cristobal river at the foot of the beautiful snow peak of Illampu and at an elevation of only 8500 ft. On the third day, a quick ascent is made to an elevation a mile greater than that of Sorata, three high passes, each over 15,000 ft. are crossed, and a slight descent made to the camp at Pallaya.

Pallaya is situated on the eastern slope of the Andes, in a glacial valley facing the north and surrounded by rugged slate mountains. The general appearance of the camp is shown in Fig. 1. Its elevation, 13,650 ft.,



FIG. 1. GENERAL VIEW OF INCAORO.

places it well above timber line, so grass and flowers constitute the sole vegetation. The elevation also renders the climate cold, and the situation on the eastern side of the Andes renders it wet. In winter there are clouds of fog nearly every afternoon, and in summer it rains almost every day. The climate is therefore unfavorable to man, and the lack of timber and fuel is a handicap to mining operations, but on the other

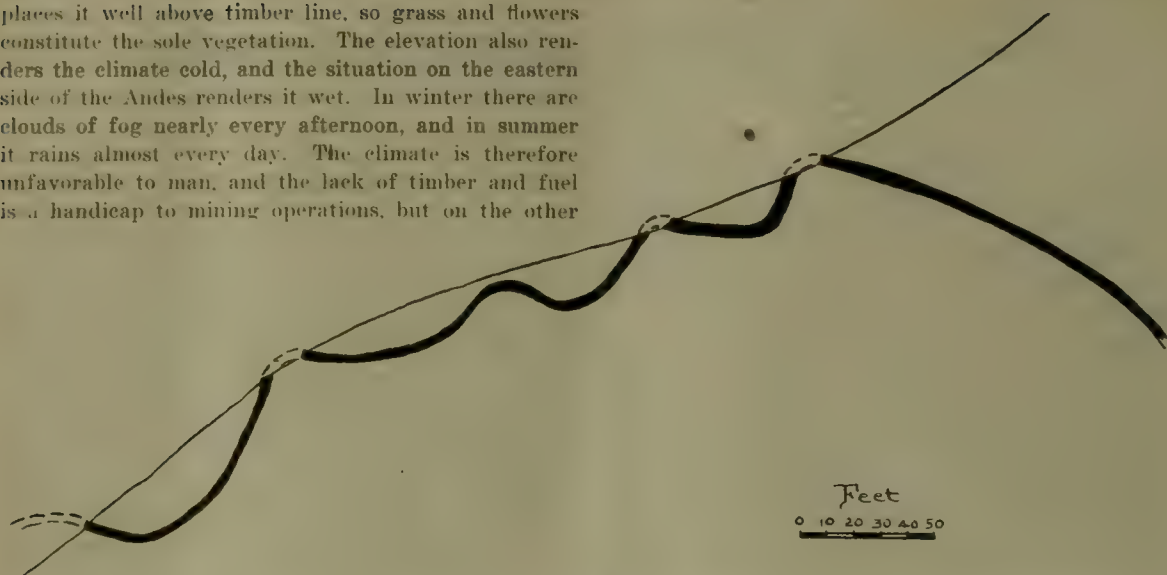


FIG. 2a.

hand the heavy rainfall supplies an abundance of water which may be utilized for power.

The country rock is a black non-fossiliferous slate, classified by d'Orbigny as of Silurian age. At a short distance from the mine, strata of fine grained gray quartzite are interbedded with the slate, while at a distance of more than a mile, andesite dikes occur. The sedimentary rocks throughout the district have been closely folded and greatly contorted during the process of mountain building.

The ore deposits are bedded veins which have been folded with the country rock and have developed most peculiar shapes as will be seen by reference to the sections shown in Fig. 2a, 2b, and 2c. In some respects, these veins resemble the saddle reefs of Bendigo, Australia, and of Nova Scotia, but in others they are unique. Quite frequently a single vein presents the appearance of a series of parallel veins as a result of erosion of the edges of the folds, as shown in Fig. 2b, and the final result of such erosion is to produce the curious elongated orebody shown in Fig. 2a. No faulting is apparent, but during the folding process parts of a vein have at times been squeezed apart for short distances or pressed together into huge irregular masses. On the whole, however, the veins retain their widths and continuities to a remarkable extent and make it appear likely either that the folding process was a slow one which gave the vein quartz time to recrystallize as it bent, or that silicious solutions were present to heal the breaks with fresh quartz as fast as they were formed. Some of the veins are undoubtedly nothing more than quartzite strata more or less replaced by vein quartz, and it is possible that all are of this character, although no unaltered quartzite has as yet been found in the vein mined.

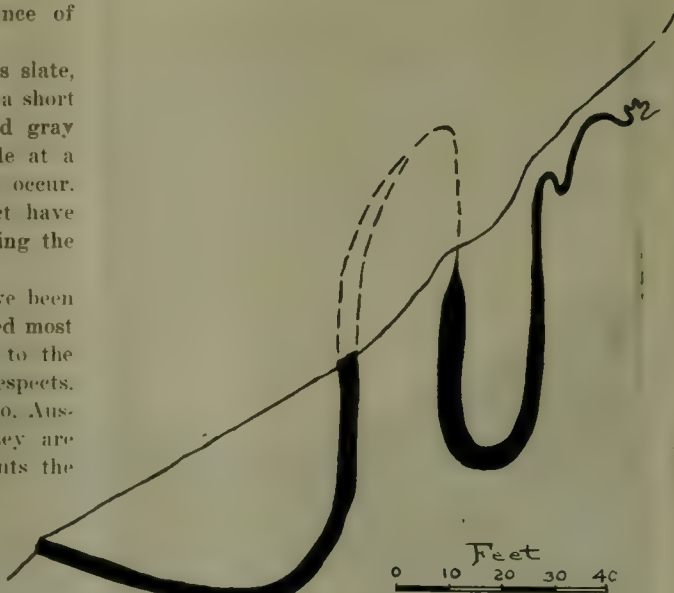


FIG. 2b.



FIG. 2c.

The principal vein mineral is quartz, always accompanied by some white mica and native gold, and occa-



FIG. 3. MINE, MILL, AND TRAM.

sionally also by arsenopyrite, pyrrhotite, and pyrite. The gold is occasionally visible to the native eye, most frequently in the quartz, but occasionally also in the

slate or intergrown with the arsenopyrite. When not visible to the naked eye, colors are obtained on panning. The arsenopyrite and pyrite have high refractory gold content, but are present in such small quantities as to be relatively unimportant.

The present producing vein is in an anticline of black slate, one side of which has been eroded till one leg of the vein is partly exposed. This vein is a wide one, and was quite extensively worked by the ancients. They left some pillars and a large amount of fillings containing gold. Mining at present consists mainly in the removal of these fillings and pillars, a task which sounds easy, but is in reality somewhat difficult owing to the extremely irregular crumplings and distortions which the vein has undergone. Development has been pushed beyond the ancient workings, and good faces of solid ore have been opened up to supply future needs.

About 100 Aymara Indians are employed in the mine, but this number is greatly reduced immediately after pay-day, and also when feast days are in process of celebration in neighboring villages. The wages paid vary from Bs. 0.40 (\$0.16) for the smallest boys to Bs. 4 (\$1.60) for mine captains. Work begins at 6 a.m., but is stopped from 9 till 9:15 to permit the Indians to chew coca; again from 11 to 11:30 for lunch; and still again from 2:30 till 2:45 p.m. for coca; and ends at 5:30 p.m. The working day is therefore $11\frac{1}{2}$ hours long with 1 hour off for rest and refreshment. Some of the development work is performed by contractors, who are supplied with steel,



FIG. 3. STORE, AND MANAGER'S HOUSE.

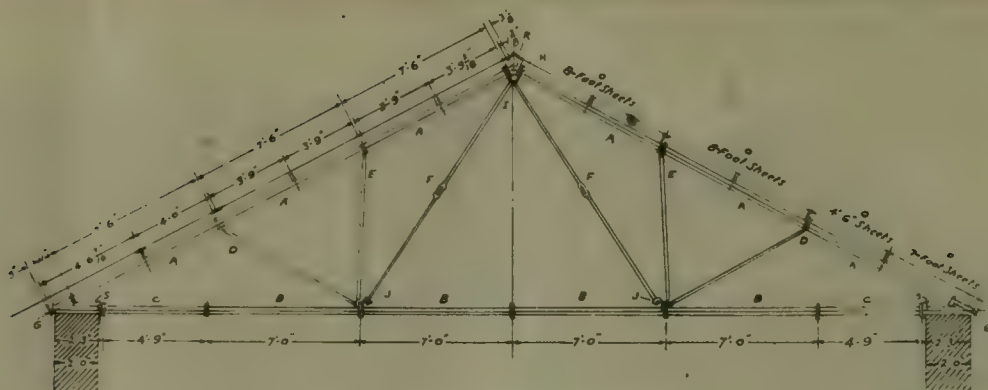


FIG. 4. DETAILS OF ROOF CONSTRUCTION.

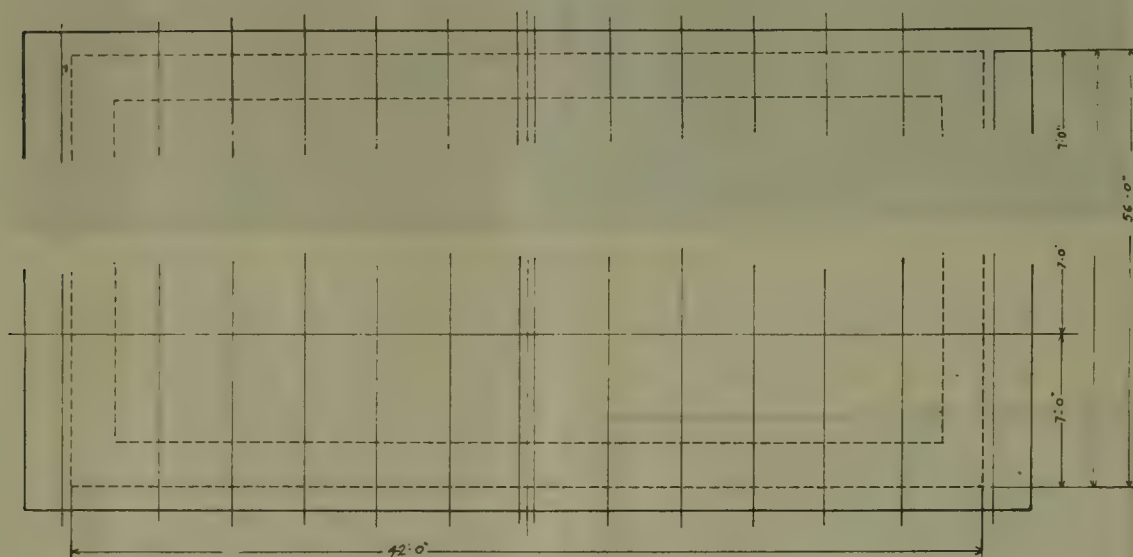


FIG. 5. PLAN OF ROOF.



FIG. 6. VIEW OF MILL, SHOWING ROOF CONSTRUCTION.

but furnish all else themselves. They are paid at the rate of Bs. 30 per linear metre (\$3.66 per linear foot) of drifts and cross-cuts. Holes are sometimes paid for at the rate of Bs. 0.10 (\$0.40) per inch when in quartz, or Bs. 0.05 (\$0.02) when in slate.

An inclined gravity tram is employed to lower ore from the mine to a large storage bin, whence it is wheeled to the mill as required. Fig. 3 gives a general view of the mines, trams, and mill. The amalgamating mill is of the Hardinge type and has a capacity of upward of 50 tons per day of 24 hours. Power is furnished by a 24-in. Pelton water-wheel which receives its water by pipe-line from a glacial lake a mile distant and 700 ft. higher. When the ore arrives at the mill, it is dumped upon a 3½ by 7-ft. grizzly with ¾-in. spaces between bars. The undersize falls directly into the mill-bin, while the oversize is first crushed in a 7 by 14-in. Buchanan jaw crusher. From the bin, the ore passes into a 4½ ft. by 13-in. Hardinge conical ball-mill, which reduces it to a maximum size of about ¼ in. The pulp then enters a 6 ft. by 22-in. Hardinge conical pebble-mill, which reduces it to about 30 mesh. The pebble-mill pulp is led over amalgamating plates, of which there are two sets of 4 by 5-ft. plates each. Concentrating tables are soon to be added to save the concentrates, which though small in amount are high in value; and in the near future a second unit is to be added to the mill, thus doubling its capacity. A peculiarity in the construction of the mill building is well worth noting. Instead of using steel or timber trusses to support the roof, the trusses are ingeniously constructed of iron pipe as shown in Fig. 4, 5, and 6. The walls of the mill building, as of all other buildings in the camp, are constructed of slate.

The gold bricks obtained from the mill are very pure, running from 796 to 902 fine in gold, from 93 to 161 in silver, and 19 to 43 in base metals. The bricks are sold to the Bank of the Bolivian Nation, and will be used in coining the recently authorized Bolivian gold coins.

A Government Coal Mine

According to the *Réclamation Record* the coal mine on the North Dakota Pumping Project mined 34,365 tons of coal in 1913 at a total average cost to date of \$1.76 for both operation and maintenance. The total average was reduced 12.1c. during 1913. The average cost for coal mined in 1911 was \$1.56; in 1912, \$1.89; and in 1913, \$1.438. It is expected to reduce the average cost at least 20c. per ton during 1914 and at the same time improve the condition of maintenance. This reduction will mean \$2000 on the annual production of 10,000 tons and a corresponding reduction in operation cost.

Bank notes were issued by the first Ming emperor of China, Hung-Wu, in 1368-1399 A. D.

Costs at the Victorious Mine

The Associated Northern Blocks operates this mine and a mill at Oro Banda, forty miles from Kalgoorlie, Western Australia. The mine is opened to No. 6 level, and the oxidized ore and country are soft, giving trouble with creeps and necessitating heavy timbering. The sulphide zone has not been opened to any great extent yet, although shipments to the Kalgoorlie sulphide plant have been made for testing purposes. The mill consists of a rock crusher, four 5-ft. Huntington mills, grinding pans, agitators, and Ridgway filters, all driven by suction gas engines. During the past fiscal year the plant treated 97,639 tons of ore yielding gold worth \$519,000, with 88.6% extraction. The mills crushed 77.5 tons each per day. The three filters averaged 90.4 tons each per day, forming cakes in 6 to 7 minutes, and washing them in 12 to 14 minutes. Magnesia in the ore gave trouble with the filter-cloths, added to which was 8 to 10% solids in the water used. At first, water was added to the solution sump, but this was changed to feeding it to the mills. Cloths now last from 6 to 8 weeks. The ore contains a large quantity of silicate of magnesia, rendering settlement difficult, the thickener product rarely being over 40% solids. Costs are as follows:

Mining:	Per ton.
Development	\$0.41
Stoping	0.47
Hoisting and transport	0.30
Timber, waste filling, maintenance.....	0.34
Supervision	0.05
General charges	0.02
Total mining	\$1.59
Milling:	
Breaking and storage	\$0.05
Milling	0.47
Pumping and grinding	0.02
Agitating and cyaniding	0.18
Vacuum filtration	0.15
Precipitation and clean-up	0.06
Disposal of residue	0.03
Power	0.14
Supervision	0.07
General charges	0.05
Total milling	\$1.22
General expenditure:	
Sundries	\$0.01
Salaries, office, etc.....	0.13
Fire and accident insurance.....	0.04
Bullion charges	0.03
Total general	\$0.21
Total costs	\$3.02

The Victorian Government, Australia, owns and operates a coal mine at Wonthaggi, about 60 miles from Melbourne. During the four years ended November 23, 1913, the total output was 1,535,212 tons of coal, exclusive of that used at the mine and sold to mines. Wages paid in that time amounted to \$2,736,000.

The Persistence of Ore in Depth

By MALCOLM MACLAREN

*A study of the recent literature of ore deposits inevitably forces the conclusion that workers in this branch of geology are endeavoring, in their zeal for the advancement of knowledge, to wrest from the scanty data available more than the simple facts warrant. Data that have been garnered from the examination of a given metalliferous deposit, and that have a real value when applied to the construction of a sound theory of deposition for that metal alone, have been transferred to stay and brace the tottering structure built for another metal, with which the first may eventually prove to have only the slightest genetic affinity, however closely allied they may appear to be today. When all the known facts concerning the deposition of any one metal have been collected, collated, and analyzed, then, and not until then, may comparison be made with the data of another metal similarly treated. Some metals—for example, tin and copper—clearly lie so far apart genetically that no confusion of data has resulted, but the general impression appears to be that the data concerning the ores of other metals are interchangeable. They may often indeed be so, but the time has not yet arrived when transfers may be made with safety. For this reason, therefore, the ores of one metal only, namely, gold, are considered in the following brief review.

What Is Depth?

As a preliminary, a definition of 'depth' appears to be necessary. Here it is assumed to cover only the (presumably) primary ore that lies beneath the zones of secondary enrichment (oxide and sulphide) and to extend for a limited depth, say 1000 ft., below the bottom of the deepest mines, or 6000 ft. in all. To take the enquiry deeper is to enter the barren zone of speculation. The combined depths of the oxide and sulphide zones of enrichment may vary with climatic conditions from a few feet to a few hundred feet. Ordinarily, below 500 ft. we are, for most gold ore-bodies, in the primary zone. A word may be said in regard to the use of the term 'primary ore.' It comprises that ore for which we know no prior state of combination and no former locus in space. In this review then, depth is understood to be a zone extending downward from 500 to 6000 ft. below the earth's surface. The ore in this zone may be assumed to have been deposited during a single short geological era, and to owe nothing to accretions of a widely separated and later period. It is probable that the irruption of auriferous solutions was normally paroxysmal in character and indeed was comparable to volcanic eruptions of the present day. Only those fissures and channels

that were open at the geological moment, so to speak, were filled with ore. An assumption of this nature may help to explain the vertical variations in the tenor of the ore in the primary zone, where in many mines, horizontal bands of richer and poorer ore alternate. These alternations conceivably represent the varying horizons at which successive upward pulsations of metalliferous solutions either became sufficiently cool to be deposited or met with fluid agents of deposition.

A Simple Classification of Deposits

I have elsewhere¹ attempted to show that the gold deposits of the world fall naturally into well defined auriferous groups, the members of each group, though widely separated in space, being closely allied in genesis, in character, and in geological age. One of the most important distinguishing characters of the several groups is persistence (or otherwise) of ore in depth. The classification adopted must therefore be outlined.

PRE-CAMBRIAN

Occurrence.	Examples.
(a) Arising as the end-product (generally following albite-porphyry) of diabasic magmatic differentiation series intrusive into schists.	Western Australia (Kalgoorlie, etc.), India (Kolar, Hutti, and Dharwar), Rhodesia, Transvaal (Witwatersrand, Pilgrim's Rest, Barberton), Brazil (?), Guianas, Appalachian fields, eastern Canada (Porcupine, etc.).

PERMO-CARBONIFEROUS TO POST-JURASSIC (?)

(b) Arising as the end-product of granodioritic intrusions.	(a) Urals. (b) Eastern Australia and Tasmania. (c) Western North America (California, Oregon, and Alaska).
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MIDDLE TERTIARY

(c) Associated with andesite volcanic eruptions.	Northern Chile, Peru, Colombia, Mexico, California (Bodie), Nevada, Utah, Colorado, Unalaska, Japan, Sumatra, Celebes, New Zealand, and Transylvania.
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The above table slightly varies from that originally adopted, but four years further field experience has enabled me to abolish the former tentative subdivision of the pre-Cambrian deposits and has given a much clearer view of the general sequence of events leading up to auriferous deposition in that age. These groups, therefore, contain all the important gold deposits of the world. Two of these, the pre-Cambrian and the Tertiary are extremely well defined; the third, including all apparently dependent granodioritic magmas, is still somewhat indefinite and will certainly be modified.

*Read before the International Geological Congress at Toronto.

¹Maclaren, 'Gold,' London, 1908, pp. 42-75.

fied with increase of knowledge. Probably, when the exact age of its auriferous impregnation is known, the Ural chain of deposits will be brought into close accordance with the eastern Australian, while the California (Mother Lode, etc.) occurrences may eventually be transferred to the Tertiary andesite group, with which they are indeed orographically closely connected.

In any consideration of the question of the persistence of gold ore in depth the foregoing divisions must be kept closely in mind, since the recurrence of the evidence of the complete dependence of gold deposits on geological conditions, both for deposition and for extension, lateral and vertical, is certainly the most salient feature arising from the study of the goldfields of the world.

The Andesitic Gold Deposits

It will probably be most convenient to first consider the younger goldfields. These are the andesite fields that have furnished some of the greatest bonanzas that have been known. Their petrological range is from pyroxene-andesite to quartz-trachyte, and occasionally to rhyolite, all apparently the differentiation members of dacitic magma. Their geological range is from Eocene to Pliocene with a special development in the Oligocene and Miocene. With one notable exception they follow very closely and are confined to the so-called 'Pacific Circle of Fire', with which line of volcanic activity they have clearly a very close genetic connection. The outstanding feature of gold deposition in this group is its modernity and its consequent intimate association with existing volcanic phenomena. The geographical exception is the Transylvanian goldfield of Hungary, the andesites of which were erupted during the Aquitanian stage, and along lines of crustal weakness initiated in the Oligocene and indicated at the present day by the active volcanoes of the Mediterranean.

Auriferous deposition in this group has probably been closely associated with solfataric action. MacLaurin has indeed shown that the hot springs of the solfataric region of New Zealand at the present day bring to the surface and deposit notable quantities of gold and silver in the silicious sinter that forms on the edges of the boiling springs. A similar deposit is recorded from near the De Lamar mine, Idaho. The New Zealand hydrothermal region is on the same line of crustal weakness as the goldfields of the Hauraki peninsula. On it, only 40 miles away from Rotorua, is the famous Waihi mine, until three years ago one of the greatest of the world's gold mines. The chalcidonic character of the silicious filling of the veins of many andesite fields also appears to point to a deposition from hot waters. In andesite and allied rocks in the neighborhood of auriferous veins 'propylitization' is universal. In this facies of the original andesite rock the feldspars and ferro-magnesian silicates have been converted to quartz, sericite, calcite, epidote, chlorite, serpentine, and pyrite.

The outstanding feature of auriferous orebodies in andesitic fields is their general irregularity, both in form and tenor. The great persistent fault fissures so often found in older and deeper seated rocks are unknown, or, at any rate, have not served as loci of deposition. There is nothing in any andesitic field comparable, for example, with the Mother Lode fracture of California.

It is, of course, conceivable that strong fault fissures could readily have been formed, but it is improbable that in any active volcanic and solfataric region, such fault fissures would remain open for any length when large quantities of cementing igneous and aqueous matter were being brought to the surface along the assumed line of weakness. The Comstock Lode with a total length of two and a half miles is probably the longest fault-fissure lode of economic importance in the andesitic fields. Normally the fissures of andesitic fields appear to be local tension fractures due sometimes to cooling and sometimes to minor local movements. They are therefore limited both in linear and in vertical extension, falling into the group of 'gash veins' of an old nomenclature. When two or more local series of fractures intersect, the 'stockwerk' so characteristic of many New Zealand and Transylvanian areas results.

Where the veins of the stockwerk are sufficiently close together a great bonanza may result as in the case of the Shotover and Caledonian mines, Thames, New Zealand. The original irregularity of the andesite fissures is greatly accentuated by the selective action of auriferous solutions that replace the fissure walls with ore.

Non-Persistence of Young Deposits

No andesitic field has as yet carried its bonanzas to great depths. By far the deepest is the Comstock where shafts were sunk to 3300 ft., but though ore was found erratically distributed through the lower workings, it was in no wise comparable to the great bonanzas that occurred between the 1000 and 1800-ft. levels. Only a few mines in andesitic regions have carried rich ore below 1000 ft., and the characteristic feature of even these is uncertainty of persistence in depth. For the lack of persistence a definite reason may very often be given, namely, the change along the downward course of the lode from dacite or andesite to the underlying basement rock, or, in rarer cases, to a member of the andesitic differentiation series unfavorable to gold deposition. Often the mere approach to the basement rock connotes impoverishment of lodes. Instances are numerous, for example, in New Zealand (at Coromandel and Thames), in Colorado (at Cripple Creek and Telluride), in Transylvania (at Vulkoj, Korabia, and Nagyag); but there are many lodes that persist in a homogeneous rock, which may be either a member of the andesitic differentiation series or may form a member of the basement complex through which andesites have burst, and that nevertheless, show a marked diminution in value at

comparatively shallow depths, often less than 500 ft. For some of these impoverishments a physical cause may be advanced, namely, approach to the bottom of the fissure of tension: but for others, indeed for the great majority, no such explanation is possible. For example, the Comstock fissure is well defined as far as it has been followed downward. The great Martha Lode fissure (Waihi) persists as strongly as ever below 1000 ft., but whereas above that level the gangue was mainly quartz, below it the matrix is calcite. The Martha Lode appears to have been originally wholly a calcite lode that was attacked by solfataric waters above 1000 ft., silica with accompanying gold almost completely replacing the calcite. Either, then, 1000 ft. below the surface marks the horizon at which solfataric waters become active agents of solution and deposition or, and more probably, the percolating waters had no access to a zone of the lode immediately below the 1000-ft. level. Whether at greater depths they used the lode-fissure as a channel and replaced its calcite gangue, future exploration alone can show. Here, as has so often been the case, the solution of the question of the persistence of ore in depth depends on economic considerations.

Cause of Impoverishment

The impoverishment of the veins of the andesitic goldfields in depth is a feature so universal that a general cause for diminution in value must be sought. I have attempted to show elsewhere that the probable form in which gold travels in solution, in depth at least, is not as the chloride, but as an alkaline auro-sulphide, and that pyrite and other sulphides are not the natural precipitants in depth but that precipitation may be due to a more general cause as cooling of uprising solutions.² Recently Victor Lenher,³ to whose laboratory researches field workers are deeply indebted, has shown that the alkaline sulphide solutions are highly efficient carriers of gold, that pyrite has no effect on their contained gold and that their gold is readily precipitated by acid waters or by exposure to oxidation. Both these agents may reasonably be assumed to operate only near the surface, especially in volcanic regions. Maclaurin found that the waters of the acid lake on White island, New Zealand, contained 5.47% of free hydrochloric acid. Little proof of the existence and wide distribution of acid waters at the earth's surface in solfataric regions is, however, necessary. While the former cause probably operates directly in andesitic regions proper, deposition of gold in the numerous cases in Colorado, Nevada, Transylvania, and elsewhere, in which the gold-quartz veins lie in older sedimentary or plutonic rocks, is more likely to be due to oxidizing waters, the influence of which naturally reaches only a short distance beneath the earth's surface.

Recognition of the irregularity and lack of persist-

ence of auriferous orebodies in andesitic fields is of prime importance to the mining engineer. For such orebodies not a single ton of ore more than has been actually proved may be assumed.

The Granodiorite Deposits

The second group of the classification already outlined includes those goldfields that are apparently genetically connected with granodioritic or closely allied magmas and that occur as a product of their differentiation. This group contains three geographical provinces: Eastern Australia, California-Alaska, and the Urals. For the purpose of the present paper they may also be divided simply into (a) lodes in granodiorite and allied rock and (b) lodes in the sedimentary complex through which the granodiorite is intrusive. The relations of the former are simple. Those of the latter are greatly complicated, from the present point of view, by changes in tenor likely to take place when lodes pass in depth from one member of the complex to another.

The deposits of the eastern Cordillera of Australia are initially dependent on great granodioritic intrusions that have taken place along an axial line of earth folding. Gold-quartz veins may occur in the igneous rock itself or in the sedimentary strata overlying or adjacent. The habitus of the gold deposits in the north is, in the main, in the granitoid rock; while in the south gold-quartz veins are generally found in sedimentary rocks. Important exceptions to both rules occur and are of special value as evidences of the general genetic connection between the gold deposits of the north and the south, respectively. The general age of the plutonic intrusion is probably late Permo-Carboniferous. All adjacent strata of greater age may therefore carry auriferous veins. Charters Towers in north Queensland with a production of nearly £29,000,000 is the most important field in the granitoid rocks. Its igneous complex comprises rocks ranging from gray hornblende granite to tonalite, the latter being the predominant rock. The two principal lodes are the Brilliant and the Day Dawn, which have been worked to depths of 2500 to 2700 ft. On the whole, the ore has shown a gradual though small diminution of tenor in depth. Similar fields are those of Croydon (Queensland), and Wyalong (New South Wales); neither furnish any evidence bearing on the point in question.

Ores in Sedimentary Rocks

Considering the number and great importance of the goldfields of eastern Australia developed in sedimentary rocks the light thrown by them on the general question of persistence of orebodies in depth is singularly little. Certainly some, as Gympie (Queensland) and Ballarat (Victoria), depend for auriferous deposition on the intersection of lodes or quartz veins and graphitic bands in sedimentary strata, a condition which is not necessarily recurrent at depth. Others, including the majority of the important Victorian

²Maclaren, 'Gold,' London, 1908, pp. 38, 78, etc.

³Econ. Geol., Vol. VII, 1912, p. 744.

fields and the Hargraves field in New South Wales, are developed in tension fractures between unlike beds at the crests of anticlines forming the famous 'saddle reefs' of Bendigo and Castlemaine. In these fields saddle reefs are successively met with in depth when sinking on an antichinal axis, so that a condition ensues very different from that met with when considering the filling in depth of a single continuous fissure. But the experience gained on these formations all tends to show that the lower saddles are not nearly so rich or so large as those above. At Bendigo mining operations were carried to 4614 ft. below the surface in the New Chum mine, but it is very probable that, taken as a whole, work on the Bendigo field below 2500 ft. has not been profitable. Certainly the tenor of the ore has decreased in depth.

In the California-Alaska belt of gold lodes which are apparently dependent on granodiorite magmas, the various Mother Lode mines and the Alaska Treadwell group in southeastern Alaska are the most important. The latter are still shallow and are of no help in the present discussion. Many of the Mother Lode mines, especially in Amador county, are nearly 2000 ft. deep and some, as Kennedy (3650 ft.), Gwin. (2650 ft.), and South Eureka (2850 ft.), have reached much greater depths.

The Mother Lode

The Mother Lode is a fissure zone that may be traced from Bridgeport in Mariposa county to near the northern boundary of Eldorado county, a distance of 120 miles. In many places it is a solid lode 100 ft. wide, but often it is merely a shattered zone in which numerous quartz stringers are developed. It is undoubtedly due to major faulting developed along a line parallel with the axis of the Sierras during the uplift of those mountains. The faulting has selected the softest beds (Mariposa slates) of the sediments and has uplifted them for great distances. So far as my three months' examination of the Mother Lode permitted I have not been able to make out any appreciable diminution in tenor in depth. Many mines have certainly 'bottomed' the ore in given fissures at depths less than 2000 ft., but it often happens that two or more parallel lodes occur within the Mariposa slates and that when one becomes barren a hanging wall or foot-wall lode may carry ore to much greater depths. In few auriferous regions is cross-cutting from wall to wall of the lode channel more necessary; in few has less been done than along the Mother Lode. The mines of Angels Camp are often instanced as evidence of the occasional non-persistence of Mother Lode mines in depth, but, assuming for the moment that no ore occurs there in depth, their evidence cannot be admitted against Mother Lode mines. They are, it is true, on the line of the Mother Lode fissure-zone, but, from the Hardenburg mine south of Jackson to near the Rawhide mine south of Tuttletown, the Mother Lode fissure-zone, keeping a straight course, leaves the Mariposa slates, which curve to the west

through the Gwin mine and run parallel for many miles before rejoining the fissure-zone south of Stanislaus river. One of the factors (the presence of carbonaceous slates) that makes Mother Lode mines is therefore lacking at Angels Camp. While, therefore, any given fissure of the Mother Lode series may cease to yield ore in depth it is probable that ore will be found at greater depth in another adjacent member. Finally when broadly considered, the Mother Lode may, with unchanged geological conditions, be expected to carry ore with undiminished tenor to and perhaps beyond the limit of 'depth' set forth in this paper.

No evidence of value is to be derived from a study of the gold veins of the Urals. They are nearly all small and irregular and no deep mining has been done on them.

Reviewing the scanty evidence furnished by the granodioritic group, we find for eastern Australia a gradual though small diminution of the tenor of ore-bodies in depth, while on the Mother Lode all the evidence points toward a general persistence in depth for typical Mother Lode mines. A mining engineer, dealing with the future of these mines, would not, therefore, unless he had evidence of an approaching change in geological conditions, be justified in disregarding all ore except that 'in sight'; some might be expected to occur below the deepest present explorations, and such ore should always be taken into economic consideration.

The Ancient Orebodies

The third group of the classification includes all pre-Cambrian goldfields and comprises the most important now being worked. These lie in two geographical areas, one on the borders of the Indian ocean, ranging from Western Australia through southern India and Egypt to Rhodesia and the Transvaal, and the other along the eastern side of America from eastern Canada through the Appalachian chain and the Guianas to Brazil and Tierra del Fuego. The former is a very well defined group of goldfields that, though geographically widely separated, present so many points of similarity that a geological description of the various rocks and of their internal relations in any given region would serve, with the mere change of place names, for any other region of the group. The members are consequently believed to form a single petrological and metallogenetic province, for which the appellation Erythraean¹ has been suggested.

A typical pre-Cambrian field is that of Kalgoorlie in Western Australia. Its total gold production has been more than forty millions sterling. I have closely studied this field and find that it throws considerable light on the general question of auriferous deposition in pre-Cambrian rocks and on the persistence of ore in depth in those rocks. Briefly, the area is one of ancient schists (mainly calc-schist) through which a quartz-

¹Maclaren, *Trans. Inst. Min. Met.*, Vol. XVI, 1907, p. 15.

dolerite magma with its differentiation products have intruded. The differentiation sequence appears to have been quartz-dolerite (quartz-diabase) followed first by members as basic as peridotite and then by more acid segregations ranging through porphyrite to final albite-porphyry, the last being often intrusive through the quartz-dolerite. Auriferous impregnation followed closely on the intrusion of the albite-porphyry. Rich lodes have been developed only in shear zones in a broad dike of quartz-dolerite, the shear zones being barren when they pass in depth or in linear extension out of the quartz dolerite. Since the shear zones are, when considered over depths of 3000 ft., approximately vertical, and the quartz-dolerite dike which is parallel to the strike of the shear zones dips west at 65°, the shear zones pass in depth out of the dike, the eastern shear zones with their contained lodes reaching barren ground sooner than the western.

Kalgoorlie, therefore, well illustrates an outstanding feature of all goldfields, except indeed some in the Tertiary group, namely, that non-persistence of ore in depth is a function not of depth but of geological structure. In Kalgoorlie three well defined parallel shear zones may be made out. Taken severally and having regard to the depth factor alone, they show (a) non-persistence of ore in depth (Australia East and Lake View-Perseverance lodes), (b) persistence of ore in depth (Great Boulder and Ivanhoe-Horse-Shoe lodes), and (c) a probable enrichment in depth (Ivanhoe West lode).

Depth Alone Misleading

Generalizations based on the depth factor alone when geological conditions are unknown are misleading. T. A. Rickard⁵, for example, has relied on the evidence furnished by the failure in depth of the eastern lodes and an impoverishment in the Ivanhoe mine at 2500 ft. to support a general theory of impoverishment in depth. F. L. Garrison⁶ also quotes the Ivanhoe impoverishment as possible evidence of non-persistence in depth. The Ivanhoe impoverishment does take place, but it is local and is due to the fact that the vertical Ivanhoe lode here passes through a thin albite-porphyry dike dipping west about 65°. The great Boulder lode passed through the same dike with local impoverishment at 2200 ft. When, however, the latter lode was encountered beneath the albite-porphyry dike it proved as rich as in upper levels, and the same result may reasonably be expected in Ivanhoe deeper levels. So far, then, as the evidence furnished by Kalgoorlie goes, it indicates that, so long as its lodes remain in quartz-dolerite, so long will they furnish ore equal in tenor to that found from the 500 to the 2000-ft. levels. The Horse-Shoe-Ivanhoe group of lodes may therefore be expected to carry ore to the 5500-ft. level, provided always that the quartz-dolerite dike persists, does not flatten in dip, and is not thrown

westward in depth by westerly dipping reversed faulting.

Archean strata, from the vicissitudes to which they have been subjected in the course of long geological ages, are normally much folded and distributed, while lode fissures in them are nearly vertical. It is a fundamental axiom in these older deposits that the nature of the lode wall exercises a vital influence on the richness and sometimes on the mineral character of the ore-body. Hence it rarely happens that a great depth is reached before the lode, worked from the outcrop downward, has passed out of the favorable rock. A notable exception is the Champion Reef of the Kolar goldfield, southern India, probably the richest single gold lode ever worked. From 3200 to 3800 ft. ore as rich as any obtained in the upper levels is now being worked and ore may be expected to persist in this fissure as long as it remains in the favorable hornblende-schist.

The greatest goldfield of the world, namely, the Witwatersrand, responsible for 37% of the world's gold production, is a pre-Cambrian goldfield, but the criteria of ordinary pre-Cambrian fields do not apply to it. Its deposits lie in sedimentary quartzites and conglomerates and are undoubtedly decreasing in tenor in depth. Having regard to all the geological conditions surrounding auriferous deposition on this field, it may be assumed that its gold was deposited relatively near the then existing surface and that deposition was due either to cooling on approach to the surface or to admixture with oxidizing waters, which in basin shaped sedimentary areas as those of the Witwatersrand, we know from analogy with artesian areas, may reach to depths of several thousand feet. The surface of most pre-Cambrian goldfields, on the other hand, has been subjected to erosion during a large portion of geological time, and the locus of gold deposition though now comparatively near the surface, was at the period of impregnation many thousands of feet below the then existing surface and beyond the reach of oxidizing waters, perhaps even beyond the influence of thermal changes.

Summary

Where auriferous orebodies have been deposited by the influence of meteoric oxidizing waters or by cooling on approach to the earth's surface, they may reasonably be expected to diminish in tenor with increasing depth and finally to disappear. The deposits to which this generalization appear to apply are those of the Tertiary andesitic group. Even for many of these, non-persistence of ore is more often a function of geological structure than of increase in depth. For all other deposits, and especially for those of the pre-Cambrian group, ore formed in strong well defined fissures may be expected to persist unchanged (apart from local horizontal variations) in 'depth', provided the rock of the lode walls is homogeneous and that the ore-bearing fissure does not pass out of that rock. In all these, therefore, geological structure and not 'depth' is the factor controlling the persistence of ore.

⁵*Mining and Scientific Press*, August 31, p. 264.

⁶*Loc. cit.*, November 30, 1912, p. 701.

tunity afforded them. The sketch (Fig. 3) shows the peculiar conditions found in tanks No. 4 and 5, and the step taken to prevent its recurrence. A crescent-shaped mass of slime and fine sand was banked up on the outer sides of these two tanks, while the opposite sides were fairly clean. Doubtless the current of pulp flowing through had cut across between the central air-lift column and the wall of the tank, leaving a dead area on the opposite side of the column where the pulp was free to settle. In order that the current might be directed straight through these two tanks, branching around both sides of the central columns as it had done in other tanks, the transfer pipe was flanged to the outer sides. This has served its purpose well, as shown by inspections of the tanks after six months service following the change; the tanks being found to be quite free from deposited slime and in no need of cleaning.

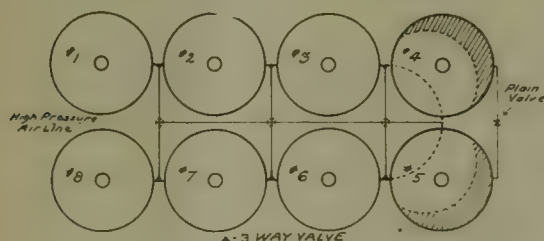


FIG. 3.

After the general overhauling referred to, an additional pipe for air supply, 1 in. diameter, was run down inside of each tank as far as the junction of the cone-bottom and the wall of the tank. At this point a circular ring of pipe was laid around the top of the cone and provided with eight $\frac{3}{8}$ -in. pipe nipples, 12 in. long, spaced at equal intervals around the ring. These pipe nipples were reduced to about $\frac{1}{8}$ in. at the tip, and were pointed downward and parallel to the side of the cone. This ring, or bustle pipe, is blown for two or three minutes on each tank twice every shift, and to this is attributed a part of the freedom from sedimentation during the past six months. There is no other air-pipe entering the tank save the air-lift supply pipe, nor is there any provision made for admitting solution under pressure through the air-lines, as is done in some plants where air-agitation equipment has been installed. High-pressure air may be admitted to the 5-in. discharge line, to which all the tanks are connected in common at the bottom of the cones. This is useful in case that tanks refuse to begin circulation with the use of the air-lift alone, but it is seldom needed. Operation conditions now admit of a much thicker pulp than was possible in the earlier days, and it is of great value as a preventive of sedimentation.

This group of agitators stands upon a combination concrete foundation and platform, with proper drainage launders leading to the sump of an air-lift which

returns any pulp or solution to the boot of the elevators that hoist pulp to the agitators. Such provision has been found to be valuable, and, in fact, indispensable, as the pulp under treatment is frequently subject to foaming. When this condition begins, large quantities of foam, or frothy pulp, are shoved out over the tops of the tanks and gather in the patio below. Ore of this character may suddenly start foaming when the level of the pulp in the tanks is near the top, and thus cause them to foam over excessively. If heavy tonnage-duty is required the pulp-level cannot be lowered, and until this is done the foam will continue to boil over, unless ore from different stopes is received. This foaming is aggravated by high protective alkalinity, but the chief cause for foaming lies in the ore itself; ore containing the largest proportion of slime causes the formation of more foam than quartzose ores. When pulp contains not more than two parts of solution to one of pulp, foaming is diminished, but the specific cause of the foaming is unknown. The solid concrete patio beneath the tanks serves as an emergency pulp-container or as a kind of safety valve, and the air-lift then will return the pulp to the tanks at the first opportunity. When running at or above the rated capacity, it is a common occurrence for a battery of agitators, connected for continuous agitation, to start foaming and sloping over in response to sudden increases in tonnage, or feed from the pulp-storage tank, and thus relieve the condition of the agitation battery. During periods when agitators have been running temporarily at a low level, I have occasionally observed clear foam on the surface of the pulp in the agitators over 50 in. deep.

Classification that will deliver pulp to the agitators for treatment with 80 to 90% passing 200 mesh, and a thickening of the pulp to 2.5 or 2 to 1, will do much to obviate the need of secondary air-equipment for starting up tanks after long periods of quiescence. These tanks call for little attention or adjustments by the solution men, occasional adjustments of the pulp level being almost the sole care required by the tanks themselves. The blowing of the bustle pipes is a part of the general routine, and does not take long—possibly about two and a half hours out of the twenty-four.

Air-compressing equipment for agitator service consists of a Sullivan Machinery Co.'s compressor, single-stage, duplex type, size 16 by 14 in., supplying 30 to 35 lb. air at the rate of 108 cu. ft. piston displacement per minute. Power is supplied to the compressor by an Allis-Chalmers motor of 100 hp., running at 490 r.p.m.; and an air-receiver, 4 by 12 ft., serves the usual purpose. Meter readings at the motor show the power supplied to be 88-90 hp., a rather higher figure than is sometimes quoted for this service. From this figure should be deducted the power consumed by the operation of eight air-lifts in the mill and cyanide plant, all of which are operated by this air-supply and all (save the one in the patio below the agitators) in constant

operation. To prorate the use of power accurately would be a tedious task, as all the air-lifts work under different conditions as to heads, tonnages, and thicknesses of pulp, but they doubtless consume as much power as one extra agitator. Therefore it appears that a fair estimate of the power required for agitation at this altitude, under conditions as described, is 9.7 to 10 electric horse-power per tank. This figure includes all power losses in motor, in compressor, and in transmission of air to tanks.

Local construction having been influenced by ideas and results achieved in the El Oro district, where the climate is mild or even hot, the consequence was that the cyanide plant was only partly enclosed, the agitators being without housing save the deck that covers them on top. Inasmuch as the winters in the Sierra Madre of Sonora occasionally have low temperatures with considerable snow and ice, it is now purposed to enclose the tanks to permit of successful heating of the pulp during agitation in cold weather, for investigations have shown that maintenance of heat in the pulp during treatment will be attended with a profit. Experimental work proved the inertness of the Na_2ZnCN_4 during cold weather, compared with its behavior during the warm months, and showed the necessity of warming the pulp in winter in order to secure the most satisfactory results.

Motor Truck Haulage

By F. L. SIZER

Below is the record of a Pierce-Arrow motor truck, No. 435, in service from June 18, 1913, to February 28, 1914, on the road between Willcox and the Mascot mine, a distance of $16\frac{1}{2}$ miles.

Total miles traveled	6,462
Gallons of gasoline used	2,135
Tons of ore hauled	763.4
Tons of merchandise hauled	170
Cost for labor and materials, per ton.....	\$2.90
Cost per ton per mile	\$0.175

The ore was hauled from the mine to the railroad station at Willcox and the merchandise hauled on return trip to the mine, which is a continuous up-grade, there being a rise of 2200 ft. in the distance of $16\frac{1}{2}$ miles. There was considerable interruption of the haulage on account of bad roads in the rainy season during the summer and also in the winter. The mine is at such an altitude that the ice and snow makes it impossible at times to use even a motor car for two or three days at a time. Taken as a whole, the truck has given satisfaction when the climate and grades are taken into consideration. It is to be noted that there are grades of 23% on the road traveled.

The British Association, a well known society of scientists, will meet in Australia in 1915. It is hoped that Madame Curie will be one of the members of the party.

Mining in Manica, Portuguese East Africa

*The chief mining events in this territory in 1913 were the progress made on the Bragança mine belonging to the Andrada Mines Ltd. and the completion of the dredge for dredging the auriferous alluvials of the river Revue which has been built by the same Company. On the Bragança, another level, the 240-ft., has been opened and two winzes sunk from this to a depth of 100 and 70 ft. respectively with a view to opening another level at about 360 ft. The 120-ft. level has also been driven a considerable distance north. Development of the lode at depth is satisfactory. The output of this mine for the year amounted to 4891 oz. fine gold of which 355 oz. was in concentrate shipped. Preparations for dredging the Revue valley have been pushed ahead with the greatest energy during the past year. In the Inhamucarara valley, a new 1000-hp. electric power-station has been erected containing two hydro-electric units each consisting of a Pelton wheel and generator.

The 3-phase current is generated at 4500, transmitted at 15,000, and reduced to 450 volts for use on the dredge. Twelve kilometres of main line, and two kilometres of low-voltage line were erected. The new plant is connected with the existing Tristao plant of the same Company. The dredge, which was built by the Bucyrus company of the United States is 110 ft. long, carrying 71 buckets, of $7\frac{1}{2}$ cu. ft. capacity each, and designed to dig 25 ft. below water level, with a bank of 20 ft. above and, under favorable conditions, it should be able to handle up to 120,000 cu. yd. per month. Under normal conditions 450 hp. will be required. Regular dredging is now under way. In addition to the Bragança mine, two small properties produced gold regularly during the year, and the Guy Fawkes and four others produced small quantities of gold during various months in 1913. The production of gold considerably increased in 1913 as compared to the two previous years. This increase was due to the opening up of the Bragança mine. The output of gold for the territory was 5699 oz. fine gold.

Fortunately, throughout the year the labor supply has been fair, the health of the white workers has continued good, and that of the natives has been excellent, as in former years. This field continues to maintain itself very free from contagious diseases and no scurvy appears to exist on the field. The work of the geological survey which is being carried out under the direction of Wyndham Dunstan, director of the Imperial Institute, London, was again continued during the dry season of 1913. The region examined including the district of Sena and the greater portion of the Circumscription of Gorongoza. During the year a mineral survey map with explanatory notes and photographs was published in English, in pamphlet form, summarizing the results of the work of the geological survey in 1911 and 1912.

*Abstract from *The Beira Post*.

Progress at Chuquicamata

AN INTERVIEW WITH DANIEL GUGGENHEIM

The head of the A. S. & R. Co. was recently interviewed for the *New York Times*, with the following results:

The London newspapers, in reporting the recent annual meeting of the Exploration Company, quoted its Chairman and Managing Director as referring to the Chuquicamata mine as the greatest copper deposit in the world, and the *Industriale*, an Antofagasta newspaper, told of the plan now in progress for building a model city in the mountain desert, 9500 ft. above sea level. Mr. Guggenheim was asked if the statements thus made were accurate, and he confirmed them. Further details given by him in a matter-of-fact way show that the development is to be not only most extensive, but in several respects unique.

General Situation

The copper district, besides being up in the mountains, is 150 miles from the port of Antofagasta by rail. It is without a natural water supply, and water for mining operations and for the thousands of workmen who will be employed there is to be piped a distance of 40 miles. Although the Company owns rights for more than 30,000 hp. at a moderate distance from Chuquicamata, it has been found more advantageous to build a power plant at Tocopilla, on the coast where 53,000 hp. will be developed by means of an oil steam plant and transmitted 89 miles in the form of electric energy to the mining site in the mountains. This plant is to cost \$3,500,000. The first contract for oil, covering a period of years, will amount to \$10,000,000.

The extent of the deposit, 8000 ft., or more than a mile and a half, makes necessary the construction of railroad tracks in various directions, and this construction, together with electrolytic tanks, is part of the work now in progress. The preparations for the health, comfort, and convenience of the population to be transplanted to the district are thus described in the *Industriale*:

"With an astonishing rapidity, Chuquicamata is taking on the aspect of a great city of the future. The North American company, which is putting in very powerful installation, is busying itself at the same time in arranging all the conveniences possible for the thousands of workmen and employees which it must use in its operation. This is not done even in the very capital of the republic. Chuquicamata, indeed, will be the most healthful city of the country, and the cleanest; in fact, a city where its population has the greatest number of conveniences. The North Americans who will exploit Chuquicamata have undertaken a task which we do not hesitate to applaud. The buildings which are to be constructed for the many who will be employed in the workings of these mines constitute an example for other industrial enterprises. This Company will erect

in the city which is being formed the following buildings among others: A soldiers' barracks, two public schools, a Court House, a telegraph and postal building, a theatre, a hospital, a public quarantine, a Protestant Church, and a Catholic Church, a music hall for workmen, and a public library, and in all of these works large capital will be invested."

The Panama Canal establishment has been drawn on for both industrial and social welfare purposes, arrangements having been made to bring from the Isthmus some of the steam-shovels that have been used in digging the canal and sanitarians having been engaged to combat the same sort of conditions that have been overcome there. Incidentally, the Panama canal is one of the most important factors in making the deposits commercially available, as shipments can be made from Antofagasta, on the west coast of South America, direct to New York or London without going around Cape Horn or around the world. The Panama canal also affords a comparison by which an idea of the magnitude of the work to be done at Chuquicamata may be gauged. The known deposits are estimated by engineers at 200,000,000 tons of ore, to mine which a total yardage of earth must be removed, about 5,000,000 more than were removed in cutting the canal. It is estimated that the amount to be paid in wages to Chilean labor alone in getting out the known ore will reach \$225,000,000.

Discovery and Early Work

Mr. Guggenheim said that the existence of the deposits had been known for a great many years, but that owing to the natural difficulties and the need of large capital they were not regarded as available until recently, when they were bought by A. C. Burrage, who subsequently interested the Guggenheims. The deposits had been passed over time and again, after examination by engineers.

"The ore deposit," said Mr. Guggenheim, "is really a long hill, extending north and south 8000 ft. and the mineralized surface shows an average width of practically 1000 ft. The drillings show conclusively that the deposit is richer in copper at a depth than it is near the surface, and that the mineral is not found in veins, but is thoroughly disseminated through minute fractures in the rock so as to make a uniformly mineralized ore-body. Our engineers on the ground, who have made the drillings, tell us that tremendous as is the amount of ore already thoroughly developed, nevertheless only the minimum is known, and no one can make any calculations as to the maximum quantity of ore which may be extracted from this deposit, or as to the average value of the ore which has not yet been placed in sight, but which is absolutely certain to be developed by future work.

"While the underlying sulphide ores—that is, practically all of the ore below 400 ft. from the surface—can be treated in the customary way by water concentration and direct smelting, no steps are being taken at present to mine or treat any part of this lower sulphide deposit. All of the attention of the Company is being given to mining by steam-shovels the upper sulphate part of the deposit and to treat these sulphates by a simple and inexpensive process. For more than a year a demonstration plant has been working upon these ores, and it has been found from months of continuous operation that 90% of the copper can be extracted from them by means of the sulphuric acid obtained from the ore itself.

"More than 1500 men are working at the millsite and

many more at the coast power plant. The work is being pushed with such energy that the latest information from Chile is that the plant will be ready for operation by March 1, 1915. The plant now being erected has a capacity of 10,000 tons of ore per day, which will produce 120,000,000 lb. of copper per year, and it is expected that the actual production of copper will be begun soon after March 1, 1915, and that it will take a few months to get the plant up to its full capacity. Later an additional 10,000-ton plant will be added, as the coast power plant is more than sufficient to take care of 20,000 tons per day. To erect the second plant probably will take about eighteen months, so that before July 1, 1917, Chuquibambata should be producing at the rate of more than 240,000,000 lb. per year."

The Weidlein Leaching Process

For some time past E. R. Weidlein has been studying the application of leaching processes to the treatment of copper ores, working in the Mellon Research Laboratories of the University of Pittsburgh, under the auspices of the Metals Research Co., which is a subsidiary of the W. B. Thompson interests. Mr. Weidlein has devised a process, for which U. S. patent No. 1,089,096 was issued on March 3, and is now engaged in the construction of a small plant at Wabuska, Nevada, to test the process on a working scale under actual operating conditions. In the patent specifications the process is described as below.

The present invention relates to the recovery of copper in the wet way, from its ores, and is based generally upon the reversible reaction



More specifically, it contemplates a mode of operation which makes the utilization of this reaction of high commercial value, in that in actual practice the copper can be precipitated substantially quantitatively in the metallic form. This substantially complete precipitation is likewise accompanied with the regeneration of twice the amount of sulphuric acid necessary to dissolve out the same quantity of copper precipitated, so that the solution, while it is still hot, and after the copper has been precipitated out, may be used for re-leaching the original body of ore, or for leaching a new batch of ore, as the case may be.

In the preferred practice of the invention, the ore is leached, by percolation, or by agitation with or without the admission of air, with a 3.6% sulphuric acid solution. The free acid content of the copper sulphate solution thus obtained is lowered during the leaching operation to less than 1% of free sulphuric acid. The free acid is thereupon neutralized by adding the calculated amount of calcium carbonate or ordinary limestone, or, in fact, any alkaline substance. If the alkaline substance added is one which forms an insoluble sulphate, as is the case when calcium carbonate

is employed, the precipitated insoluble sulphate is separated by filtration or otherwise removed in any known way.

The copper sulphate solution will be neutral and will contain 1.5% copper, in which condition it is supplied to the absorption tower, of any suitable or convenient type. Sulphur dioxide (for instance, sulphur dioxide contained in smelter fume) will thereupon be pumped into the solution until the desired concentration of (1.5%) sulphur dioxide for the amount of copper in solution is obtained. The solution is then pumped to the precipitation tank or tanks, which may be made of iron, lead-lined throughout, and which are adapted to withstand, with safety, a relatively high pressure. Heat is then applied to the solution, in any suitable way, until a temperature of 150°C. is attained, giving a pressure of 100 lb. per square inch. As soon as these conditions of temperature and pressure are obtained, the pressure is released, the tanks emptied upon a filter, and the hot solution is run back on the ore for re-leaching purposes. The solution is very easily filtered, and the copper remains on the filter in a finely divided form. It may then be conveniently handled by melting and poling, or by compressing it to form anodes.

The typical example given embodies the conditions necessary for completing the reaction for the attainment of the best results. Thus, it has been found that the best results are obtained with 6% solution of $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ (containing 1.5% copper) and under a pressure of about 100 lb. per square inch, at a temperature of about 150°C. It is commercially feasible, however, to increase the strength of the solution up to 3% metallic copper and to obtain a precipitation of approximately three-fourths of the copper.

The treatment of the solution, as it comes from the leaching tank, with an amount of calcium carbonate or other alkaline substance sufficient to neutralize the free acid, together with the conditions of temperature and pressure and of concentration of the sulphur di-

oxide in solution relatively to the concentration of copper in solution in the sulphate liquor, determine the nature of the precipitate which, under these conditions, closely approximates 100% finely divided metallic copper. The quantity of sulphur dioxide passed into the solution is determined by the degree of concentration of the copper, that is to say, the concentration of the sulphur dioxide solution expressed in per cent by weight should not materially exceed the concentration of the copper in solution expressed in the same terms. In this connection, it is to be carefully noted that solutions of copper sulphate stronger than 6% $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ may be, in part, precipitated by sulphur dioxide as metallic copper when the solution is first neutralized by the calcium carbonate or other neutralizing agent employed, but, in such case, the precipitation as metallic copper will not be complete. So also, at higher temperatures and pressures than 150°C . and 100 lb., complete precipitation of the copper in the solution may be obtained, but this precipitate will consist only partly of metallic copper and will contain, in large quantities, oxides, sulphites, and sulphides of copper; although sulphuric acid will nevertheless be regenerated under these conditions in sufficient quantity for re-leaching purposes.

The process is particularly applicable to the extraction of copper from low-grade copper ores, principally the carbonate, oxide, and basic sulphate ores. The sulphur dioxide may conveniently be obtained from smelter fumes, inasmuch as the percentage of sulphur dioxide in such fumes is normally sufficient to saturate a 6% $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ solution. Furthermore, the process finds a special application in connection with sulphide ores, inasmuch as the conversion of the sulphides usually occurring in such ores into the oxide by roasting will yield, in most cases, even more sulphur dioxide than is required for subsequent treatment of the solution. It may, therefore, be said that the process is applicable to all ores or other products containing copper, as, for instance, in addition to those above noted, to roasted matte from which the copper may be efficiently brought into solution by sulphuric acid. It is proposed to leach with the solution as it comes hot from the precipitation tanks, thereby utilizing its maximum leaching efficiency, and making the process continuous in the sense that the leaching solution is utilized over and over again for re-leaching the ore, after the copper has been precipitated each time out of the solution.

In order to maintain a constant volume of solution, the leaching is effected, as hereinbefore indicated, with a 3.6% sulphuric acid solution, assuming a chemical and mechanical loss in the leaching operation of about 25%. The precipitated copper is not contaminated with other metals more electro-positive, such as iron, as they will not be precipitated under the same conditions. The ferric iron present in the solution will use up some of the sulphur dioxide and convert it into sulphuric acid which will be an added advantage

to the process, and, at the same time, the reduced ferrous sulphate in the solution, when agitated with air, is an excellent leaching agent for copper.

It will be noted that the amount of copper precipitated, expressed in percentage by weight, corresponds, within certain limits, to the ratio of the amount of SO_2 employed to the amount of copper contained in the solution. For instance, if the solution contains 1.5% copper and the amount of SO_2 employed is 1.5%, then approximately 100% of the copper present will be precipitated as metallic copper. Or, if the same 1.5% copper solution contains 1% SO_2 , then approximately 66% of the copper present will be precipitated as metallic copper. If the percentage of SO_2 exceeds 1.5%, a complete precipitation of the 1.5% copper solution will be obtained, but will consist more or less of oxides, sulphites, and the like.

It will, of course, be understood that I do not claim broadly the use of sulphur dioxide as a precipitating agent in the treatment of copper sulphate solutions, inasmuch as the general reaction, as hereinbefore indicated, is well known, and its utilization, for commercial purposes, has been heretofore attempted. In every such attempt, however, in so far as I am aware, the precipitation of the copper in the metallic state substantially quantitatively has not even been approximated, and even its precipitation in the form of a mixture consisting largely of oxides and sulphites accompanied sometimes with a relatively small proportion of metallic copper has been incomplete. By the practice of the present invention, on the contrary, practically complete precipitation of all the copper in the solution may be obtained in the metallic form, by observing the conditions of temperature and pressure and of concentration of the sulphur dioxide solution relatively to the concentration of the copper in solution in the sulphate liquor, as hereinbefore specified; and, even with higher concentrations of copper in solution, and at higher temperatures and pressures, the preliminary neutralization of the free acid permits the complete precipitation of the copper partly in the metallic state. So also, with the employment of the preferred conditions of temperature and pressure hereinbefore specified, even though the concentration of the copper in solution may exceed the optimum, a much larger proportion of copper in the metallic form will be precipitated than is obtainable, in so far as I am aware, in the commercial practice of any other process based upon the employment of sulphur dioxide in the reversible reaction quoted.

By the term "substantially quantitatively" as used in the specification and claims is to be understood such a precipitation as will result in a residual leach liquor, which when used as a final wash-water, will leave associated with the spent ore an amount of copper so small that it shall not represent a material loss; that is, a loss whose maximum may be said to be one-fourth of the amount of copper originally present in the ore.

Blasting and Use of Explosives^{*}

1. Powder magazines must be kept dry and well ventilated. Powderman in charge must keep magazine clean and free of litter of papers, sawdust, empty boxes, box covers, etc. All powdermen must observe and obey the special rules and instructions posted in the magazines relative to the storage, handling, thawing, and caring for explosives.

2. Separate magazines are provided. Dynamite and black powder must not be stored or kept in the same magazine. Blasting caps, electric fuses, and exploders must not be stored with dynamite and black powder.

3. Open or exposed lights positively must not be used in or around magazines or fuse and cap houses.

4. Smoking is positively prohibited in or around magazines or fuse house, or in or around the pit or mine workings where explosives are being conveyed or are being used.

5. Employees must not slide or handle roughly or carelessly cases of dynamite or other explosives, either in magazines, in wagon transportation, or in and around the mine workings.

6. Blasters and their helpers and all employees engaged in the handling of explosives must not wear hob-nailed shoes. Shoes with soles studded with hob-nails, or other heavy nails, or with metal toe or heel plates may be a source of danger and must not be worn.

7. The accumulation of an excessive quantity of explosives at or near a hole is prohibited. The necessary supply of powder for one or more bore-holes prepared for loading must not be delivered within 50 ft. of the nearest hole. From this temporary supply, powder must be carried to bore-hole only in such quantity as can be rapidly loaded, so that at no time during the charging of a hole will there be more than 150 or 200 lb. of powder in the immediate vicinity of or at the collar of the hole.

8. Blasters must protect their field supply of explosives. Canvas tarpaulins, asbestos or fireproofed coverings are furnished by the Company and must be used by blasters to protect their supply of powder from dampness and the possible danger of flying sparks and flying rocks and debris from blasts.

9. The use of frozen or chilled explosives is positively prohibited. Blasters must not cut or break a frozen stick or cartridge of dynamite.

10. Iron or steel bars or tools for tamping must not be used. Use only a wooden tamping stick with no metal parts.

11. Packages of explosives must not be opened with a nail-puller, chisel, pick, shovel, or other steel or iron tool. Employees must use hardwood wedge and mallet provided for this purpose.

12. After 'springing' a hole, that is, exploding a

charge to chamber a bore-hole, blasters must wait at least an hour, or until the bore-hole is cool, or has been cooled by a deluge of water, before loading charge to blast.

13. A primer, a cartridge of dynamite with blasting cap and fuse, or an electric fuse attached, must not be forced into a bore-hole.

14. The regulation crew for loading bore-holes shall be and consist of not more than 4 men, the blaster in charge with three helpers. At no time shall there be more than four men allowed at or around a bore-hole when same is being loaded or charged.

15. Employees, other than blaster and his regular helpers, are positively prohibited from approaching closer than 50 ft. of a bore-hole when same is being charged with explosives. Employees or other person or persons violating this rule do so at their own risk.

16. Blasting caps, electric fuses, and miner's or safety fuses with detonators attached must not be carried or conveyed around the pit or mine workings with dynamite or black powder.

17. Blasting caps, electric fuses, and safety fuses with caps attached must not be carried by employees in their pockets.

18. Electric blasting apparatus must be frequently tested, and must not be used unless in good repair, and all leading wires and electric fuse wires, etc., must be in perfect condition. Do not use old, damaged electric fuse or connecting wire.

19. For bank blasting, electric fuses with insulated copper fuse wires less than 30 ft. long must not be used.

20. Safety fuses for use in bull-dozing or top blasting must be prepared in fuse magazine. Blasting caps or detonators must be securely and properly crimped upon the fuse.

21. Safety fuses, cut and prepared in the fuse house for regular blasting operations, must not be less than 24 inches in length.

22. The use of a fuse less than 24 in. long is positively prohibited. Powdermen and blasters must not cut fuses short to save time or for any other purpose.

23. In bull-dozing or dobie blasting, blasters must not light or fire more than 20 charges or shots at one time.

24. In dobie blasting, when a piece or length of safety fuse is used to spit or light a number of charges to be fired, blasters must see to it that the fuse so used has no cap attached. The use of a fuse with blasting cap attached for a 'spitter' is positively prohibited.

25. In firing two or more charges, no two fuses should cross each other.

26. The free end of safety fuse must be slit and turned sideways to expose the powder train or core without spilling out the powder so that the fuse can be readily and quickly lighted.

27. When blasting is to be done after regular shift hours, powdermen and blasters must always wait 10 minutes after dismissing the shift before firing shots.

^{*}From the book of 'Rules and Regulations' of the Nevada Consolidated Copper Company.

The Ching Hsing Coal Basin

By EDWARD DI VILLI

The Ching Hsing coal basin is one of a series of bituminous coal basins in western (Chile) province, north China, at about 114°E and 38°N, skirting the foothills which border the flat flood plain of the Yellow river. To the west are the well known and extensive anthracite deposits of Shansi province, while to the north and south are other coal deposits extending south to N 35° 15' and north 40° 50'. These deposits must not be confused with those worked by the Chinese Engineering & Mining Co., and the Lanchow M. Co., which are near Tongshan, in the same province but northeast of Tientsin.

A competent mining engineer has given the following section through a part of the Ching Hsing coal field:

	Feet.		Feet.
Loess	46	Fine grained basalt....	1½
Argillaceous shale	2	Baked coal	3
Arenaceous shale	2	Marl	3
Argillaceous shale	3	Arenaceous shale	3
Yellow sandstone	3	Dark arenaceous shale ..	3
Compact sandstone	12	White slate	3
Marl	12	Calcareous shale	3
Marl	4	Light indurated clay....	3
Carbonaceous shale	1½	Clay-slate	3
Coal	1½	Coal	28
Arenaceous shale	8	Coal	1½

These last dimensions are in Chinese feet = 1½ English feet.

The Chü Yang Hsien coal field is situated 60 miles north of the Cheng Hsing Hsien coal field. The geolo-

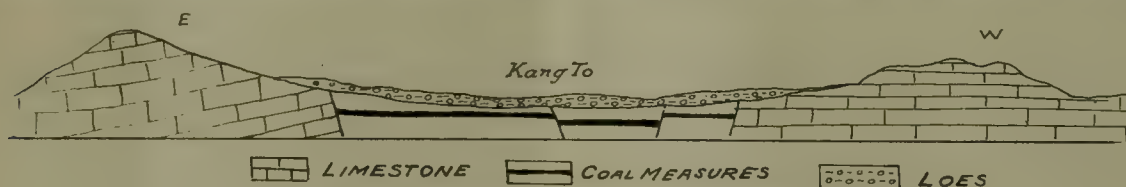


FIG. 1. SUPPOSED CROSS-SECTION AT CHING HSING.

My own observations were made in different workings and the geological section as below:

gical age and mode of occurrence are the same for both fields. The area of the coal fields is about 10 square

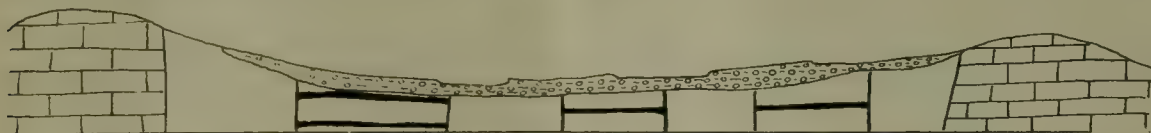


FIG 2. BLOCK FAULTING AT CHING HSING. THE COAL IN THE BLOCK TO THE LEFT IS 120, THAT IN THE MIDDLE IS 160, AND THAT AT THE RIGHT IS 280 FT. BELOW THE SURFACE.

Geology of the Basin

The geological horizon in any direction for several miles is of Carboniferous age and I was able to obtain reliable paleontologic evidence to confirm this opinion. The ground is formed into a series of square plateaus by step-faults, intersecting each other at right angles, and having north-south and east-west trends. The earlier and greater faults run east-west. The later ones are more numerous and have a lesser throw. The result of this system of faulting is that there are certain areas in which it is unprofitable to mine. The depth from the surface to the coal varies from 120 ft., 157 ft., 180 ft., 280 ft., up to 400 ft. That the north-south faults are of recent geological age is shown by the unworn edges of the fault scarps, sometimes as much as 100 ft. high, but more often only 5 or 10 ft. high. The slickensides are not mineralized, but some very pretty crystals have been extracted from the slickensides of the east-west system of faults.

The following log shows the thickness of the strata passed through in sinking a shaft at Hsi Kou:

miles with some smaller detached areas to the north and east. A typical section through the strata is as follows:

	Feet.		Feet.
Loess, clay, sandstone, slate	300	Sandstones and shales..	5
Coal (very poor and stony)	1½	Coal, No. 3.....	10
Slate, sandstone	100	Sandstones and shales..	5
Coal, No. 1.....	4	Coal, No. 4.....	12
Sandstones and shales..	3½	Limestone, sandstones, and shales	
Coal, No. 2.	7	Coal	
		Limestone	

The Chinese work these coal mines in a primitive manner and solely to meet the local demand for pottery making. Shafts have been put down everywhere and abandoned. Flooding is a problem with which they do not care much to grapple. The work seems to go on in a haphazard manner with nobody in command. If you go down a shaft you will be let down in a very dilapidated and dirty basket, and if you are inclined to be at all nervous don't examine the ropes. That can always be done afterward, it provides food for

reflection. No consideration has been given for the comfort and convenience of the coolies. Ventilation is a problem that has ever troubled Chinese mining engineers. Fatal underground explosions are not at all of rare occurrence. In fact, everywhere you will find evidence of the Celestial total disregard for the value of human life. Nevertheless the Chinese always manage to extract handsome profits from their mining ventures. With their primitive methods they have carried out some truly wonderful work. Eliminate the 'hanger-on' system and I would sooner work with the Chinese than with any other man on earth.

Concreting the Junction Shaft of the Calumet & Arizona

*This is one of the main shafts of the Superior & Pittsburg portion of this property at Warren, Cochise county, Arizona. It is a splendid piece of work and was finally finished February 8, when the putting in of the guides and cleaning of shaft was completed. The work was commenced December 2, 1912, and the actual working time on the job was 295 days. The shaft has five compartments, 6 by 27¼ ft., and is concreted to the bottom, a depth of 1535 ft. below surface, the first forms being placed in position there, and work being upward from this point. Concrete was sent down the shaft by a 4-in. pipe, the material being delivered to an iron bucket in which was a bottom of wood, and leading from which was a distributing pipe which could be directed to any point in the forms desired to be filled. This method worked without any hitch and progress was rapid. When the 1535 ft. was completed, work was started at the bottom of the shaft, on the 1800-ft. level, and brought up to connect with the concrete above. All divisions in the shaft were concreted, and the pump stations at the 1000 and 1500-ft. levels were made fire proof by putting in concrete floors and plastering the walls. There was 6530 sq. ft. of flooring in the 1000-ft. station. Guides in the shaft were bolted to the walls, holes being drilled through the concrete and timbers.

The concrete walls of this shaft are from 8 to over 24 in. thick. In places where there were openings behind the shaft that were not too large they were completely filled with the concrete. There were no bearers put in the shaft, as these wall inequalities when filled with the concrete made them unnecessary. It was found that it was about as cheap to fill the moderate-sized openings back of the shaft with concrete as with waste, the cost of the concrete poured being about \$4.50 per yard. In places where openings were particularly large, waste rock was used. Through the central portion of the shaft is a weak piece of ground, an old water course filled with water-worn boulders and where trouble could be looked for if it came in any portion of the shaft. Extra precautions were observed here in making the shaft as strong as possible. The

shaft is a fine one, not a half inch out of line for its entire length, and cages go through it smoothly.

The cost of concreting this shaft was about \$200,000 the top 1535 ft. requiring an expenditure of \$164,701. The cost of wooden forms was \$5160; cost of the pipe through which the concrete was fed, \$1443; and storage bins, \$7500. The work also included the concreting of the ore-pocket at the 1400-ft. level. There was a complete plant at the mouth of the shaft for crushing, mixing, and handling the materials. The limestone with which the cement was mixed came from the Company's quarry near by. The sand was obtained at Fairbanks. All of this, with the storage bins, etc., has been removed and there is nothing about to indicate that such an important job was done. Eight men were employed per shift, three shifts worked per day and for seven days in the week.

Determination of Sulphur in Pyrite

A new method for the determination of sulphur in pyrite has been described by Ernest Martin in *Mon. Sci.*, and an abstract is given in *Chemical Abstracts*. The method is as follows:

Treat ½ gm. of finely ground pyrite in a 150-c.c. flask with 25 c.c. aqua regia (equal parts HCl and HNO₃) prepared a few minutes in advance. Allow to act several hours (preferably over night) in the cold, add about 1 gm. NaCl, evaporate almost to dryness on a sand bath, take up with 2 c.c. HCl and sufficient water, then add 50 c.c. boiling water and little by little 4 gm. Na₂CO₃. The precipitate is not bulky and does not retain sulphates when washed with boiling water. To the filtrate add two drops methyl orange (0.1%) and neutralize exactly (rose tint) with HCl. Boil off CO₂, add 60 c.c. of Ba(OH)₂ (45 gm. per litre) and a drop of phenolphthalein. Pass CO₂ (carefully washed), stopping the flow of gas the moment the rose color just disappears. Filter, wash with hot but not boiling water, cool, and titrate with 0.5 NHCl to a rose color. Multiply the c.c. HCl used by 0.008 to find the S in the sample, or by 1.6 to find the percentage. To determine S in burned pyrite, weigh out 3 gm. and proceed as before, but use 8 gm. NaCO₃ and 25 c.c. Ba(OH)₂. To determine Pb, Cu, and Zn in pyrite, mix 3 gm. in a porcelain crucible with 2 gm. S and 8 gm. KNaCO₃, cover with a little Na₂CO₃, put the lid on the crucible and fuse for 15 minutes. Extract the cooled mass with 300 to 400 c.c. of hot water, add 20 c.c. HCl (22°B.), allow to digest several hours, remove, and wash the crucible. Add 25 gm. crystals sodium acetate, allow to settle, filter, and wash with H₂S-water containing sodium acetate. Separate the ZnS by dissolving in HCl, precipitate as ZnS and weigh as ZnO. Burn the filter + CuS + PbS in a porcelain crucible, dissolve in HNO₃ and electrolyze, or, if preferred, separate the Pb as PbSO₄.

Bank clearings in the United Kingdom in 1913 totaled \$79,987,760,065.

*Abstract of an article by George A. Newett in *Iron Ore*.

Discussion

Readers of the MINING AND SCIENTIFIC PRESS are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment. Insertion of any contribution is determined by its probable interest to the readers of this journal.

Some Unwritten Cyanide History

The Editor:

Sir—Decision of the suit for infringement by the Tonopah Mining Co. of the Brown patents removes one threat of pestiferous litigation from the field of metallurgy. It also recalls a bit of history which may interest others. In the years 1900 to 1903 I was associated with mining companies in Colorado, with some of which Alden H. Brown, the patentee in the suit concerned, was also connected. Mr. Brown is a graduate of the State University of Iowa. After service in the engineering corps of the Burlington, Cedar Rapids & Northern railway, he came to Boulder county, Colorado, about 1898, and, in connection with J. C. Beeler, a prominent contractor and quarryman at Cedar Rapids, Iowa, purchased, worked, and shortly sold at a good profit, the Longfellow mine. Later he took the management of the Wano Mining & Milling Co., which owned a property near Jamestown, also in Boulder county. The ore contained gold, partly in the form of tellurides and partly finely divided and intimately associated with metallic sulphides. One of the officers of the Wano company was James G. Berryhill, of Des Moines, now vice-president of the Nevada Douglas Copper Co. Mr. Berryhill was at the same time the principal stockholder in companies operating at Idaho Springs and Cripple Creek, upon whose staffs I was then serving. Mr. Berryhill learned in Chicago of the work done at Mystic, South Dakota, by Frederick H. Long, and visited the plant. Being impressed with the results Mr. Long was obtaining in the treatment of the so-called 'blue ores' of the Black Hills, he sent me to make preliminary tests and investigate the process. This was in the summer of 1901. It will be remembered that this was when cyanidation had progressed only to the point of leaching relatively coarse sand and when chlorination was still the dominant process at Cripple Creek. Mr. Long, however, was grinding his ore fine, 'all-sliming' we have since learned to call it, was agitating his solutions with an air jet much as is now done with a Pachuca vat, except that the apparatus was smaller and the circulation was down through the vat and up through an outside pipe, and he had developed a filter, which depended upon a water pressure to wash the cake and which filtered excellently though it was out of commission for hours afterward while the cake was being removed by hand. Mr. Long was attempting to treat ore by chlorination, developing the chlorine by electrolysis in the solution while it was being circulated

in a closed apparatus not greatly unlike the agitator already described. Incidentally, cyanide was added to the solution, but the main reliance was upon the chlorine.

Preliminary tests being favorable, arrangements were made for a thorough trial, running upon ore from the Wano and from the Hull City or Independence Consolidated at Cripple Creek. Samuel Newhouse and Messrs. W. P. Dunham and Eben Smith joined in having the tests made. A. J. Bettles represented Mr. Newhouse, W. C. Oates came from Philip Argall's staff to represent Dunham and Smith, Mr. Brown looked after the interest of the Wano company, and I represented Mr. Berryhill. With the enthusiasm of youth and lacking somewhat the experience of years, I recommended a large-scale test. In the consultation of the principles at Denver this grew until several carloads of Cripple Creek ore were shipped to Mystic, as well as one car from the Wano. Mr. Brown and I went ahead to organize the staff for the mill test, he acting as assayer. When the ore arrived, a car was unloaded and work began. The first difficulty involved was the fine grinding of so large a quantity. It was before tube-mills had penetrated beyond cement manufacture and the apparatus used was a Kent mill. It did the work, but at large cost for repairs. Eventually the Wano ore was pulverized, and, the others having arrived, a test was run. It resulted in an extraction of 65 in place of the expected 90%. A subsequent test on the Cripple Creek ore gave about the same result. After the first trial the use of salt and the electric current was discontinued, and straight cyanidation was done. While it was found impossible to raise the extraction, surprisingly quick results were obtained. My recollection is that on the Wano ore as much gold went into solution with sliming and air agitation in 15 minutes, as Mr. Brown had been able previously to dissolve in five days' leaching. This fact and the filter impressed all of us, but the main result claimed, decomposition of the tellurides, having failed to materialize, further work was abandoned. I recall that in studying the tailing from one of the tests, Mr. Brown suggested that the coarse gold and that associated with the sulphides could be saved by simple concentration following cyanidation. Doubtless this was the germ of the idea that he later worked out in practice at Jamestown and patented. The patents, passing into other hands, became the basis of the speculative lawsuit just decided.

The little group that worked together those pleasant summer days is widely scattered. Bettles is dead and his great mill at Bingham has been rebuilt; Oates has gone, I know not where; Brown turned his attention to Cuban iron ores and has done well; Long is in Chicago, and, I believe, applied his filter to other uses; and I now work with pen and paper in place of sampling cloth and notebook. It was a congenial circle and the work itself most interesting. Not far away, C. W. Merrill was then working on the slime press

be later perfected. Still nearer, J. V. N. Dorr was perfecting the Moore filter and developing the other processes and devices that are now being so widely adopted. At Mystic, with the value of all sliming demonstrated, with air agitation in use, and with a workable if imperfect pressure filter, we let slip the chance to make the Black Hills notable for other of the more important inventions that through cyanidation have let loose on the world a flood of gold.

H. FOSTER BAIN.

San Francisco, March 25.

Prospecting and Government Aid

The Editor:

Sir—I had some experience in British Columbia last winter which I think should interest those who have been discussing how the Government can help the prospector and mining companies.

I was working for the British Columbia Copper Co. in connection with a big diamond-drill job near Princeton. Charles Camsell was district geologist of the Canadian Geological Survey. He had been there and written a paper based on the work done there several years previous. With the accumulating data that the British Columbia company was gathering, he was enabled to correct and modify original ideas. He made frequent trips to the camp to keep in touch with new data. He did not bring a staff with him, but came alone. Before leaving, he would express opinions and give ideas and then write them up at headquarters. He made the rounds of all the mining properties in his district with some regularity, and was familiar with geological conditions prevailing in that region because he visited so many properties. Most of them were prospects. It must be remembered that we were developing by drill-holes mainly, and that the mines had never made any shipments, and that there was no assurance that there ever would be any at that time. The fact that the Company was spending a large sum every month in that district made the Canadian Geological Survey feel that they should give us the benefit of a geological expert who would do all he could to guide us. This meant that he frequently expressed an opinion instead of a demonstrated generality, and you could take it as an opinion or leave it. I think these reports on that whole district were as practical and helpful as any geological studies could be. They were intended to bear directly on our problem. They were not expensive. There were no elaborate preliminary topographical maps.

The points that impressed me were: (1) that by constantly making the rounds of one district, the district geologist becomes more familiar with the conditions in his territory; (2) that examinations were frequent; (3) that they were inexpensive; (4) that almost any prospector could get information from a well qualified government geologist by doing work on his ground; (5) that the geologist in his examination, and also in his reports, would take the chance of drawing a con-

clusion like any other mining engineer has to do, and not confining his report to what is already known; (6) that these papers appeared in print promptly.

I examined one prospect owned by two men who worked on it conscientiously. They had a good road built part way and a trail the balance of the way. The Government had built that road the previous year. They applied to the road supervisor for a road. He actually looked over their ground to see that it was not a fraud. Being satisfied, he spent \$200 that year on a road to a prospect that had not shipped a pound of ore. The Government must have spent at least \$20,000 on the road from Princeton to the British Columbia company's drilling ground before the tonnage was developed and, therefore, at a time when help was most needed.

Now it has been my experience that as far as metal mines are concerned, our United States Geological Survey does not come into the district until its reputation has been established, which is when you need it least. Like most American mining engineers, I am proud of our Geological Survey and the splendid personnel, but I do wish they would get in the same touch with us that they did in Canada. I am beginning to believe that our Survey would do better in covering more ground and by not going into such minute details about matters that are inconsequential, and going over the ground oftener. I recently made an examination in the Eureka, Nevada, district. The Geological Survey reports are classics that date back to Clarence King in the early eighties. Since then a great deal of work has been done, and these old reports are not now worth much. They go into great detail about fossils and correlation of strata. If the geological work had been confined solely to economic considerations and geologists had been going in there at regular intervals, the whole job would not have cost any more and there would be some modern ideas on the files. There is no use making a most detailed academic report on a camp at a time when it is booming and everybody has plenty of ore and then leaving the poor thing neglected for 30 years. Eureka is by no means a 'dead one.' A few kind words from the Survey today, based on a comparatively inexpensive examination of present conditions, might do more good than all the reports made 30 years ago.

I should like to see the district geologist in our Western states making his rounds continually and reporting annually on the geological progress and laying stress on published ideas that have been disproved or new theories that the companies are trying out. Such a district geologist would not need to be a first-class man. Through association with the managers in his district he would get into much closer touch with the needs of his district, and might get to that stage after a while where he could make a report without telling how many millimetres in length are the various feldspar crystals. Occasionally the enormous appetite of the Survey for this sort of stuff could be

satisfied by sending in a 'regular' geologist.

There are many obscure camps which could be made successful by the solution of some geological problem, but the operators do not know enough about geology to even know their own needs or recognize the solubility of their own problem. The Survey will overlook that camp until it has a reputation, which might never be. The district geologist, acting as a scout, would not overlook it and would bring it to the attention of his superiors, with the possible development of a new camp. When a camp is prosperous the Survey comes in with both feet, but when a camp is on the wane and ore is getting scarce, and we need the geological data like a sick man needs a doctor, that is just the time they 'shake' us and leave us high and dry with data that are ancient history. I have made examinations in several camps which the Survey had not visited for the last eight years and which were by no means decadent.

I think the Survey will work in closer touch with us as time goes on, and the point I want to make is that I think we can learn something from Canada in this respect, though I do not like to admit it.

F. SOMMER SCHMIDT.

Salt Lake City, March 9.

Prospecting and Leasing

The Editor:

Sir—I have read with interest the discussion relative to prospecting, and am glad to note the consensus of opinion regarding the ways in which prospecting may be aided and the unanimity of opinion against any direct government aid. There is one point which it seems to me has not been brought out as clearly and emphatically as it warrants. The greatest handicap to prospecting is that under the present laws the prospector is virtually confined to the unexplored regions, and these are no longer where they used to be.

For as soon as a find of any consequence is made, the world rushes in and patents all ground in the whole region, forcing the prospector back into the wilderness, where a find to be worth attention must be of exceptional value. While it is true that some of these claims are dropped after the collapse of the boom, it is done gradually and it is difficult for the man in the field to discover what is open and what is held. If claims were leased instead of being patented, and reverted to the Government when the holder ceased to take further interest in it, the prospector could always know in the field the ground upon which he could pursue his calling, and this he would still be able to do close to transportation, in many cases even in the midst of a producing district, where capital would be most willing to support his efforts and where anything found would have a value. Under such conditions there would also be less likelihood of camps being abandoned while yet there was much undiscovered mineral in them.

R. W. BROCK.

Ottawa, Canada, February 9.

Ore

The Editor:

Sir—Ore is metal-bearing rock; no more and no less. I find an outcrop of ore; by hard work and living on straight beans and jackrabbit, I manage to make expenses or a little more. Along comes T. A. Rickard, and I take a liking to him at once; we go into partnership.

Mr. Rickard by adding tomatoes and canned salmon to our bill of fare, at once turns my ore into waste, and we have our first squabble. By cutting down expenses and working harder, we manage to break exactly even at the month end, and I take a day off washing clothes in the wheelbarrow, while my partner fossicks around for a new word.

We keep digging, put up a whim, and hire a few miners; my partner doing the assorting, which he does into four piles: (1) ore, (2) probable ore, (3) possible ore, and (4) waste. I entreat him to call the hole a mine, as we have to use candles, and the windlass days are over. He insists that it is still a prospect, and we call on the cook as judge. He tells us that if we will both casually fall down the hole, he will be able to form an opinion: that if we break our necks it is a mine, if not then it is only a prospect. Things rock along in this way for some time, when my partner, after balancing up the books, comes over to the boarding house and addresses us in this way: "I am sorry men, but you are not miners at all, you are all 'muckers'; I find that the 'ahem' is not paying expenses." Then one of us quietly closes the door and we surround him and we all talk at once. We tell him that a mine is an excavation where ore is extracted; that the other fellow's hole may or may not be, but one's own is a mine every time; that a definition or a word, to have place in our language, must stand the test both of time and place; that we do not use 'Gadzooks' today, nor will we use 'piffle' tomorrow; that ore is ore just as sure as eggs is eggs and it makes no difference if the rancher who raises them does go broke at it. Mr. Rickard admits his mistake (there were 12 of us), and to play safe I will not sign my name.

Nacozari, February 9.

VENTURESOME.

New topographic maps, 16½ by 20 in., recently published by the U. S. Geological Survey, are as follows: Holt quadrangle, San Joaquin county, California; Marysville, Butte, and vicinity, embracing parts of Butte, Colusa, and Sutter counties, California; Red Mesa, in La Plata county, Colorado; Slug creek, embracing parts of Bannock and Bear Lake counties, Idaho; Stockton, San Joaquin county, California; and Woodland island, including parts of Contra Costa and San Joaquin counties, California. The price is 10c. each, or \$3 for 50.

Fifty tons of metallic tin was produced in the United States in 1913. This came from three places in Alaska, one in South Dakota, and one in South Carolina.

Concentrates

Most of those are in reply to questions received by mail. Our readers are invited to ask questions and give information dealing with the practice of mining, milling, and smelting.

The foundry of the Mysore mine, India, produced 395 tons of castings in 1913.

St. Louis is now building a filtration plant to handle 160,000,000 gal. of water per day. When completed it will be the largest rapid sand filter in the world.

Mule traction is being used on No. 10 level of the Tonopah Belmont mine. The animal hauls three cars of 1900 lb. each trip, and lessens tramming costs.

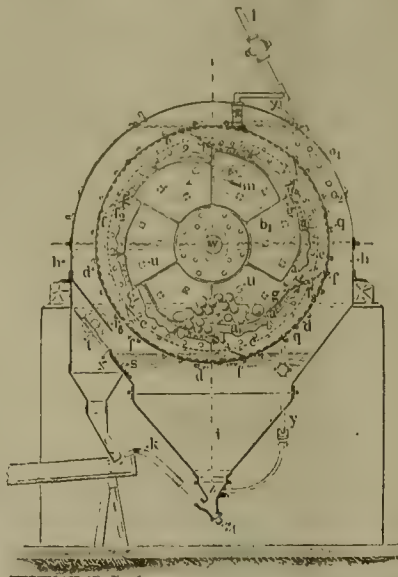
Consumption of chemicals at the Nundydroog cyanide plant, India, during 1913, was as follows: cyanide, 0.557; zinc, 0.075; caustic soda, 0.180; and lime, 0.542 lb. per ton.

Flotation at the Lloyd copper mine, New South Wales, is doing good work. Before treatment the tailing averages 1.3%, and the residue 0.25% copper, a recovery of about 81 per cent.

Transporting wire rope to inaccessible points is often necessary. In the state of Puebla a track cable weighing 29,000 lb. was carried to a mountain top in connecting coils of about 100 lb. each, by an army of peons. When mules are employed about 220 lb. weight is allowed to each mule.

Crushing equipment for a simple gold ore may not extend beyond rock breakers and stamps; but the best results from leaching practice are generally obtained when a large percentage of the sand passes 60-mesh screens. There are, of course, instances where a coarsely crushed product can be leached with economic success; but such cases are exceptional and comprise instances where the ore is usually porous. With a normally hard ore, comparatively fine crushing is essential to success, and the stamp-mill is not altogether suitable for the purpose. The practice of following stamp-mill crushing with regrinding in tube-mills is generally adopted as an alternative scheme. A tube-mill is, however, essentially a sliming machine, and two disadvantages accrue from its use in this connection. Amalgamation after tube-milling does not recover the percentage of gold obtainable after single crushing by stamps, and more slime is made than by the alternative method of reduction. Increase in slime production often means an increase in cost of treatment in excess of the increased recovery. Power consumption, especially where coarse mine rock is used in the tubes, and where comparatively large tonnages of chippings and gravel from the 'pebbles' have to be ground to the same mesh as the final product to be cyanided, is out of all proportion to the work done. On the other hand,

fine crushing in a stamp-mill, that is beyond 30-mesh screens, involves insurmountable difficulties in screening and discharge. The latter operation can be only partly successful and is unsatisfactory when fine screens are used. Besides, there is constant trouble due to impact of coarse rock and jar on the fine mesh wire which results in frequent breakages of the screens and consequent loss of time. As a suggestion toward obviating these disadvantages, in single crushing to beyond 30 mesh, the use of the wet-crushing ball-mill may be mentioned. In the latter case, the screens, of what-



SECTION OF A KRUPP WET BALL-MILL. PARTS AS FOLLOWS:

- | | |
|--|--|
| a Perforated grinding plates | k Discharge nozzle |
| a ₁ Flange bolts | l Supply pipe for fresh water |
| b Side liners on the feed side | o, o ₁ , o ₂ Roses |
| b ₁ Side liners, rear side | p Stopcocks |
| u Side plate bolts | s Slide |
| c Inner coarse screen | r ₀ Slide-racking gear |
| c ₁ Inner screen bolts | t Hand wheel for slide-rack- |
| d Fine screen (frame with wire | ing gear |
| cloth) | m Manhole |
| q Bolts for screen frame | w Main shaft |
| f Return scoops | x Overflow for slime |
| f ₁ Return screen | y Supply pipe for ascending |
| f ₂ Bracket for coarse screen | water |
| h Sheet iron casing | z Discharge box |
| i Spitzkasten | z ₁ Plug |

ever mesh, are kept free and clean by a constant reverse spray of water through the screening and into the mill. The fact that the screening is, in addition, constantly passing through a water-bath is also an advantage. There is no danger of breakage of the screens except as the result of direct wear, and even the latter is minimized. The ground pulp is screened automatically through coarse punched screening before going to the fine screens, the oversize being returned to the centre of the mill for regrinding. Hence only fine material comes into contact with the fine screens. An additional advantage also results with regard to amalgamation, and lies in the fact that the classifying action of the mill allows of the immediate discharge of the amalgamable gold as soon as it can pass the outer screening. Unnecessary 'hammering' is therefore avoided, and a higher amalgamation efficiency obtained.

Special Correspondence

JOPLIN, MISSOURI

GRANBY MINING & SMELTING CO. STARTS SECOND FIFTY-YEAR LAP.—PREPARE TO FIGHT HEAVY WATER IN SHEET-ORE DISTRICT.—ZINC AND LEAD NOTES.

The oldest mining company in the Missouri-Kansas-Oklahoma district is the Granby Mining & Smelting Co., which has just completed a corporate existence of 50 years. The Company began work when only galena was mined commercially, zinc ore, known as 'jack,' being discarded as worthless. At a meeting of directors of the Company in St. Louis, holders of 19,684 out of a capital stock of 20,000 shares voted unanimously authorizing the officers to continue the life of the Company. Five directors of the Company were elected as follows: Norris B. Gregg, J. H. Grover, H. O. Edmonds, Kennett Burns, and Elias S. Gatch. The Company's first mining was at Granby, Missouri, where several hundred acres had been purchased. A small lead smelter was operated there before the war. During the Civil War the rival armies alternated in the possession of the lead smelter. Today the Granby company has nearly 30,000 acres, much of which has been proved to be mineralized. A lead smelter is operated at Granby, and a zinc smelter of 3760 retorts at Neodesha, Kansas. A new zinc smelter of 3240 retorts will be completed at East St. Louis this year. In addition to operating its smelters and several large mines, the Company also does a leasing business, and scores of producing mines are operated on its various tracts.

An electrically belt-driven pump, of centrifugal design, with a capacity of 1500 gal. per minute, has been installed as an emergency pump at the North Webb City, Missouri, central pumping plant, which drains the bulk of water from that field. Expectation of heavy spring rains caused operators to make the addition. The North Webb City plant is the largest ever operated in that field. At the present time three pumps are kept going continuously, throwing 1800 gal. per minute. These consist of two centrifugals and one steam pump. There is also an extra 5-in. steam pump for emergency. Water is lowered to 210 ft., above which level all the mining is done. The ore carries from 1 to 3% blende and galena, the former predominating. Operators of the various mines affected by the pumping contribute toward its upkeep.

Homer Sewall, representing Ohio capitalists, paid \$35,000 for first lease on 120 acres of the Sheridan-Adams Royalty Syndicate property at Thoms Station, the lease being held by the Coats & Ort Mining Co. Two concentrating plants are in operation on the property, one, the Coats & Ort mill, having recently made an unusually good showing. The other is the Vinegar Hill mill, operated by the Hardy Mining Co. This has been a steady producer for more than a year. Prior to about a month ago, the ore at the Coats & Ort mine was low grade. Operations were extended to deeper ground, the result being an improvement in the concentrate, which now runs close to 60% metallic zinc.

Deeper work is being done at the Little Mary mine, operated by T. F. Lennan and associates, northwest of the Neck City, Missouri, camp. The ground is so soft that timbers have to be set almost touching each other and spiling has to be driven ahead of the heading; but the richness of the orebody coupled with the high grade of the cleaned concentrate makes this soft-ground mining attractive. The Little Mary ranks as one of the longest lived producers of the north part of the district. Operators have faced several handicaps, such as caving ground. At one time the ground caved in beneath a creek that flows across a portion of

the lease and the mine was flooded. Months of steady pumping were required to drain the ground, while a new channel had to be dug for the creek. The new work is being conducted from a shaft, just completed, which was sunk to a depth of 165 ft., northwest of the mill. Driving is being carried into virgin ground.

Three prospect churn-drills are at work in section 12, Newton county, Missouri, by the Granby Mining & Smelting Co. At a depth of 200 ft., 30 ft. of ore has been cut in several drill-holes. The clippings indicate a mill recovery of 4 to 5% blende. The prospecting is in virgin territory, although shallow mining has been carried on nearby.

DEADWOOD, SOUTH DAKOTA

REOPENING THE ORO HONDO BY COLORADO PEOPLE.—DEVELOPMENT OF THE HEIDELBERG GROUP.—DAKOTA CONTINENTAL AND MINNESOTA MINES.—SCHOOL OF MINES.

What is regarded as one of the most important and significant mining transactions in this section in several years is the opening of the Oro Hondo by J. T. Milliken, president of the Golden Cycle Mining Co., of Cripple Creek. Mr. Milliken states that he is furnishing all of the funds himself; has no partners or associates in the enterprise other than advisers and engineers. Oro Hondo is a Spanish phrase which may be literally interpreted to mean 'deep ore.' Developments indicate that the name is 'apt and pat.' At a depth of 1000 ft., about 1500 ft. of cross-cutting failed to reveal any profitable orebodies, although the workings are believed to be directly on the strike of the Homestake ore deposits. The shaft is 2640 ft. from the Ellison, the main shaft of the Homestake, and the most southerly on that Company's property. It is stated that the ore-shoots opened on the lower levels of the Ellison are pitching rather steeply to the south and east, and that in order to cut the ore the Oro Hondo shaft must be sunk to deeper levels. Mr. Milliken intends to do this, and has announced that the shaft will be quickly sunk to the 2000-ft. point. The boilers have been fired and two skips of 600 gal. capacity each are in operation removing the water which stood within 50 ft. of the collar. As the mine makes but little water, it is expected that the workings will be drained by the end of this month. Sinking will be undertaken with a full equipment of Ingersoll-Rand jackhammer drills. A boarding house at Pluma, one mile from the shaft, has been rented and equipped for 25 men. E. J. Carr is superintendent.

Fifty business men of Deadwood each pledged themselves, by signing notes, to pay \$100 each to a fund to be used in the development of the Heidelberg group, on Two Bit creek, three miles east of the city. This was a concrete result of work by the mines and mining committee of the Deadwood Business Club, in an attempt to promote the mining interests of this area. The agreement with the owners provided that in return for this \$5000, which was to be expended in exploitation of the ground, the subscribers were to receive a one-half interest in the property. Under the arrangement as perfected, the details of which need not be given here, the first payment of the subscribers was made on August 23, and on that date work was started on the construction of a wagon-road to the camp. Nearly two miles of road was constructed, a part of it heavy work, but which gives a maximum grade of 3% from the mine to the top of the Two Bit divide. This road cost \$750, and the commissioners of Lawrence county appropriated \$250 of the amount. Bunkhouse, blacksmith-shop, assay office, small barn, kitchen, etc., have been built, and within the past couple of months some energetic work has been done underground. The formation is shale of the upper Cambrian, with sills and sheets of rhyolitic porphyry, and through which an 'ore vertical' has been followed for a distance of 160 ft., with the end not in sight and the face still

in ore. The vertical vein, which cleanly cuts the horizontal shales, has a course of north 25° east, and has a width of about one foot. On contact with strata of sand shale this vein is from 3 to 10 ft. wide; this has been removed as the incline adit has been driven. Of the ore taken out, 35 tons, in two shipments, has been sent to the Golden Reward cyanide mill at Deadwood. This assayed \$16 and \$20 per ton in gold, as received at the plant. Several thousand tons of \$3 to \$6 material, which would pay well to cyanide in a mill on the ground, has been piled on the dump. Tub tests of the ore, made at the Golden Reward mill, show an extraction of 91 and 93% on material crushed to 25 mesh and treated without classification or agitation. As the last payment is not due until May 23, considerable in the way of development, it is anticipated, will be done in the meanwhile. The property consists of 185 acres, including several good sites for a gravity mill, with excellent tailing dump and plenty of water. A part of the ground is covered by a heavy growth of yellow pine. A. T. Roos is superintendent and an owner in the property. He located it eight years ago and found the ore three years since.

In the first 17 days of sinking at the Dakota Continental Copper shaft, 17 ft. of depth was made. This is considered good work, as the jackhammer drills which are being used were new to nearly the entire crew. Better headway is anticipated in the future, and it is hoped to have the shaft 1000 ft. deep (it is now 830 ft.) in a comparatively short time.

At a recent general meeting of the Deadwood Business Men's Club, C. C. O'Harra, president of the 'South Dakota School of Mines, suggested that effort be made to induce the state legislature to make such provision and appropriation as would permit the school to make ore assays for gold for 25 cents. His opinion was that at such a price the school would be enabled to help the prospectors and others of limited means to get reliable assays for a modest sum that would about cover the actual cost of the materials employed. The suggestion was heartily received by the gathering, and it is quite probable that the Club will authorize a strong lobby to go before the next session of the state's lawmakers. Among other matters, Mr. O'Harra touched on the interests of the school, and mentioned that it was rapidly growing both in enrollment and course of study. Many of its graduates hold responsible positions, not only in this state, but are fairly well scattered through the mining districts of the world. It is an educational institution of college rank.

The Minnesota property, at Maitland, was recently examined by E. J. Collins on behalf of Michigan and Minnesota people, and since his return home, and pending his final decision, the workings have been kept pumped. A favorable report will make the immediate resumption of operations. The Minnesota has been idle for several years, but it is the general belief that the remedy for all its ills lies in sufficient money to equip and develop it in miner-like manner.

BULAWAYO, RHODESIA

BRIGHTER MINING PROSPECTS.—NEW MILLS WORKING AND NEW GOLD YIELDS.—DIVIDENDS IN 1913.—GLOBE & PHOENIX.—GEOLOGICAL INVESTIGATIONS.

A more hopeful feeling now prevails in Rhodesia in regard to the future of the mining industry than has obtained for a considerable time past. It is indeed safe to say that not since the middle of 1910 has there been so much optimism as prevails today, and it might be here remarked that a cheerful outlook is far more justified at the present time than was warranted 3½ years ago. During the boom of 1910, Rhodesian stocks were inflated by operators who made promises that in the majority of cases have never been fulfilled, and moreover are never likely to be. It would have been amazing if the campaign of deceit did not have its own consequences. The

inevitable came in the shape of an aftermath of depression, and during the reaction Rhodesian mining suffered severely. It is to be hoped that the lesson of 1910 will not be forgotten and that in the future there will be fewer regrettable incidents, more clean finance, more businesslike methods, and less 'wildcats' than in the past. Such things are in large degree inseparable from mining, but in the future Charterland will have to be as free from unpleasant flotation incidents and share-market scandals as is humanly possible. If not, interest in mining in Rhodesia will soon die a natural death. A repetition of some of the incidents arising out of the 1910 boom would effectually close up the pockets of investors, on whom the development of the country largely depends, for many years to come. A period of honest finance and capable conscientious management would quickly bring due reward. For today the mines of Matabeleland and Mashonaland, taken as a whole, are in a more sound condition than ever previously. Ore reserves are much greater, development has proceeded on more businesslike lines, plants are better adapted to the ores which they are intended to crush and treat, and the prospects of an immediate increase in production and profits are undeniably good. Numbers of well informed mining men in both Matabeleland and Mashonaland anticipate that the effect of production by the several new mines which have recently been brought to the revenue earning stage will be to increase the present rate of output by 50%. Today the output is approximately 58,000 oz. fine gold per month.

The Cam & Motor plant has now been working for several weeks and is said to be giving every satisfaction. The Shamva



DORR THICKENERS AND PACHUCA AGITATORS AT THE LONELY MINE, RHODESIA.

Nissen stamp equipment has had trial runs. Within the next few months the following additions to the monthly gold output may reasonably be expected: Shamva 12,000 oz.; Cam & Motor 7500 oz.; Falcon 3000 oz.; Bell 2000 oz.; and Antelope 1100 ounces. This gives a total of 25,600 oz. and adding this to the 58,000 oz. of present output, it will be realized that a return of between 83,000 and 84,000 oz. per month, or say one million ounces per annum, is not an unreasonable anticipation. In any case it looks as if Rhodesia would advance in the list of the world's chief gold producing countries during the current year.

As regards profits it is not at this juncture advisable to attempt any prophetic figures, but it is certain that there will be a substantial increase in earnings. While on this subject, it may be remarked that during 1913 Rhodesian gold mining companies distributed \$489,613 in dividends. In addition to this there are the profits earned by the smaller companies, mines operated by small syndicates and tributaries; but it is not possible to give even a rough estimate of the

earnings of concerns of this kind. It is probable, however, that the profits won by small operators if added to the dividends distributed by the large companies would give a total of close to £1,000,000. As to the limited liability companies, the *Globe & Phoenix* easily heads the list with £280,000 followed by the *Eldorado*, £90,000, and *Lonely* £81,301. Six other gold mining concerns distributed earnings among stockholders, the *Rezende* £17,765; *Giant*, £13,104; *Umniati*, £2643; *Pickstone*, £1800; *Susanna*, £1750; and *Criterion*, £1250. One coal mining company, the *Wankie Collieries*, is in the dividend list with £35,457, and one base metal mine, the *Rhodesia Chrome*, paid £11,891. This latter industry would expand considerably were railway rates on this material reduced. Reverting again to the gold mines, the overwhelming importance of the *Globe & Phoenix* to the dividend aspect of the Rhodesian industry calls for remark. This Company accounts for 60% of the total distributed by all the auriferous ventures of *Matabeleland* and *Mashonaland* during last year. The third interim dividend of 24 cents per share in respect of last year's operations was paid recently and compares with 42 cents a year previously. But in this regard it should be recalled that at the meeting held on October 27 last, it was announced that the directors had decided, although there had been no diminution in the returns from the mine, to reduce the dividend to provide for capital expenditure of a cash reserve. This decision of the board is limited to the dividend above referred to. The profit earned by the Company during December was £31,000, and ore reserves at the end of the year were estimated at 180,757 tons of an average stoping value of \$27.20. The figures would have been more informative had they been expressed in terms of recoverable value; but at the same time it should be clear that, despite recent criticism regarding the management of the Company, this mine is in a sound condition, and no reasonable minded shareholder should begrudge the lesser dividend if the financial status of the Company is to be further bettered.

Science is considerably indebted to F. E. Studt, who for some years past has been doing excellent geological pioneer work in Northern Rhodesia and the Katanga region of the Belgian Congo. Mr. Studt has from time to time given to the Geological Society of South Africa details of some of his investigations and results, but in his latest contribution, 'The Geology of Katanga and Northern Rhodesia,' he has given a more comprehensive description than previously of a portion of Africa which stratigraphically is but little known, and which, on account of the copper, zinc, and lead deposits which it contains, is of considerable economic importance. Detailed investigation of the geology of these territories has, according to Mr. Studt, shown that there is a striking parallelism with the rocks of South Africa, so that on broad lines, the general South African classification of rocks may be applied there. The general absence of fossils except in a few limited areas, however, limits the scope of determination in regard to age. What Mr. Studt terms the Transvaal system, covers by far the larger portion of this area. The basal beds form a series of carbonaceous puddingstones and shales and are followed by a series of dolomitic rocks with interspersed shales and sandstones, and having copper, iron, and gold deposits. In the years to come much economic results may come of Mr. Studt's investigations. Meanwhile his painstaking work is being noted with interest in Southern Rhodesia, which has played such an important part in the opening of the mineral deposits of the trans-Zambezi territories.

The last annual report of the Bechuanaland Copper Co., which owns 180 claims 120 miles southwest of Bulawayo, covers the term ended May 31, 1913. The mine was closed down in April to enable a reduction plant to be erected. The Siemens-Halske process, tried by Dr. Huth, proved satisfactory for the ore, giving 91% recovery. The ore reserves amount to 30,000 tons of 8% copper ore which is proved by only 10,000 ft. of development work.

BOSTON

NEVADA-DOUGLAS AFFAIRS.—ARIZONA COMMERCIAL SHARES.—
CALUMET & ARIZONA.—LAKE SUPERIOR COPPER AFFAIRS.—
THE BUTTE, WISDOM & PACIFIC RAILWAY.

Nevada-Douglas shares recently slumped from \$1.25 to 73c., afterward recovering to 85 and 90c. per share. The stock has been weak for several months, but the break through \$1 per share was not generally expected. Reports were circulated that the Company faced reorganization, that it could not finance its leaching plant, and that J. G. Berryhill, the largest stockholder, was 'unloading.' All these rumors were flatly denied by the president, A. J. Orem. The Company's mainstay now appears to be the leaching process with which it is experimenting. The management at Ludwig sends out the interesting announcement that it feels confident the Company has found a way to treat the sulphide as well as the oxide ores without the necessity of giving them preliminary roast, and that in the treatment of the sulphide ores all the iron and sulphur will be obtained as by-products in the form of ferric oxide, red paint, and sulphuric acid. It claims that ferric oxide will have a ready market on the Pacific Coast for at least 2c. per pound, while the sulphuric acid produced will be worth not less than \$10 per ton to the Company itself for the treatment of its oxidized ores. It expects the value of the by-products to be ample to cover the entire treatment cost of the sulphide ore.

If the Arizona Commercial mine had cut the Old Dominion lode, and the Davis-Daly the Belmont vein, the former in cross-cutting on the 1400-ft. level and the latter on the 1050-ft. level, there is no telling what might have happened in a market way on the Exchange and the Curb. Arizona Commercial is an Exchange issue, and Davis-Daly is on the Curb. But both expectations miscarried and the stocks suffered in a market way. A report was current here that Phelps, Dodge & Co. had taken an option at \$5 per share on 5000 shares of Arizona Commercial, and the recent weakness in the stock was stated to have been due to the option not being exercised; but it was also said that the option has until April 15 to expire and action has not yet been taken upon it.

The annual report of the Calumet & Arizona company was well received in Boston from the standpoint of the Company's expansion. Much interest was expressed in the low costs, its new smelter, its acquisitions in Bisbee and the New Cornelia property, and the prospects of increased production. It is thought here that the New Cornelia will prove to be one of the large steam-shovel properties of the Southwest.

The reorganization of the Butte Central Copper Co. is proceeding rapidly, and it is expected that the Company will resume operations at an early date.

At last the Lake Superior strike is officially off, the Western Federation of Miners having stopped all strike benefit payments, it is announced, and closed its supply stores, placing them in the care of sheriffs. As the result of the stopping of the strike, a revival in Lake copper shares is looked for in Boston, and the feeling of investors is much more favorable toward them. Even the assessments are likely to be generally paid in the majority of instances. The United States Smelting, Refining & Mining Co. is expected to eventually consolidate several of the 'drill coppers' in the south range and make a strong company out of them. The latest report of the Michigan state geologist, R. C. Allen, states that there is more unmined than mined copper in the Lake district, and sentiment is much more optimistic that it has been since J. R. Finlay's famous 'revision downward' in the summer of 1911.

Western and English interests are understood to have recently pledged subscriptions running into millions of dollars for the purpose of completing the construction of the Butte,

Wisdom & Pacific railway, which will run from Butte to Jackson, Beaverhead county, Montana, connecting with the Elkhorn mining district in that county, and the French Gulch district in Deer Lodge county. The road will be about 110 miles long and is bonded for \$3,000,000, the property being that of the Boston & Montana Development Co. Freeman I. Davison, of Boston, went early in February to London and interested an English syndicate, headed by Sir Robert William Perks, in the building of this road, and the latter and his engineers will check the route during April, it is understood. The English interests are also supposed to have taken large options on the Boston & Montana stock. A Butte syndicate composed of bankers and capitalists has been formed to furnish additional financing to the mining properties. This syndicate is practically the same as the one which acquired, in the latter part of 1913, 1,094,000 acres of ranch lands in Sonora, west of Juarez, where cattle breeding will be done and the cattle driven to the Big Hole basin of Beaverhead county for feeding, preparatory to shipping them to Seattle and Alaska. This deal was consummated in anticipation of the new railroad being built into the Big Hole country.

NEW YORK

ANNUAL REPORT OF PHELPS, DODGE & CO.—FRAUDULENT MINE PROMOTERS.—FEDERAL LEAD CO. AND AMERICAN SMELTING & REFINING CO. SUIT.

Although the Phelps, Dodge & Co. mines made a record of output in 1913, the income of the Company was \$9,581,495, as compared with \$10,411,535 in 1912. The average net price realized for the copper sold being 15.37c. net cash f.o.b. New York, as compared with 15.51c. in 1912. The dividends were \$7,425,000, \$1,500,000 was charged off for depreciation, and \$173,786 was paid for taxes and other expenses, thus reducing the surplus of \$2,035,185 of last year to \$482,709. In addition to the 151,080,018 lb. of its own copper, the Phelps-Dodge organization sold 50,409,778 lb. of outside copper on commission. In addition the Company produced 5,701,628 lb. of lead, though it is not commonly thought of as a lead producer. Of precious metals, the output was 32,037 oz. gold and 2,073,376 oz. silver. The Stag Cañon Fuel Co. mined 1,322,813 tons of coal. Of the ore mined, about 55% was concentrated and 45% smelted direct. In his presidential report, Dr. Douglas calls attention to the necessity for providing increased ore reserves as the mines are depleted by ordinary mining, and additional property has been acquired by the Detroit Copper Mining Co., and the Burro Mountain and Chamung mines have been purchased. In the Copper Queen and Moctezuma mines, exploration work has disclosed increased ore reserves. It is interesting to notice that the gold and silver output of this Company only amounts to about $\frac{1}{4}$ c. silver and $\frac{1}{4}$ c. gold per pound of copper produced. In the report of the Phelps-Dodge company, Dr. Douglas calls attention to the increased working expenses of that Company through the increased cost of labor, higher taxes, etc. The daily papers in New York have read into this the argument that since working costs are to be higher the price of copper will be higher, an obvious error. As a matter of fact, when the Chile Copper Co. begins turning out copper at 6c. per pound delivered in Europe, and some of the big Western companies work out a successful scheme for recovering the copper in their tailing, it is highly probable that the other companies will have to devise a scheme for lowering their total production cost, even if some items in it do go up.

Judge Julius M. Mayer, of the United States District Court of New York, last week ordered that Albert R. Freeman be granted a new trial. It will be remembered that Freeman was convicted, along with Julian Hawthorne and W. J. Morton, of using the mails for fraudulent purposes in connection with their activities in the promotion of mines in Ontario. Freeman was sentenced to five years in the penitentiary; Haw-

thorne and Morton got one year each, and have served out their term, Hawthorne having utilized his as material for a series of articles which are doubtless more profitable than the mining venture. Freeman has all the while been out on \$150,000 bail. The learned judge now finds that one of the jurors in the trial of Freeman had previously sat on a grand jury which had considered the question of these mining frauds, and that therefore Freeman had not had an impartial trial. Whether the public prosecutor will go to the expense of another trial has not been announced. If a second conviction is secured there is always the doubt as to whether on appeal, it may not be disclosed that the wife of one of the jurymen had a prejudice against men named Freeman, and a third trial ordered. In face of the fact that it has now become almost impossible to secure the conviction of any criminal who has enough funds to take advantage of all the technical evasions possible, while on the other hand no innocent person is safe from charges will bring almost as much abuse as a conviction, and without redress, it is not remarkable that the public is becoming very tired of our present system of judicial procedure.

The disturbed condition in Mexico is reflected in the report of the American Smelting & Refining Co. which shows earnings of 7.47% in 1913 as compared with 10.1% the year before. The gross income was \$13,429,933. By cutting down its depreciation charge to \$1,525,517, or only about half of that allowed last year, the total of charges was kept down to \$3,675,392, leaving net earnings of \$9,756,540. Considering the fact that at times all the Mexican plants of the Company have been shut down, and only the Aguascalientes and the Chihuahua plants have been able to keep up even an approximately steady rate of output, it is cause for congratulation that the shrinkage in earnings has not been greater. The profit and loss surplus amounts to \$18,495,782 and the assets and liabilities show no material change as compared with the two preceding reports.

The suit of the minority shareholders to abrogate the smelting contract between the Federal Lead Co. and the American Smelting & Refining Co. was heard last week. The plaintiffs' attorney pointed out that, in 1903, a sixth contract was made providing that the American Smelting & Refining Co. was to pay for 90% of the lead content of the Federal ore on the basis of New York prices up to 4.10c. per pound, and about that figure to divide the excess. In 1905 Charles Sweeney, then president of the Federal, sold the control of the Company, then vested in himself, J. D. Rockefeller and George J. Gould, to the Guggenheim interests. When the Guggenheim representatives went on the board existing contract was extended for 25 years, providing for a treatment charge of \$8 per ton and the right to deduct freight charges to Denver or Pueblo. Shortly after the International Smelting & Refinery Co., at Tooele, became an active bidder for lead ores, and the rates prevailing in the open market became much more favorable to shippers. The contract between the American Smelting & Refining Co. remained in force, and minority shareholders in the Federal, which was barely meeting working expenses for part of the time, naturally were not pleased to be obliged to pay more than the prevailing rate for treatment charges. The counsel for the defense argued that if the contract was profitable in 1905, and it was profitable at that time, it was proper that it should be extended. In 1905 the Federal ores yielded 31 oz. silver and 51% lead, against 15 oz. and 43% in 1913. The decision has not yet been handed down, but the chief point at issue is whether a contract between companies where the contracting parties have neutral affiliations is legal or not.

In the course of the month aluminum lost at least $\frac{1}{2}$ c., the quotations early in the month being 18.50 to 18.75c. for both domestic and foreign prompt delivery, whereas toward the close it was down to 18 to 18.25c. for metal 98 to 99% pure. The demand was not good.

General Mining News

ALASKA

CORDOVA

The disputes regarding mining claims at Chisana were before the court at Cordova on March 12. They include the following: C. H. Lakaitis v. W. A. Johnson; Lakaitis v. James, claiming No. 7 fraction and \$10,000; Sutherland v. Jurdy, No. 3 Big Eldorado; Woodman v. Eriksen, No. 1 Chicken; Cloninger v. Flindansen, No. 1 Bear; Nikell and Foster v. W. A. Johnson, No. 8 Bonanza; Hussey v. Eriksen, No. 1 Caribou; Foster v. Johnson, No. 1 below Chathenda; Dattaitis v. James, No. 1 above Bonanza; Delander v. McPhail, No. 2 above Gold Run; Maddox v. Moskley, No. 2 above Skookum gulch; Cloninger v. Moskley, No. 4 below Big Eldorado; Costello and Bollinger v. Jurdy, No. 8 above, fraction, Bonanza; Delander and Simpson v. James, discovery annex, Gold Run; Hertzberg v. Doyle, No. 3 above Glacier; Wolfe v. Gates, No. 1 above Gold Run; and Tibbs v. Verreau, No. 1 Skookum gulch. On March 18, Judge F. M. Brown gave his decision in the case of Lakaitis v. Johnson, which involved the right of the defendant to title of No. 1 above Bonanza creek, and was in his favor. In the case of Lakaitis v. James, the jury could not agree after 56 hours' deliberation, and was dismissed. The amount of litigation is creating much dissatisfaction.

At the Mother Lode mine, an 80-hp. gasoline engine is being installed to drive an air-compressor for 7 Sullivan drills. A cross-cut adit will be driven to give 350 ft. of vertical depth below the Marvelous adit. A winze will then be sunk 300 ft. After this is done a power-plant will be erected, and then a 3400-ft. adit driven to cut the vein at a vertical depth of 1400 ft. The work will take 10 months, at a cost of \$175,000. A road 13 miles long, from Shushanna Junction, the old McCarthy station, to the mine will be constructed, costing \$25,000. Two auto-trucks will then haul 40 tons of ore per day to the railway.

JUNEAU

February returns from the mines on Douglas island were as follows:

	Alaska Mexican.	Alaska Treadwell.	Alaska United.*
Development, feet	67	129	1,508
Stock of broken ore, tons.....	8,665	46,776	8,072
Stamps working	120	240—300	240
Days	27.4	26.8—20.6	25.14—27.7
Ore crushed, tons	17,850	61,866	33,172
Concentrate saved, tons	321	1,273	659
Gold by amalgamation.....	\$19,299	\$ 95,550	\$34,056
Gold by cyanidation.....	20,734	82,117	24,331
Total realizable value	\$39,632	\$175,890	\$57,803
Net profit	8,518	108,594	†714

*Includes the Ready Bullion and 700-Ft. Claim mines.

†Loss.

The work in the 700-Ft. Claim mine consisted principally of stations and ore-bins for the Treadwell, Mexican, and 700-Ft. Claim at the Central shaft.

The following information has been published by B. L. Thane, general manager of the Alaska Gold Mines Co.: The Sheep Creek adit is now within 500 ft. of being connected with the main shaft and this should be made within the next three weeks, as they are continuing not only the work at the adit end, but are also driving from the bottom of the shaft to make the connection sooner. The adit is now in good ore, both at the Sheep Creek end and the end being driven from the shaft, and has been in this ore for over 100 ft. This point is about 2300 ft. below the surface ore

and is a good quality of gabbro, with quartz, galena, and free gold. It is the Ground Hog orebody lying to the foot of the Perseverance slate vein, and is much better here than it is on the main Alexander level. The indications are therefore favorable to a large high-grade body on this level. This is one of the most important developments that has taken place at the property since it has been under the present control, particularly in the indication of the maintenance of good ore at depth.

ARIZONA

COCHISE COUNTY

Metal production of the Calumet & Arizona company's mines in 1913 was as follows: copper, 52,987,383 lb.; silver, 880,915 oz.; and gold, 18,989 oz. The value of precious metals was \$24.36 per ton of refined copper.

A bond issue of \$3,000,000 was authorized by the stockholders of the Mascot Copper Co. at a special meeting held in Chicago on February 28. At the same time the stock of the Company was increased to \$15,000,000. The bonds are to be convertible into stock at \$6 per share after July 1, 1917, and it is hoped that the present stockholders will absorb them on the basis of payment subscriptions one-half in stock at \$4 per share. Recent quotations of the stock at San Francisco have been from \$1.50 to \$2.50. Development at the mine is favorable, but has been slow, and additional equipment is desired.

GILA COUNTY

The Starlight copper and lead mine, 9 miles southwest of San Carlos, is to be cleaned out for examination. As there are between 8000 and 9000 ft. of underground workings, this will take about six weeks. An engineer of the Tri-Bullion Smelting & Development Co. will make the inspection. In 1906 the mine produced ore containing up to 18% copper, 49% lead, and some gold and silver.

PINAL COUNTY

(Special Correspondence.)—Work on the Copperosity group of mines is progressing favorably. J. F. Wagner, the superintendent, has a force of men driving from the 200-ft. level to connect the old workings and has 180 ft. of this work done. Connections will be made shortly. The property is an old one from which considerable ore has been shipped, but it is the intention of the company to devote all present effort toward the thorough opening of the mine. The main shaft is down 270 ft., and the mine is equipped with a gasoline hoist and air-compressor, and machine-drills are used on work in the drift. The company has three silver-gold-lead claims adjoining, on which it will do some development. The district is lively up, and the prospects for the future are bright.

Casa Grande, March 26.

CALIFORNIA

According to the state mineralogist, F. McN. Hamilton, the estimated mineral output in 1913 was as follows:

Petroleum	\$ 46,000,000
Gold	20,000,000
Cement	8,900,000
Copper	5,500,000
Crushed rock and granite	6,000,000
Brick	3,000,000
Borax	1,250,000
Natural gas	1,250,000
Silver	800,000
Quicksilver	700,000
Other minerals, including asphalt, clay, lead, marble, mineral earths, salt, tungsten, zinc, etc...	7,500,000
Total	\$100,000,000
The total in 1912 was	\$91,472,385.

BUTTE COUNTY

The North California Mining Co., in which H. H. Yard was the principal holder, has sold several thousands of acres of land in Butte, Yuba, Plumas, and Lassen counties, comprising all its holdings in these four counties, to the Western Realty Co. of Denver, Colorado. The North California company now passes out of existence.

INYO COUNTY

Most of the lead ore produced in California has come from the Cerro Gordo, Darwin, and Modoc districts of this county, according to Adolph Knopf in *Bulletin 680-A* of the U. S. Geological Survey. The Cerro Gordo has produced about \$7,000,000 in argentiferous lead, and the Darwin between \$2,000,000 and \$3,000,000. The latter district lies at an altitude of 4750 ft., and is arid country, the rainfall at Keeler, 1100 ft. lower, being 3.15 inches. Water is piped 8 miles and sold in 1913 for a $\frac{1}{2}$ c. per gallon for mining and 1 c. for domestic purposes. Ore is hauled from the mines to the railway at Keeler at \$6 to \$8 per ton. Freight to the district is \$1 per ton more. Miners' wages are \$3.50 to \$4 per day. There is telephone connection between Darwin and Keeler. The ore deposits are generally inclosed in lime-silicate rocks, although some are in limestone, and small isolated masses of ore are found in the quartz-diorite. The minerals are galena with silver, cerussite, anglesite, and the gangue calcite and fluorite. Several mines are described, and in the early part of 1913 there was considerable activity in the district, especially at the Christmas Gift, Lucky Jim, and Custer mines. The Death Valley railroad, now under construction from Death Valley Junction on the Tonopah & Tidewater line, will be completed and in operation by July 1, 1914. This road, primarily constructed for the purpose of handling the crude borax of the Pacific Coast Borax Co. from its deposits, will make the development of other minerals easier in this region.

NEVADA COUNTY

An adit at the Premier mine is in 1500 ft., and enough ore has been developed to supply a 5-stamp mill for a considerable time. Rich ore was recently opened in a raise. There is said to be good gravel on this property. The Conlan mine will probably be worked again, after seven years of idleness. A 5-stamp mill is to be erected shortly at the Bennefontaine mine at Willow Valley. Richard Martin is superintendent.

PLACER COUNTY

All the mines at Iowa Hill are busy. Twenty stamps are being added to the Pioneer mill. The Mohawk and Copper Bottom are preparing for an active season.

SHASTA COUNTY

Dredging ground near Redding has been sold for \$65,000 to J. K. Kendrick of Willows, Glenn county. Four miles from Redding is the Silver King, shut down on account of a disagreement among shareholders, but it will probably be reopened in a few weeks. It is said that good headway has been made in the East in securing money for the Afterthought Copper company, operating near Ingot. A large tonnage of gold-silver-copper-zinc ore is developed. S. E. Bretherton is manager. Work with the Hall process at the Balaklala plant has been stopped until it has been decided what to do about the recently destroyed crusher plant. S. A. Holman, Jr., is now in charge of the mine.

SIERRA COUNTY

Although there are about 150 men employed at the mines about Alleghany, there is little new to chronicle, and there will be no increased activity until the summer. The same may be said of the Forest City district, where steady work is being done at the Kate Hardy, North Fork, North Fork-Wisconsin drift-gravel mine, and the South Fork. Operations have been resumed at the Miners Home gravel claim at Howland Flat. A mill is being erected at the Mexican mine.

TRINITY COUNTY

The Trinity Dredging Co.'s boat has been laid up most of the winter, awaiting a casting weighing 15,000 lb. This has arrived, after being dropped into the river with a wagon. The dredge will start early in April.

At the Globe mine, near Dedrick, No. 6 level is being rapidly advanced. It will cut the main orebody at a vertical depth of 585 ft. below No. 2 adit. The 20-stamp mill and cyanide plant is treating 120 tons per day, yielding about \$40,000 per month.

TUOLUMNE COUNTY

Diamond-drilling at the old Sledge mine, near Confidence, is to be done by the Tuolumne Deep Channel Mining Co. A thick lava capping covers 130 acres of the property, under which is the gravel deposit.

COLORADO

CLEAR CREEK COUNTY

(Special Correspondence.)—Three feet of smelting ore has been opened for 30 ft. in the Centennial vein on Leavenworth mountain, and assays return 18.2 oz. gold and 170 oz. silver per ton. D. Kennedy is manager. The Malm mill, partly built here three years ago and left uncompleted, is under option to the Bunker Hill & Sullivan M. & C. Co., of Kellogg, Idaho. That Company has obtained such favorable results from preliminary tests with the process that a working plant is desired. It is undecided whether ore will be shipped to Georgetown for a series of tests or the mill will be taken to Idaho and re-erected, though the former plan, it is believed here, will be adopted. Ore assaying 140 oz. silver per ton has been cut in the east drift on the Rosebud vein on Democrat mountain. G. W. Teagarden is manager.

Georgetown, March 23.

LAKE COUNTY (LEADVILLE)

Work has been started and ground broken for the new zinc smelter at Leadville. The first 50-ton unit is to be ready by August next. It will consist of a crushing plant, eight furnaces, cooling pipes, and a bag-house. The ore to be treated will be low-grade carbonate of zinc, and the products will include oxides used in paint manufacture. Mr. Augustine is in charge of the work.

OURAY COUNTY

A 200-ton blast-furnace is to be installed by the Wanakah Mining Co., while the present 100-ton plant will be held as a reserve. The new furnace will cost from \$10,000 to \$15,000. A sintering machine is also to be installed. John T. Roberts, Jr., is manager. The Ouray-Michigan Mining & Development Co. has been formed to work the Stenographer and Cabinet-maker mines on Oak creek. A 300-ft. cross-cut will be driven, and a raise put up to connect with the old workings.

SAN JUAN COUNTY

At Silverton, machinery is being installed at the Wilfey-Mears plant. A flume is being erected for the treatment of tailing in the lake near the mine and a large tonnage is awaiting treatment.

SUMMIT COUNTY

In the Breckenridge district the Tonopah Placers Co. is overhauling the two Bucyrus dredges for the coming season. For No. 2 boat in the upper part of Swan valley, 51 new buckets have arrived. There are 70 buckets on the line. No. 1 boat, in the Blue River valley, will have 100 buckets. The Reliance dredge is working upstream in French gulch, from its junction with the Blue river. Steam is used to prevent the dredged material from freezing while being washed and on the stacker. The Reiling boat of the French Gulch Dredging Co. will soon be started again. It has a good record.

TELLER COUNTY (CRIPPLE CREEK)

On March 26 there was a meeting of mining men held at Cripple Creek, and a branch of the Colorado Metal Mining

Association was formed, with H. L. Shepherd as chairman and E. P. Arthur, Jr., as secretary. It was decided that the board of directors consist of nine members, three from Cripple Creek, three from Victor, one from Goldfield, one from Independence, and one from Elkton. Local dues are 50c. per year.

IDAHO

According to the report of the state inspector of mines, Robert N. Bell, the various counties of the state produced minerals valued as follows: Ada, \$9034; Adams, \$26,795; Bingham and Bonneville, \$3114; Blaine, \$175,416; Boise, \$604,333; Bonner, \$52,265; Canyon, \$521; Clearwater, \$57,448; Custer, \$892,133; Elmore, \$102,014; Fremont, \$380,143; Idaho,



MAP OF IDAHO.

\$55,311; Lemhi, \$888,926; Lincoln, \$312; Nez Perce, \$3528; Owyhee, \$217,784; Shoshone, \$21,115,812; Twin Falls, \$457; and Washington, \$5209; a total of \$24,572,396.

OWYHEE COUNTY

Very rich gold ore has been found in the Ruth mine on War Eagle mountain, near Silver City. Great excitement prevails in the district. Portland people own the property.

SHOSHONE COUNTY

The Bunker Hill & Sullivan company pays on April 4 dividend No. 199, amounting to \$81,750. The total to date is \$15,056,000.

MICHIGAN

HOUGHTON COUNTY

The report of the Winona Copper Co. for 1913 gives the following data:

'Rock' stamped, tons 120,806
Refined copper yield, pounds 1,448,737

Revenue from copper \$223,299
Total revenue (\$128,506 from assessments) 419,235
Expenditure 344,727
Balance of assets over liabilities 74,508

MONTANA

SILVERBOW COUNTY

The recent report of the Tuolumne Copper Mining Co., of Butte, covers work in 1913. The three-compartment shaft was sunk from 2080 to 2400 ft., stations cut at 2200 and 2400 ft., and cross-cuts driven to the vein. On the former level the vein was opened to the eastern boundary, while at 2400 ft. it was only cut on February 20. This level is promising. Ore was mined from the east end of the 1800-ft. level, in two raises at 2000 ft., and at 2200 ft. The output was 2,633,651 lb. copper and 109,705 oz. silver, worth \$200,218. Expenses were \$233,222; dividends \$160,000; cash on hand January 1, 1913, \$202,763; cash on hand at end of 1913, \$12,787.

NEVADA

ESMERALDA COUNTY

According to the February report of J. W. Hutchinson, assistant general manager of the Goldfield Consolidated, 26,731 tons of ore yielded a net realization of \$182,183. Costs were as follows:

	Per ton.
Stopping and development	\$3.32
Shipping expense	0.17
Dump moving	0.04
Transportation	0.10
Milling	1.95
Marketing	0.10
General expense	0.47
Bullion tax	0.10
Total costs	\$6.25
Miscellaneous earnings	0.04
Net costs	\$6.21

Development covered 2688 ft. at \$9.45 per foot, and generally there was nothing of importance from this work. Costs are 36c. per ton higher than the preceding month, due to extraordinary administration charges, and a poor quality of pebbles in the tube-mills; the increased cyanide consumption raised costs 20c. per ton. Two 2½-in. machine-drills are now working on the 500-ft. level of the Silver Pick mine, replacing the hand drilling. Walter S. Norris is superintendent. Rich ore has been opened on three levels in the Florence. The Velvet claim of the Merger company has been sold to the Jumbo Extension company. Since this deal was concluded, the 921-ft. level drift has opened 4 ft. of \$58 to \$70 ore. The Merger company is to continue development on a larger scale than formerly. Up to the middle of last November, a total of \$254,414 has been spent in prospecting, sinking the shaft, and equipment. The 1750-ft. level of the Atlanta is opening satisfactorily.

EUREKA COUNTY

A shaft has been sunk 900 ft. at the Nevada Central Copper Co.'s property, at Cedar, 50 miles from Buckhorn, but work is temporarily suspended. Deposits of copper ore have been only small on the surface. Nothing was cut in the shaft. H. A. Linke is manager.

HUMBOLDT COUNTY

(Special Correspondence.)—James Edmunds has had two men working on a promising copper-gold-silver ore here all winter, and is planning to make shipments to the smelter. The ore assays from \$40 to \$100 per ton. This discovery was made by a couple of Indian boys while hunting deer last fall. Mr. Edmunds has ample funds of his own and

is backing the discoverers, and going right ahead with the property without looking for any outside help financially. John A. Hassell, of New York City, is expected here soon to commence operations on a large scale on his property, which is patented, developed, and ready for a plant. He has about 20,000 tons of 4 to 6% copper ore developed. Curry and DeVoe are extracting ore and getting ready to ship as soon as the roads will permit from their Winnebago mine. They shipped 7 or 8 tons from this property last fall which returned 20.8% copper with several dollars in gold and silver per ton. Frank Baldes has two lessees preparing to commence shipping ore from his property. Former shipments gave about 22% copper with several dollars in gold and silver per ton. W. E. Christiernsson has about ten tons of ore sorted and ready to ship from his best vein on the Champion group, where he has several thousand tons of ore blocked out and ready for a plant on the ground. W. S. Elliott, a well known mining man, is making quiet trips into Sulphur and has several men locating and developing some gold and silver prospects with a view to putting in a 50-ton concentrating and cyanide plant.

On the whole, the outlook is bright for this district, and a boom is neither expected nor desired. A prosperous and steady producing mining camp will be here during the coming season. A custom smelter is needed to handle the ores from the numerous high-grade prospects which are situated along the range for twenty miles or more.

Sulphur, March 8.

A rush has set in to a new goldfield in the Kings' River district, in the northern part of the county, near the Oregon boundary line. The National district is being deserted for the new camp. Reports from the new district are most encouraging and a large number of miners from various parts of the state are going into this district.

The Seven Troughs Coalition mill has yielded \$17,908 from 52 tons of ore so far for March. The winze is below No. 10 level, and shows 110 ft. of ore from where it was cut. In the bottom, 4 ft. averages \$28.35 and 15 in. \$1445 per ton. The gold is worth \$12 to \$13 per ounce.

The property of the Seven Troughs Mining Co. is situated 30 miles northwest of Lovelock, on the Southern Pacific railway. The report covers the year ended December 31, 1913. C. W. Poole is manager.

The Seven Troughs range is about 8 by 24 miles in area, and has a maximum height of 3000 ft. above sea-level. The property consists of 29 claims and fractions. Country rocks are mostly rhyolite, basalt, and andesite. The Fairview-Florence and Lowden veins occur in intrusive basalt dikes. A fault at 600 ft. has completely cut off the veins, and the throw has been so great as not to warrant further prospecting for them. Lessees have secured several blocks of ground, and royalties in 1913 were \$5.79. Cash on hand at the end of 1913 was \$15,547. The present salary list is \$250 per month. The total output of the property to date is about \$275,000.

The annual report of the Rochester Weaver Mining Co. for 1913 gives the following information: The property was leased in 300 by 600-ft. blocks, and ore was opened by three lessees. The Colligan lease produced ore worth from \$22.40 to \$31.74 per ton. The claims have been proved better by lessees than the Company could have in over twice the time. The Company drove an adit 430 ft., and 150 ft. of driving on three veins, showing 5 ft. of ore worth \$8.50 per ton. Development by the Company and lessees was 1164 and 2430 ft., respectively. Ore has been developed to 350 ft. depth, and the leasing system is to be canceled. It is planned to consolidate the Rochester Weaver, Rochester Mines, Nenzel Crown Point, Rochester Belmont, Original Rochester, and Pocahontas properties. Ore shipped from all leases was 953 tons, worth \$30,254, from which the Company drew royalties of \$2783. The year's results left a deficit of \$3582.

NYE COUNTY

Preparations are being made at the Railroad Valley Co.'s property for a resumption of drilling for potash. No. 7 well, which was left at 745 ft., will not be put down deeper, but another one sunk nearby. On April 21 the Tonopah Mining Co. will pay a dividend amounting to \$250,000. At the Jim Butler, a Nordberg hoist with herringbone gear, and driven by a 150-hp. electric motor, is to be installed. The mine continues to develop in a promising way. The West End shipped 48,124 oz. bullion last week, the clean-up for 18 days in March. The Belmont's Western vein being opened on No. 12 and 13 levels is an important orebody. At 1640 ft. the Belmont vein has been crosscut for 15 ft. in the trachyte formation. During February the 10 producing mines at Tonopah yielded 42,736 tons of ore, worth \$816,455.

STOREY COUNTY

In summing up his reports of the Crown Point Gold & Silver Mining Co., Belcher Silver Mining Co., and Yellow Jacket Gold & Silver Mining Co. for the year ended December 31, 1913, George S. Sturges, the manager of these companies stated: The Jacket mill in 184 days either whole or part operation treated 23,943 tons, of which 6678 tons was from the Crown Point, 2924 from the Belcher, and 14,341 from the Jacket. This ore yielded 3319 oz. gold and 29,049 oz. silver. A considerable part of the year the work of all three companies was concentrated on preparation for and installation of two centrifugal incline sinking pumps in the joint Crown Point-Belcher incline and in necessary equipment for their operation. The Jacket mill was placed in better working condition by the Jacket company and the shaft and incline were repaired jointly by the three companies and are now in better condition than for a considerable time past.

OREGON

Southwestern Oregon has long been known for its widespread and varied mineral resources, among which gold, silver, copper, platinum, and coal are the most important. They have been the subject of investigation for a number of years by J. S. Diller, of the U. S. Geological Survey, and the results have just been published in *Bulletin* 546. The gold rush of '49 landed many a prospector in southwestern Oregon. Placers were opened and placer mining has ever since continued to be a thriving branch of mineral industry. The gold produced in southwestern Oregon before 1881 can not be closely estimated, but it was many millions of dollars, while from 1881 to 1912, inclusive, the production of gold has been \$11,257,772. During the 10 years 1903 to 1912, inclusive, the placer mines produced \$2,014,715 and the lode mines \$1,523,226. Besides the gold and a considerable amount of copper, the production of silver during the same period was valued at \$63,385, platinum \$15,293, and coal \$2,602,122.

JOSEPHINE COUNTY

A 10-day run at the placer claims of Martin and Daniels, 1½ miles below Galice, yielded 184 oz. gold. At the Anderson placer mine, owned by 'Dry Wash' Wilson of Nevada, 8 miles of ditch and pipe-line was completed recently, but a slide carried away 1500 yd. of the ditch. Rich quartz has been found by R. Boswell, at a depth of 15 ft., on Sucker creek, 4 miles from Holland, and near the Anderson placer.

TEXAS

BRAZORIA COUNTY

(Special Correspondence.)—A steady shipment of sulphur from the Freeport mines has been sent by rail to the Eastern and Northern markets since the first of the year, and Texas sulphur is meeting with marked favor with paper manufacturers and chemical buyers who have purchased the Freeport product. The first shipload of sulphur from the Freeport mines is scheduled to leave this port on the steamer

Honduras of the Seaboard & Gulf Steamship Co.'s line early in April.

Freeport, March 18.

UTAH

JUAB COUNTY

The Dragon Consolidated Mining Co. operates at Tintic, and the report covers the year 1913. A large tonnage of iron ore is blocked out ready for the smelters when they desire this class of material. Shipments of quartz are limited at present, as it is low-grade and better suited for milling. Development covered 4765 ft., and was encouraging. The surface adit has been extended along the Governor vein for 1700 ft., opening a large tonnage of mill ore. Results were as follows:

Quartz ore, tons	3,558
Value per ton in gold, silver, lead, and copper.....	\$19.83
Iron ore, tons	12,892
Iron, per cent	55.8
Value per ton	\$3.05
Revenue from ore sales	\$91,988
Operating expense	92,023

SUMMIT COUNTY

Ore shipments from Park City during the past week were 1258 tons. The annual report of the Daly West Mining Co. gives the following information: The mill and hoist were burned on December 28, 1913, but these will be rebuilt by September 1, 1914. The mine produced 1555 tons of shipping and 59,233 tons of milling ore. Of the ore, 13,428 tons came from old workings at 900 and 1550 ft. The larger ore-bodies occur from the 1700 to the 2000-ft. level; but most of the output was from the former depth. The mill treated 59,233 tons of ore in 319 8-hr. shifts, producing 8332 tons of lead and 1598 tons of zinc concentrate. Assays of the crude ore and concentrate were as follows: lead, 5%; silver, 7.7 oz.; zinc, 4.3%; lead, 35.54%; silver, 40.01 oz.; and lead, 4.83%; silver, 18.27 oz.; and zinc, 35.37% respectively. Recoveries were 79.55% of the silver and 99.6% of the lead, according to the mill superintendent, F. W. Sherman. Of the 5038 tons of crude ore marketed, the average was 52.61 oz. silver, 0.0398 oz. gold, 20.06% lead, and 1.86% copper. The year's revenue was \$517,093, a dividend of \$27,000 was paid, and the cash on hand at the end of 1913 was \$23,648.

WASHINGTON

KITTITAS COUNTY

At an altitude of from 2500 to 5000 ft. in the Wenatchee mountains, on the eastern slope of the Cascade range, the Dovre Mining Co. is developing five groups of claims in the Cle Elum and Swank districts. The Northern Pacific railroad is 28 and 16 miles distant respectively from these places. The former district ores contain gold, silver, copper, lead, and antimony, while the Swank ores contain gold and silver. At the Black Bear, Ruby King, Majestic, and Grizzley Bear claims, at Cle Elum, a good deal of encouraging development, 1800 ft. in all, has been done. Assays of ore from these claims, by Falkenburg & Laucks of Seattle, have given high returns. In the Swank claims a total of 500 ft. of work has been done. The Company has been formed with a capital of 2,000,000 shares of \$1 each.

STEVENS COUNTY

On March 25 the lower adit of the United Copper mine cut the vein at 4220 ft. from the portal, and at a depth of 1100 ft. from the surface. The cross-cut went through 27 ft. without reaching the foot-wall. On the east side of the vein is 30 in. of high-grade ore. This adit cost about \$70,000. At a depth of 500 ft. in the Copper King, 700 ft. from the United Copper mine, 4 ft. of gray copper ore has been opened. The new 100-ton smelter may be ready in about 30 days.

CANADA

ALBERTA

The annual report of the International Coal & Coke Co., operating mines and coke-ovens near Colemont, shows that the net profit for 1913 was \$146,829, of which \$120,000 was paid in dividends. Cash on hand at the end of the year was \$40,300. The Company's engineers estimate workable coal at 205,000,000 tons. So far, 3,198,323 tons has been mined.

BRITISH COLUMBIA

During February the Standard mine, near Silverton, shipped 1337 tons of silver-lead ore and some zinc concentrate, giving a net return of \$81,699. No. 7 level is in 2700 ft., and 600 ft. from the point under the shoot from No. 6. The surplus is \$293,332. During 1913 the Hedley Gold Mining Co. treated 70,796 tons of ore yielding \$802,330, with a profit of \$405,255.

ONTARIO

The mineral production of Ontario in 1913, according to Thomas W. Gibson, deputy minister of mines, was as follows: gold, 220,837 oz.; silver, 29,724,931 oz.; copper, 12,941 tons; nickel, 24,338 tons; iron ore, 195,937 tons; pig iron, 648,899 tons; cobalt oxide, 1,188,526 lb.; and nickel oxide, 232,255 lb., with a total value of \$37,794,277.

Sixty feet of ore has been opened on the 120-ft. level of No. 3 Right of Way shaft in the new vein encountered some weeks ago. The vein averages 2 in. wide containing from 2500 to 3000 oz. per ton. The vein is an extension of No. 12, worked on the Princess mine by the La Rose Consolidated company on which a 200-ft. ore-shoot has been opened.

During February the Buffalo mill treated 6163 tons of ore yielding 103,256 oz. of silver. The Hollinger company reports that, during the four weeks ended February 25, No. 8 vein was cut by a cross-cut on the 300-ft. level, and No. 4 vein was cut by a drill at 425 ft. The main shaft is 425 ft. deep. Development covered 635 ft., and 522 ft. of drilling, at a cost of 49.3c. per ton milled. Mining cost \$1.88 per ton. The mill treated 10,042 tons of ore averaging \$17.50 per ton, with 97.4% extraction, at a cost of \$1.31 per ton. Total costs were \$5.52 per ton, and the profits were \$111,679.

COLOMBIA

The Pato dredge produced gold worth \$8300 from 25,500 cu. yd. during the week ended March 3.

MEXICO

MEXICO

During February the Mexico Mines of El Oro mill worked 24 days and treated 11,500 tons of ore. The gold and silver output was worth \$134,670, and profit \$86,690.

DURANGO

(Special Correspondence.)—In 1913 the Desengaño mine, next to the Fortuna, in the Guanacevi district, was worked in a desultory manner, and produced bullion worth \$1,300,000 at a cost of \$200,000. A good deal of ore has been stoped at the Mexico Consolidated, and ore has been opened in the Fortuna. As soon as railway communication is restored, stoping will be started in the latter property. The contact orebody of this district will probably be of considerable size, and produce high-grade ore, as the Desengaño has 100 tons in one pile which will return \$1000 net per ton.

Guanacevi, January 21.

VENEZUELA

(Special Correspondence.)—There is a fair amount of mining activity here, but owners find it difficult to get sufficient labor, on account of the miners being able to recover gold by panning river gravel and stealing it. The class of labor is poor, being chiefly composed of negroes from the West Indies.

Ciudad Bolivar, March 6.

Personal

POPE YEATMAN is expected in New York.

E. H. LESLIE has returned to San Francisco.

P. A. O'BRIEN has left Nicaragua for Colombia.

R. B. STANFORD has been visiting the Canal Zone.

LESLIE H. WEHR was in San Francisco this week.

THOMAS T. READ has gone to Ducktown, Tennessee.

J. H. COLLIER is now associated with the Joshua Hendy Iron Works.

HORACE ROBERTSON has returned to New York from Bisichi, Northern Nigeria.

J. A. VEATCH is investigating the placer deposits of Battle Mountain, Nevada.

W. J. RICKELL has left Seattle for Knik, Alaska, where he will be until October.

H. A. LINKE, manager for the Nevada Central Copper Co., Eureka county, Nevada, is in San Francisco.

FOREST RUTHERFORD and G. D. VAN ARSDALE, of the Phelps-Dodge company, have been visiting the Anaconda smelter.

W. H. STORMS has returned from a mine examination in Tuolumne county, California, and is in Nye county, Nevada, on professional business.

JAMES C. H. FERGUSON, for the past thirteen years Pacific coast sales agent of the Midvale Steel Co. of Philadelphia, has severed his connection with that Company and is now the Pacific coast representative of the William Cramp & Sons Ship & Engine Building Co. of Philadelphia, with his office in the Monadnock building, San Francisco.

WALTER LAIDLAW, who fell dead from heart disease in New York while going home, March 24, was secretary of the International Steam Pump Co., and with his brother Robert one of the founders of the Laidlaw-Dunn-Gordon company of Cincinnati. He was a Scotchman, 65 years of age at the time of his death, and an educated mechanical engineer who was an important factor in the development of the types of machinery manufactured by his firm.

Pig Tin in March

NEW YORK CORRESPONDENCE

February deliveries into consumption exceeded expectations, amounting to 3300 tons. The total visible supply March 1 was 17,308 tons, which was 5004 tons above that of the same date a year previous. Total deliveries for January and February of this year showed a decrease of 300 tons as compared with the same months last year. On March 2 the price was 38c.; on March 9, 37.37½c.; on March 16, 38.05c.; and on March 23, 38.50c. The lowest quotation was 37.37½c., on March 9, and the highest 38.65c., on March 24. Early in the month the market was adversely affected by the erratic behavior of London, and business was also hindered by the storms which cut off communication with interior points. At times in the month there was a steady, though moderate, business, but at no time was there any real heavy trading. Toward the close of the month the supply of the metal was more than ample, the arrivals up to and including March 27 totaling 4718 tons, while there was afloat on that day 3997 tons. Deliveries into domestic consumption in March are estimated at 4500 tons. The auction sale of Banca tin in Holland on March 26 realized an average price of 108½ florins, equivalent to 39.60c. c.i.f. New York or £180 15s., a high figure in view of the fact that it was £6 over the closing price at London (£174 15s.). The amount sold was 2300 tons.

Society Meetings

APRIL

Name.	Date.
American Chemical Society	8-11
American Institute of Electrical Engineers	10
American Electro-Chemical Society	16-18
Institution of Mining and Metallurgy.....London....	16

MAY

Mining and Metallurgical Society...San Francisco....	4
National Fire Protection Association	5-7
American Iron and Steel Institute	22
Institution of Mining and Metallurgy.....London....	21

JUNE

American Institute of Electrical Engineers	22 or 26
American Society for Testing Materials	23-27
Society for the Promotion of Engineering Education	29 to July 2
American Society of Mechanical Engineers.....	end of June
Franklin Institute	Philadelphia....end of June

AUGUST

American Inst. Mining Engineers..Salt Lake City....	10-14
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SEPTEMBER

American Institute of Electrical Engineers.....	not fixed
American Chemical Society	9-12

OCTOBER

American Institute of Electrical Engineers.....	9
American Iron and Steel Institute	23-24

NOVEMBER

American Institute of Electrical Engineers	13
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DECEMBER

American Society of Mechanical Engineers	7-8
Society of Gas Lighting (annual meeting).....	10
Society of Naval Architects	11-12
American Institute of Electrical Engineers	11
American Museum of Safety	11-20
Geological Society of America, Philadelphia.....	29-31

SEPTEMBER 1915

American Institute of Mining Engineers, San Francisco..	14-17
Engineering Congress, San Francisco	20-25

Schools and Societies

COLUMBIA UNIVERSITY has decided to raise the requirements of admission to the school of mines, or engineering, and of chemistry, and generally to elevate and strengthen the course of engineering and technical study, from and after July 1, 1914. The new arrangement will make no substantial change in the age of graduation from the professional school. The last bulletin describes the various departments and illustrates the apparatus used, besides the accommodation obtainable.

The *Harvard Engineering Journal* contains the following articles: 'Notes on the Construction of Section A of the Dorchester Tunnel,' by Philip C. Nash; 'The Catskill Water Supply of the City of New York,' by Charles S. Brisk; 'Scientific Management—a Viewpoint,' by Edward L. Lincoln; 'Limnology at Squam Lake,' by Carl Marsh; 'Experiences with the United States Coast and Geodetic Survey,' by P. S. Donnell; 'The Proposed New Water Supply for Oklahoma City,' by Theodore R. Kendall; 'Comparative Application of Gas-Electrics, Storage Batteries, and Trackless Trolleys,' by G. Hall Roosevelt; and several editorial subjects.

New York Metal Market Review

Standing out above all other features in copper are the continued heavy exports. In March there were periods of fair buying on the part of domestic consumers, but the heaviest buying was on foreign account. The producers and agencies have shown a tendency to advance prices on the slightest taking hold by buyers, probably on the principle that domestic consumers usually buy on the rise of the market and that a good movement might be started by such tactics. Domestic consumers, however, have been wary. The demand for brass and copper products is not at all what it should be. Lead descended to the low level of 3.90c. New York, and the exports heretofore referred to have increased. Spelter has not been active to any considerable degree and the course of prices in the month has been downward. Antimony has been dull and some brands are lower. Heavy dealing in tin was wanting and its most noteworthy feature was the large supplies on hand. Aluminum has been quiet and quotations have declined.

COPPER

A remarkable feature in copper is the enormous exports which, up to and including March 27, totaled 40,546 tons. Much conjecture has been indulged in as to where all this metal is going, or, at least, what disposition is being made of it, but after all is said it remains but conjecture. Some say it is going into unofficial warehouses abroad, others declare that the Germans are accumulating enormous stocks which for some time will make them practically independent of outside sources, while others say that foreign manufacturers are loading up at the comparatively low prices which have prevailed abroad. Business reports, especially those from England, would scarcely indicate that unusual quantities are being consumed in that country. The exports in February reached a total of 34,384 tons. The month of March opened dull with electrolytic metal held at 14.50c. cash New York, a price which was followed by a decline for the reason that big consumers refused to pay more than 14.37½c. cash New York. The willingness of at least a few producers to accept the lower price paved the way for still lower quotations, and business was done at 14.25c. cash New York in the first week of the month, domestic consumers taking fair quantities. In the second week foreign buying loomed up strong again. On the strength of the better demand an effort was made to send the price up ½c., but consumers refrained from touching copper at the higher price, and the 14.25c. level was for the time adhered to. The statement of the Copper Producers' Association for February had little effect on the market. While stocks were shown to have decreased, this was offset by the fact that domestic deliveries in February were about 12,000,000 lb. less than they were in the same month a year ago, while the combined deliveries of January and February of this year were over 29,000,000 lb. less than those of the same two months in 1913. Toward the middle of the month a good business was done with both domestic and foreign buyers, a movement which was precipitated by the dropping, on March 13, of the cash price to about 14.12½c. New York. This quotation held for two or three days, when there was an advance to 14.25c. cash and on April 18 there was a further advance to 14.37½c. cash New York. Buying subsided with the higher price, and between the last advance and March 26 there was little done. Despite the lull, producers on March 24 again advanced their price, this time to 14.50c. cash New York, a figure which, while called the market, could be shaded. The new quotation was based on an advance caused abroad by speculative bull influences and it occasioned much comment to the effect that it was unjustified by conditions existing in the United States. At the time, many of the mills in Connecticut were operating on a 4 or 5-day week basis and the demand for finished copper and brass products could not be called good. The American Brass Co. on March 13 reduced its prices for hot rolled sheet

copper ¼c. per pound, making the base 19¼c. per pound, and on March 16 it reduced various of its brass products ¼c. per pound also, making the base on high brass sheet metal 15¼c. per pound and high brass rods 15¼c. per pound. Prime Lake copper was scarce throughout March and prices were nominal, or practically so, at all times. The quotation was 15c. cash in the first few days of the month, with the last previous sale made at 15.12½c. Then 14.75c. cash was quoted, but later the nominal quotation was 15.87½c. cash, where it stood March 25. What selling there was in open market was mostly of arsenical and other inferior brands not suited for high-grade brass work and prices for these ranged down to 14.37½c. cash. On March 25, prime Lake was said to be unobtainable for April delivery. The heavy snow and wind storms which swept over the Atlantic coast states in the early days of March helped the copper wire industry by destroying hundreds of miles of telephone and telegraph wires, mile after mile of poles being snapped off at or near the ground, while in other cases they were stripped of cross-arms. The Waterbury average for February was 15.12½c. per pound.

LEAD

At the beginning of March there were more sellers of lead than buyers. At this time 4c. was the New York price, with St. Louis between 3.85c. and 3.87½c., and it was believed that the bottom had been touched, but before the month was over 3.90c. New York was quoted. The exportations of lead, which had become a subject of comment about this time, continued throughout March, gradually growing heavier until, in the week ended March 21, they amounted to 1800 gross tons. The exports of January and February combined were 1577 gross tons. It is to be remembered, however, that the government statistics do not differentiate between strictly American lead and that smelted in bond, but it is certain that with the trouble in Mexico the bonded lead is far below normal. On March 5, 6, and 7 there was a fair business and the price in the West became stronger at 3.90c. St. Louis, but New York remained unchanged until March 26, when the American Smelting & Refining Co. reduced the price 10c. per 100 lb., or 3.90c. During the greater part of March the market was dull, and toward the third quarter independent interests were willing to make concessions in some instances to get business. When the big interest announced the reduction referred to, the St. Louis price dropped to 3.75c. Needless to say, at these prices the metal is exceedingly cheap, and it is predicted that some sellers will withdraw from the market until conditions are bettered.

SPELTER

Not many features of interest are to be noted in spelter's course in March. When the month began, quotations were around 5.35c. New York, with St. Louis 15 points lower. Then came a decline to 5.30c. New York, a price which held until about March 20, when there was a second decline of about 2½ points, making the New York quotation 5.27½c. and that at St. Louis 5.12½c. Business was dull almost steadily throughout the month, with what demand there was coming from the sheet mills. Toward the end of March it was learned that the European stock of the metal, largely held by a syndicate, were rapidly increasing and the foreign market was soft, but at the same time it was pointed out that the margin between New York and London prices was sufficient to forestall any depressing effect on domestic prices. On March 12 the base price of sheet zinc in carload lots at the mill was reduced 25c. to \$7 per 100 lb. basis.

ANTIMONY

March opened with Cookson's at 7.20 to 7.25c.; Hallett's at 7 to 7.25c. and Chinese and Hungarian grades at 6 to 6.25c. In the last week of the month Cookson's was unchanged, Hallett's was quoted at 6.75 to 7c., and Chinese and Hungarian grades at 5.75 to 6c. The market was uniformly dull and there was evidence that consumers were amply supplied.

The Metal Markets

LOCAL METAL PRICES

San Francisco is not a primary market for the common metals except quicksilver. The prices quoted below therefore represent sales of small lots and are not such as an ore producer could expect to realize. Our contracts usually call for settlement on the basis of Eastern prices, less freight and treatment charges. The prices quoted are in cents per pound, except in the case of quicksilver, which is quoted in dollars per flask of 75 pounds.

San Francisco, April 2.

Antimony	9 — 9½c
Electrolytic copper	15½—15¾c
Pig lead	4.05—5.00
Quicksilver (flask)	\$39.00
Tin	40½—42 c
Spelter	6½—6¾c
Zinc dust, 100 kg. zinc-lined cases, 7½ to 8c. per pound.	

EASTERN METAL MARKET

(By wire from New York.)

NEW YORK, April 1.—There was a slight drop in copper at the beginning of the week, but it is now firmer with more demand both for domestic and export trade. Total exports in March were 45,973 tons, which beat all records. Lead and spelter are quiet, the former making the first move for several weeks. Tin is easy at 37.50 to 38.87½c. for spot. Antimony is dull, Cookson's being 7.25c. per pound. Bar silver is 58¼c., and 26.81d. per ounce in London, the latter market being steady. Investment stocks in London were buoyant.

SILVER

Below are given the average New York quotations in cents per ounce, of fine silver.

Date.	Average week ending
Mch. 26.....58.00	Feb. 18.....57.37
" 27.....58.00	" 25.....57.53
" 28.....58.00	Mch. 4.....57.72
" 29 Sunday.....58.00	" 11.....58.23
" 30.....58.00	" 18.....58.04
" 31.....58.00	" 25.....58.06
Apr. 1.....58.12	Apr. 1.....58.02

1913.	1914.	1913.	1914.
Jan. ....63.01	57.58	July ....58.70	....
Feb. ....61.25	57.53	Aug. ....59.32	....
Mch. ....57.87	58.01	Sept. ....60.53	....
Apr. ....59.26	....	Oct. ....60.88	....
May ....60.21	....	Nov. ....58.76	....
June ....59.03	....	Dec. ....57.73	....

A comparison of the totals of silver exported to the chief European and Asiatic countries during January and February of this year with those relating to the same countries during the first two months in 1913 is full of interest. It will be observed from the figures that last year the Asiatic exceeded the European demand. This year the reverse is the case. Also, the European demand is greater by about £376,000 than that of last year, while the Asiatic demand is less by about £553,000, according to Samuel Montagu & Co. It is worthy of remark that the exports to these five countries alone comprise almost the whole of the exports in the periods mentioned, for those to all other countries combined merely amount to about £141,000 in 1913, and about £183,000 in the current year.

Exports to:	1914.	1913.
Russia	£ 448,937	£ 59,840
Germany	481,450	273,590
Netherlands	154,000	375,000
Total	£1,084,387	£ 708,340
China	£ 40,000	£ 115,000
India	898,265	1,376,350
Total	£ 938,265	£1,491,350
Combined total	£2,022,652	£2,199,690

COPPER

Quotations on copper as published in this column represent average wholesale transactions on the New York market and refer to electrolytic copper. Lake copper commands normally 1-5 to 1-4c. per lb. more. Prices are in cents per pound.

Date.	Average week ending
Mch. 26.....14.25	Feb. 18.....14.55
" 27.....14.25	" 25.....14.34
" 28.....14.25	Mch. 4.....14.22
" 29 Sunday.....14.30	" 11.....14.04
" 30.....14.30	" 18.....14.01
" 31.....14.30	" 25.....14.18
Apr. 1.....14.35	Apr. 1.....14.28

Monthly averages.

1913.	1914.	1913.	1914.
Jan. ....16.54	14.21	July ....14.21	....
Feb. ....14.93	14.46	Aug. ....15.42	....
Mch. ....14.72	14.11	Sept. ....16.23	....
Apr. ....15.22	....	Oct. ....16.31	....
May ....15.42	....	Nov. ....15.08	....
June ....14.71	....	Dec. ....14.25	....

Last week the copper market was at first quiet, but by March 24 active buying began and the market stiffened so that on the 25th the price was advanced ½c. with good sales, especially for foreign shipment, chiefly for May and June deliveries. Reports from the Connecticut valley stated that the brass mills are now running nearly full time, instead of half time, as they have been doing recently. Spring construction work is now beginning, and the telephone and telegraph companies are busy repairing the damage done by the heavy storms last winter. The market at the end of the week was quiet but firm. Exports between March 1 and 26 amounted to 81,092,000 lb., as compared with 76,410,000 lb. in the same period last year.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.	Average week ending
Mch. 26.....3.80	Feb. 18.....4.00
" 27.....3.80	" 25.....4.00
" 28.....3.80	Mch. 4.....4.00
" 29 Sunday.....3.80	" 11.....4.00
" 30.....3.80	" 18.....4.00
" 31.....3.80	" 25.....4.00
Apr. 1.....3.80	Apr. 1.....3.80

Monthly averages.

1913.	1914.	1913.	1914.
Jan. ....4.28	4.11	July ....4.35	....
Feb. ....4.33	4.02	Aug. ....4.60	....
Mch. ....4.32	3.91	Sept. ....4.70	....
Apr. ....4.36	....	Oct. ....4.37	....
May ....4.34	....	Nov. ....4.16	....
June ....4.33	....	Dec. ....4.02	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending	Mch. 19.....
Mch. 5.....39.00	26.....39.00
" 12.....38.50	Apr. 2.....39.00

1913.	1914.	1913.	1914.
Jan. ....39.37	39.25	July ....41.00	....
Feb. ....41.00	39.00	Aug. ....40.50	....
Mch. ....40.20	39.00	Sept. ....39.70	....
Apr. ....41.00	....	Oct. ....39.37	....
May ....40.25	....	Nov. ....39.40	....
June ....41.00	....	Dec. ....40.00	....

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date.	Average week ending
Mch. 26.....5.13	Feb. 18.....5.25
" 27.....5.13	" 25.....5.20
" 28.....5.13	Mch. 4.....5.15
" 29 Sunday.....5.13	" 11.....5.13
" 30.....5.13	" 18.....5.10
" 31.....5.13	" 25.....5.10
Apr. 1.....5.13	Apr. 1.....5.13

Monthly averages.

1913.	1914.	1913.	1914.
Jan. ....6.88	5.14	July ....5.51	....
Feb. ....6.13	5.22	Aug. ....5.51	....
Mch. ....5.94	5.12	Sept. ....5.55	....
Apr. ....5.52	....	Oct. ....5.22	....
May ....5.23	....	Nov. ....5.09	....
June ....5.00	....	Dec. ....5.07	....

TIN

New York prices control in the American market for tin, since the metal is almost entirely imported. San Francisco quotations average about 5c. per lb. higher. Below are given average monthly New York quotations, in cents per pound:

Monthly averages.

1913.	1914.	1913.	1914.
Jan. ....50.45	37.85	July ....40.70	....
Feb. ....49.07	39.76	Aug. ....41.75	....
Mch. ....46.95	38.10	Sept. ....42.45	....
Apr. ....49.00	....	Oct. ....40.61	....
May ....49.10	....	Nov. ....39.77	....
June ....45.10	....	Dec. ....37.57	....

The Stock Markets

SAN FRANCISCO STOCKS AND BONDS (San Francisco Stock and Bond Exchange.)

April 1.

BONDS

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Associated Oil Co.	97½	98½	Natomas Consol. Co.	—	26
Unlisted.			Pac. Port. Cement Co.	100	—
Ass. Oil Co.	—	88	Santa Cruz Cement Co.	43½	—
General Petroleum Co.	36	—	Union Oil	—	88

STOCKS

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Amalgamated Oil	—	81½	General Petroleum	2	—
Associated Oil	39½	40½	Noble Electric Steel	75c	—
Giant	—	86	Natomas Consol.	50c	—
Pac. Cst. Borax, com.	—	57½	Pac. Port. Cement	90	94
Pacific Crude Oil	—	30c	Riverside Cement	—	63
Sterling O. & D.	—	1.40	Santa Cruz Cement	55	50
			Stand. Port. Cement	2½	—

NEVADA STOCKS

(By courtesy of San Francisco Stock Exchange.)

April 2.

Atlanta	30	Montana-Tonopah	91.00
Belcher	40	Nevada Hills	30
Belmont	7.75	North Star	35
Con. Virginia	12	Ophir	34
Florence	61	Pittsburg Silver Peak	34
Goldfield Con.	1.40	Round Mountain	32
Goldfield Oro.	12	Sierra Nevada	15
Halfax	80	Tonopah Extension	2.07
Jim Butler	97	Tonopah Merger	64
Jumbo Extension	31	Tonopah of Nevada	6.75
MacNamara	08	Union	10
Mexican	1.10	Victor	28
Midway	34	West End	84
Mizpah Extension	47	Yellow Jacket	30

COPPER SHARES—BOSTON

(By courtesy of J. C. Wilson, Mills Building.)

April 2.

	Bid	Ask		Bid	Ask
Allouez	42½	43	Mohawk	44½	45
Ariz. Commercial	4½	4½	Nevada Con.	15½	16½
Butte & Superior	35½	36	North Butte	28½	29½
Calumet & Arizona	69	69½	Old Dominion	50½	51
Calumet & Hecla	421	424	Osceola	78	79½
Copper Range	37½	37½	Quincy	62	64
Daly West	2½	2½	Shannon	5½	6
East Butte	11½	11½	Superior & Boston	2½	2½
Franklin	6½	6½	Tamarack	36½	37
Granby	89½	89½	U. S. Smelting, com.	39	39½
Greene Cananea	57½	57½	Utah Con.	10½	11
Isle-Royale	19	19½	Winona	3½	3½
Mass Copper	3½	3½	Wolverine	45	46

NEW YORK CURB QUOTATIONS

(By courtesy of E. F. Hutton & Co., Kohl Building.)

April 2.

	Bid.	Ask.		Bid.	Ask.
Braden Copper	8½	8½	La Rose	1¾	1¾
Braden Co.	162	170	Mason Valley	3	3¾
B. C. Copper	2½	2¾	McKinley-Dar.	75c	80c
Con. Cop. Mines	2½	2¾	Mines Co. Am.	2½	2¾
Davis-Daly	7	1¾	Nipissing	5¾	6
Ely Con.	4	6	Ohio Copper	¾	¾
First National	2¾	2¾	Stand. Oil of Cal.	347	347
Giroux	1	1½	Tri Bullion	¾	¾
Hollinger	16	17	Tuolumne	¾	¾
Iron Blossom	1½	1½	United Cop. com.	¾	¾
Kerr Lake	4	4½	Yukon Gold	2¾	3

NEW YORK STOCK EXCHANGE

(By courtesy of J. C. Wilson, Mills Building.)

April 2.

	Bid.	Ask.		Bid.	Ask.
Amalgamated	77½	77½	Miami	23½	24½
Anaconda	35½	35½	Nevada Con.	15½	16
A. S. & R., com.	69	69½	Quicksilver, com.	1½	2
Calif. Pet., com.	26½	27½	Ray Con.	22½	22½
Chino	42½	42½	Tenn. Copper	35½	35½
Guggenheim Ex.	56½	56½	U. S. Steel, pfd.	110½	110½
Inspiration	18½	18½	U. S. Steel, com.	63½	63½
Mexican Pet., com.	68½	67	Utah Copper	67½	67½

Current Prices for Ores and Minerals

(Corrected monthly by Atkins, Kroll & Co.)

The prices are approximate, subject to fluctuation, and to variation according to quantity, quality, and delivery required. They are quoted, except as noted, f.o.b. San Francisco. Buying prices marked *.

	Min.	Max.
Antimony ore, 50%, $\frac{1}{2}$ ton	\$18.00	\$20.00
Arsenic, white, refined, $\frac{1}{2}$ lb	0.02½	0.03½
Arsenic, red, refined, $\frac{1}{2}$ lb	0.08	0.08½
Asbestos, chrysotile	100.00	350.00
Asbestos, amphibole	5.00	10.00
Asphaltum, refined, $\frac{1}{2}$ ton	11.50	20.00
Barium carbonate, precipitated, $\frac{1}{2}$ ton	40.00	45.00
Barium chloride, commercial, $\frac{1}{2}$ ton	40.00	42.50
Barium sulphate (barytes), prepared, $\frac{1}{2}$ ton	20.00	30.00
Bismuth ore, 15% $\frac{1}{2}$ ton	250.00	upward
Chrome ore, according to quality, $\frac{1}{2}$ ton	10.00	12.50
China clay, English, levigated, $\frac{1}{2}$ ton	15.00	20.00
Cobalt metal, refined, f. o. b. London, $\frac{1}{2}$ lb	2.50	
Coke, foundry, $\frac{1}{2}$ 2240 lb	15.00	20.00
Diamonds:		
Borts, according to size and quality, $\frac{1}{2}$ carat	2.00	15.00
Carbons, according to size and quality, $\frac{1}{2}$ carat	55.00	80.00
Feldspar, $\frac{1}{2}$ ton	5.00	25.00
Firebrick:		
Bauxite, $\frac{1}{2}$ M	175.00	
Magnesite, $\frac{1}{2}$ M	190.00	275.00
Silica, $\frac{1}{2}$ M	50.00	55.00
Flint pebbles for tube-mills, Danish, $\frac{1}{2}$ 2240 lb	21.50	22.50
Fluorspar, $\frac{1}{2}$ ton	10.00	15.00
Fullers earth, according to quality, $\frac{1}{2}$ ton	20.00	30.00
Gilsonite, $\frac{1}{2}$ ton	35.00	40.00
Graphite:		
Amorphous, $\frac{1}{2}$ lb	0.01½	0.02½
Crystalline, $\frac{1}{2}$ lb	0.04	0.13
Gypsum, $\frac{1}{2}$ ton	7.50	10.00
Infusorial earth, $\frac{1}{2}$ ton	10.00	15.00
Iridium	55.00	
Magnesite, crude, $\frac{1}{2}$ ton	5.00	7.50
Magnesite, dead calcined, $\frac{1}{2}$ ton	20.00	25.00
Magnesite, brick (see firebrick)		
Manganese ore, oxide, crude, $\frac{1}{2}$ ton	10.00	15.00
Manganese, prepared, according to quality, $\frac{1}{2}$ ton	30.00	70.00
Mica, according to size and quality, $\frac{1}{2}$ lb	0.05	1.00
Molybdenite, 95% MoS ₂ , $\frac{1}{2}$ ton	500.00	750.00
Monazite sand (5% thorium), $\frac{1}{2}$ ton	150.00	200.00
Nickel metal, refined, $\frac{1}{2}$ lb	0.45	0.60
Ochre, extra strength, levigated, $\frac{1}{2}$ 100 lb	2.00	2.50
Osmiridium, $\frac{1}{2}$ oz	25.00	
Platinum, native, crude, $\frac{1}{2}$ oz	30.00	45.00
Silica lining for tube-mills $\frac{1}{2}$ 2240 lb	35.50	37.50
Sulphur, crude, $\frac{1}{2}$ ton	20.00	25.00
Sulphur, powdered, $\frac{1}{2}$ ton	30.00	35.00
Sulphur, 80%, $\frac{1}{2}$ ton	16.50	18.50
Talc, prepared, according to quality, $\frac{1}{2}$ ton	20.00	50.00
Tin ore, 60% $\frac{1}{2}$ ton	450.00	500.00
Tungsten ore, 65%	425.00	450.00
Uranium ore, 10% uila	25.00	per unit
Vanadium ore, 15% V ₂ O ₅ , $\frac{1}{2}$ ton	150.00	180.00
Wolframite (see tungsten ore)		
Zinc ore, 50% up, $\frac{1}{2}$ ton	*15.00	20.00

Current Prices for Chemicals

(Corrected monthly by Braun-Knecht-Heilmann Co.)

Prices quoted are for ordinary quantities in packages as specified. For round lots lower prices may be expected, while in smaller quantities advanced prices are ordinarily charged. Prices named are f.o.b. San Francisco and subject to fluctuation. Other conditions govern Mexican and foreign business.

	Min.	Max.
Acid, sulphuric, com'l, 66°, drums, $\frac{1}{2}$ 100 lb	\$0.85	\$1.10
Acid, sulphuric, com'l, 66°, carboy, $\frac{1}{2}$ 100 lb	1.25	1.75
Acid, sulphuric, C. P., 9-lb. bottle, bbl., $\frac{1}{2}$ lb	0.13	0.18
Acid, sulphuric, C. P., bulk, carboy, $\frac{1}{2}$ lb	0.09½	0.12
Acid, muriatic, com'l, carboy, $\frac{1}{2}$ 100 lb	1.85	3.00
Acid, muriatic, C. P., 6-lb. bottle, bbl., $\frac{1}{2}$ lb	0.15	0.20
Acid, muriatic, C. P., bulk, carboy, $\frac{1}{2}$ lb	0.10½	0.15
Acid, nitric, com'l, carboy, $\frac{1}{2}$ 100 lb	6.00	6.50
Acid, nitric, C. P., 7-lb. bottle, bbl., $\frac{1}{2}$ lb	0.16	0.22
Acid, nitric, C. P., bulk, carboy, $\frac{1}{2}$ lb*	0.12½	0.15
Argols, ground, bbl., $\frac{1}{2}$ lb	0.10	0.20
Borax, cryst. and conc., bags, $\frac{1}{2}$ 100 lb	3.00	4.35

*Extra charge for packing nitric acid for shipment to conform to regulations.

Borax, powdered, bbl., $\frac{1}{2}$ 100 lb.	3.38	4.50
Borax glass, gd. 30 mesh, cases, tin lined, $\frac{1}{2}$ 100 lb.	10.50	13.60
Bone ash, 60 to 80 mesh, bbl., $\frac{1}{2}$ 100 lb.	6.60	4.80
Bromine, 1-lb. bottle, $\frac{1}{2}$ lb.	0.55	0.85
Clay, domestic fire, sack, $\frac{1}{2}$ 100 lb.	1.50	2.00
Cyanide, 98 to 100%, 100-lb. case, $\frac{1}{2}$ lb.	0.18	0.22
Cyanide, 98 to 100%, 300-lb. case, $\frac{1}{2}$ lb.	0.18	0.22
Cyanide, 120%, 100-lb. case, $\frac{1}{2}$ lb.	0.22	0.26
Cyanide, 120%, 300-lb. case, $\frac{1}{2}$ lb.	0.22	0.26
Lead acetate, brown broken casks, $\frac{1}{2}$ 100 lb.	9.00	10.50
Lead acetate, white broken casks, $\frac{1}{2}$ 100 lb.	10.50	10.75
Lead acetate, white, crystals, $\frac{1}{2}$ 100 lb.	12.50	13.25
Lead, C. P., test, gran., $\frac{1}{2}$ 100 lb.	13.00	16.00
Lead, C. P., sheet, $\frac{1}{2}$ 100 lb.	15.00	18.00
Litharge, C. P., silver free, $\frac{1}{2}$ 100 lb.	11.50	13.50
Litharge, com'l., $\frac{1}{2}$ 100 lb.	8.00	9.50
Manganese ox., blk., dom. in bags, $\frac{1}{2}$ ton	20.00	25.00
Manganese ox., blk., Caucasian, in casks, $\frac{1}{2}$ ton	39.00	60.40
(85% MnO ₂ —15% Fe)		
Nitre, double ref'd., small cryst., bbl., $\frac{1}{2}$ 100 lb.	7.00	8.00
Nitre, double ref'd., granular, bbl., $\frac{1}{2}$ 100 lb.	6.50	7.50
Nitre, double ref'd., powdered, bbl., $\frac{1}{2}$ 100 lb.	7.25	8.00
Potassium bicarbonate, cryst., $\frac{1}{2}$ 100 lb.	12.00	15.00
Potassium carbonate, calcined, $\frac{1}{2}$ 100 lb.	7.50	9.00
Potassium permanganate, drum, $\frac{1}{2}$ lb.	0.10	0.13
Silica, powdered, bags, $\frac{1}{2}$ lb.	0.03	0.05
Soda, carbonate (ash), bbl., $\frac{1}{2}$ 100 lb.	1.50	1.75
Soda, bicarbonate, bbl., $\frac{1}{2}$ 100 lb.	2.00	2.50
Soda, caustic, ground, 98%, bbl., $\frac{1}{2}$ 100 lb.	3.00	3.25
Soda, caustic, solid, 98%, drums, $\frac{1}{2}$ 100 lb.	2.50	2.75
Zinc shavings, 850 fine, bbl., $\frac{1}{2}$ 100 lb.	12.00	13.00
Zinc sheet, No. 9—18 by 84, drum, $\frac{1}{2}$ 100 lb.	10.20	11.00

Company Reports

GREAT BOULDER PERSEVERANCE GOLD MINING CO.

The last quarterly statement of this Kalgoorlie company shows the following:

Development, feet	1,536
Broken ore in stopes, tons	200,178
Value, per ton	\$6
Ore treated, tons	57,267
Gold yield	\$278,500
Working costs, per ton	\$4.30

Generally, development was satisfactory.

MYSORE GOLD MINING CO., LIMITED

This is one of the great gold mines of the world and is situated in the state of Mysore, India. The report for 1913 is replete with every detail, and covers 75 pages with an index and large plan of the mine. The report of Arthur Gifford, the superintendent, shows the following:

Labor:	
Europeans, 171; Eurasians, 108; Indians, 8312..	8,591
Machine-drills working	110.9
Lowest working-level, feet	3,226
Development, feet	27,331
Stopping, fathoms	17,467
Other work, fathoms	427
Ore reserves, tons	1,377,102
Rock rejected, tons	59,616
Ore stamped, tons	302,662
Sand and slime treated, tons	264,829
Total gold yield, ounces	232,178
Revenue	\$4,330,000
Profit	2,352,000
Dividends	1,824,000
From 1884 to 1914:	

Ore treated, tons	3,917,109
Gold yield	\$73,344,000
Dividends	35,530,000

APOROMA GOLDFIELDS, LIMITED

This Company owns 1277 acres of gold placer deposits near the Bauri river, province of Sandia, Peru. The report is for

the year ended March 31, 1913. Hydraulic machinery has been installed. The Company's largest reservoir, which was destroyed by a flood in December 1912, has been rebuilt. Two other smaller reservoirs have had their capacity increased. The water-supply available from these sources should in future enable continuous sluicing operations to be carried on upon a limited scale for about eight months in each year. Owing to the accident to the large reservoir, gravel washing during the year under review has been restricted. There was 48,500 cu. yd. of gravel washed, realizing \$7400, showing a net recovery of 15c. per cubic yard.

PREMIER DIAMOND MINING COMPANY, LTD.

This Company operates at Pretoria, Transvaal, and the report for the year ended October 31, 1913, shows the following:

Ground washed, loads of 1600 lb. each	10,434,680
Yield per load, carats	0.202
Total output, carats	2,107,983
Value per carat	\$5.32
Value per load	\$1.08
Cost per load	\$0.62
Total value of output in 1913	\$11,216,000
Total value of output in 1912	9,620,000
Stock of diamonds unsold at October 31, 1913	2,210,000
Operating profit	4,061,000
Dividends for Company	1,920,000
Royalty for Transvaal Government	2,400,000
Carried forward	528,000

MONTANA-TONOPAH MINES COMPANY

Monthly outputs and details of mine development of this Company have been given regularly in this journal, and results for the year ended August 31, 1913, need only be summarized now. Arthur H. Lawry, the superintendent, reports as follows: Development covered 10,243 ft., against 10,076 ft. in 1912. This work was confined to the opening of the different veins, and to the exploration of their walls and blocks of unexplored territory on the various levels. Although no new veins were discovered, bodies of good mill ore were found in the undeveloped portions of each of the known veins. The most important discoveries made during the year were in the Shaft and Triangle veins, in which good bodies of high-grade ore were found. The cost was \$4.86 per foot, a reduction of 37c. from 1912. Ore reserves are roughly estimated at 32,000 tons, as the veins are broken and faulted. Mining cost \$2.62 per ton. The mill treated 52,402 tons, yielding 8978 oz. gold and 784,494 oz. silver, worth \$665,208. The recovery was 91.2%. Silver averaged 61.15c. per ounce. A dividend of \$100,000 was paid, \$156,757 advanced to the Commonwealth Mining & Milling Co., and cash assets are \$312,051. Detailed costs of mining and treatment will be given in another issue of this journal.

COMMONWEALTH MINING & MILLING COMPANY

This Company is a subsidiary of the Montana-Tonopah Mines Co., and operates at Pearce, Arizona. A new 300-ton mill is now in operation. The report covers the year ended April 30, 1913. The superintendent, Edgar A. Collins, says in part: The past year has been one of preparation entirely, no ore having been shipped. A certain amount of ore was necessarily broken in the development and stope preparation work. This has been hoisted to surface and placed on the mill ore dump, or has been stored underground at some suitable point. Shipments of old tailing, averaging 50 tons per day, have been made by the Calumet & Arizona smelter under its contract with this Company. Development covered 6773 ft., of which 82% was away from the vein, at a cost of \$4.11 per foot. Station and ore-bin cutting cost 12.2c. per cubic foot. The total ore reserves, averaging \$5.35 per ton, are worth \$1,378,000. This is down to about No. 7 level. Churn-drilling was done in 1912, but the ground was so hard and fissured

that it was abandoned. The cost was \$9.57 per foot. The new mill cost \$335,271, supplied by the Allis-Chalmers Co., Mine & Smelter Supply Co., Oliver Continuous Filter Co., Stearns-Roger Manufacturing Co., Merrill Metallurgical Co., Pacific Tank & Pipe Co., and the Ingersoll-Rand Co. B. A. Bosqui is mill superintendent.

VAN RYN GOLD MINES ESTATE, LIMITED

This Company operates on the Rand, and the report is for the year ended June 30, 1913. It may be summarized as follows:

Ore reserves, tons	2,064,529
Value, per ton	\$6.50
Ore treated, tons	456,190
Gold recovered	2637.788
Dividends	237,500
Transvaal Government tax	25,598
Miners' phthisis expenses	4,618
Costs per ton:	
Mining	\$1.85
Development	0.45
Milling	0.46
Sorting, crushing, and transport	0.16
Cyaniding sand and slime	0.36
General, London, and Johannesburg	0.54
Total	\$3.82

DALY-JUDGE MINING COMPANY

The Daly-Judge Mining Co. operates an area approximately 4000 ft. wide and 11,000 ft. long, on the trend of the Ontario-Daly-West vein system at Park City. Another group of claims, of 120 acres, is in the Big Cottonwood cañon, two miles west of the main property. Formations are of altered sedimentaries, quartzite, limestone, shales, and quartz-dolerite. Dikes of diorite and porphyry are found filling several fissures, according to a geological report by George D. Blood. Normal faulting is a feature of the Daly-Judge area. Ore deposition is closely associated with fissuring, the ore occurring as fissure filling, as replacements of wall rocks and of certain beds some distance from the fissures. Ore of milling grade greatly exceeds in quantity that which may be marketed directly, but milling is done to separate zinc from lead-silver minerals. The mine is operated through an adit 6600 ft. long, and a vertical shaft 1600 ft. deep. The former cuts the latter at its 1200-ft. station, and serves as an outlet for ore to the shipping bins and mill in Empire cañon, near Park City. Waste is hoisted to the collar of the shaft. Levels have been driven from the shaft at 500, 700, 900, 1100, 1200, 1400, 1500, and 1600 ft. below the collar. Three levels have been extended from the Daly West into the Daly-Judge, corresponding to the latter's 1900, 2100, and 2300-ft. levels. When completed, the Snake Creek tunnel will serve as an outlet and drainage channel for the southwest portion of the property. The general superintendent, O. N. Friendly, reports to the general manager, G. W. Lambourne, as follows: A large number of improvements were made to the main adit, such as 8000 ft. of new rails, replanking, timbering, etc. Excluding work done in ore, development covered 16,461 ft. Good ore was mined from the Daly vein above the 500-ft. level. At 700 ft., 5912 tons was extracted; 17,533 from 900 ft. and 5881 from 1100 ft. Fissure No. 1222, the Middle and Back veins are opening well. On the 2300-ft. level, on the Daly and Ontario veins, work covered 1654 ft. Top-slicing was adopted during the year for the Daly ore-bodies. The mill treated 48,943 tons of ore in 376 days of 8-hours each, producing 11,909 tons of lead concentrate, and 3719 tons of zinc middling. Ore sold amounted to 4954 tons. The year's revenue was \$617,393; balance from 1912, \$524,478; expenses, \$469,521; dividend, \$180,000; balance at end of 1913, \$492,350.

Decisions Relating to Mining

EAST TINTIC DECISION REVERSED

In a decision rendered February 2, 1914, the Secretary of the Interior has reversed the former ruling of the Interior Department in the matter of the East Tintic lodes. (41 Land Decisions 255). The effect of the new ruling is to give the Department's approval to discoveries of mineral made through diamond drill borings and to permit such borings to count as common improvements toward patent. The new decision has caused rejoicing among Utah mining men.

CANCELLATION OF MINERAL ENTRY—EFFECT OF

Where a mineral entry has been finally canceled by order of the Commissioner of the General Land Office after application for patent and after acceptance of purchase money, the mere fact that the money remains on deposit in Washington does not create any equity in the land in favor of the applicant. He is relegated to his former position as a mere locator and if he fails to perform his annual assessment work during the ensuing year, his claim becomes forfeited upon the subsequent location by another person, made after the expiration of said year in which work was not performed.

Shank v. Holmes (Arizona) 137 Pacific, 371. January 14, 1914.

CONFLICT BETWEEN CALLS OF NOTICE AND BOUNDARIES

In a suit on an adverse claim the defendant proved that his location end-stakes were placed at a greater distance from the discovery point than called for in the location notice. Defendant claimed that the position of the stakes in the ground should prevail over the calls of the notice. When the survey for patent was made the lines were swung within the limits of the marked boundaries so as to include some rich ground claimed by plaintiff under a location junior to defendants. Held that defendant could not make an excessive location and then remodel it to suit subsequent developments, and that in a case such as the one at bar the calls of the location notice should fix the limits beyond which stakes could not be set. Title to the disputed area was awarded plaintiff as being subject to the valid junior location.

Swanson v. Koeninger (Idaho), 137 Pacific, 391. December 24, 1913.

ROUND MOUNTAIN CASE AGAIN

The Supreme Court of Nevada has reversed itself on rehearing in the case of Round Mountain Mining Co. v. Round Mountain Sphinx Mining Co., granting a new trial. The former ruling of the court that where the patent upon its face showed a conflict in area and ambiguity, the field notes were admissible in evidence to explain the ambiguity and determine priority of location was reaffirmed. The court, however, reconsidered its former ruling that priority of a location as shown by the field notes would open the case to a determination of its validity by the courts, as other elements such as discovery might enter into the matter. It was held, moreover, that as respondent had failed to adverse during application for patent it was forever estopped from raising questions not directly appearing from an inspection of the patent and field notes, that the findings of the Land Department cannot be set aside by a mere showing of apparent conflicts in priorities in the field notes, and that no conclusion of law in favor of the senior locator can be presumed therefrom.

Round Mountain Mining Co. v. Round Mountain Sphinx Mining Co. (Nevada), 138 Pacific, 71. January 3, 1914.

Book Reviews

PHYSICAL MEASUREMENTS. By A. Wilmer Duff and Arthur W. Ewell. P. 244. Ill., index. Philadelphia, 1913. For sale by the *Mining and Scientific Press*. Price \$1.50.

The third edition of a text-book on physical measurements designed for college students and written by two professors of the Worcester Polytechnic Institute. The book is intended for laboratory work where the apparatus mentioned is at hand.

ANNOTATED BIBLIOGRAPHY OF IOWA GEOLOGY AND MINING. By Charles Keyes. Iowa Geological Survey. Vol XXII. Pp. 908. Des Moines, 1913.

This is an unusually complete bibliography and is of interest and value to all who have occasion to study either geology or mining in the Middle West, since Iowa is but a portion of that great region, and papers descriptive of it are in the main equally descriptive of much of the surrounding area.

THE ELECTRIC FURNACE. By Alfred Stansfield. P. 415. Ill., index. McGraw-Hill Book Co., New York, 1914. For sale by the *Mining and Scientific Press*. Price \$4.

On account of the rapid development of the electric furnace since the first edition of this book, in 1907, the present edition was necessary in order to bring the work approximately up to date and to include all recent developments of importance. The second edition has been in preparation for three years, and contains double the quantity of material that appeared in the original book. The history of electric smelting, design and operation of furnaces, and results of laboratory furnaces are subjects which are interestingly covered at some length. The chapters on the manufacture of iron, steel, zinc, copper, nickel, and other metals by means of electric furnaces are especially pertinent and of great value. Mr. Stansfield has contributed an excellent work on a subject which is of growing interest to all modern metallurgists.

THE MINING MANUAL AND MINING YEAR BOOK FOR 1914. By Walter R. Skinner. P. 1240. Ill., index. Walter R. Skinner, and *Financial Times*, London, E. C., 1914. For sale by the *Mining and Scientific Press*. Price \$6.

This indispensable compilation is now in its twenty-eighth year, and appears with its usual promptitude. The author's preface briefly covers mining throughout the world during the past year, and the current year's prospects. Seventeen pages give statistics of gold outputs of the leading mines. As was stated in the last issue, the volume is divided into two main divisions, 'African' and 'Miscellaneous,' occupying 390 and 540 pages respectively. These give all necessary information on mines in Africa and the rest of the world, whether they produce gold, silver, copper, lead, or zinc. A directory of mining directors covers 202 pages; mining secretaries, 43 pages; mining and consulting engineers, mine managers, etc., 35 pages; mining terms, 8 pages; and an appendix with new company registrations up to the end of January 1914, 7 pages. This book will be found useful in libraries, editorial rooms, mining companies' offices, stockbrokers' offices, and by mining men in all branches of the industry.

DETAILS OF CYANIDE PRACTICE. By Herbert A. Megraw. P. 215. Ill., index. McGraw-Hill Book Co., Inc., New York, 1914. For sale by the *Mining and Scientific Press*. Price \$2.

Although the millman who operates a treatment plant is the best person to explain the sundry troubles and general results met with, yet the man who has been through it all,

and visits other mills, is well able to study their practice and compare it with his and other experiences. The descriptions of plants in this volume were first published in 1912 and 1913 in *The Engineering and Mining Journal*, and attracted a good deal of attention, followed by some discussion on the points raised. The author's examinations included the following: the Cobalt district, Ontario; Nipissing high-grade mill; the Hollinger mill, Porcupine; cyaniding at the Dome mill; practice in the Black Hills, South Dakota; the Liberty Bell mill, Telluride, Colorado; practice at Cripple Creek; practice at Tonopah; practice at the Nevada Wonder mill; methods at Republic, Washington; the mills of Grass Valley, California; the Gold Road mill, Arizona; two Arizona mills; and discussion on various subjects. The presswork is generally good, but several half-tones are very poor.

HOW TO BUILD UP FURNACE EFFICIENCY. By James W. Hayes. P. 126. Ill. Published by the author, Chicago, 1914. For sale by the *Mining and Scientific Press*. Price, \$1.

The way to build up furnace efficiency, according to Mr. Hayes, is to teach the fireman how to do it, not by relying on a consulting engineer's infrequent visits. The logic of this argument compels respect, and Mr. Hayes has contributed much toward putting his idea into practice by writing this little book in so readable a form that the aforesaid fireman can be reasonably expected to read and digest it. But the reviewer closes the interesting little volume with words suggesting that much of what has been directed at the fireman is really intended to produce an effect on the manager, a suspicion confirmed by the epigram on page 26: "It is a short distance, as the crow flies, from the manager's office to the boiler room, but it is a dickens of a long road by the route the manager travels." Not a few managers make a fad of motion study in the shop, while dollars are being shoved away in the boiler room. The book is so interestingly written that it holds the attention of the general reader, and even the man who only uses coal for household purposes ought to be able, as a result of the useful hints received, to save many times the cost of the volume.

THE COPPER HANDBOOK. By Walter Harvey Weed. Vol. XI, 1912-1913. P. 1413. Published by the author, Houghton, Michigan, 1914. For sale by the *Mining and Scientific Press*. Price \$5.

The long expected and much needed revision of the Copper Handbook has been accomplished and in the new volume is found an enormous mass of useful information. Mr. Weed, the new editor, follows the lines laid down by the founder, the late Horace Stevens, but has introduced features that give additional value to the work. The material is classified into five parts. The first includes the usual detailed descriptions of mines in North America. The second is a geographical index which permits the quick finding of a mine when the name of the company has slipped from mind. The third comprises descriptions of mines in foreign countries and here the detail covering South American countries seems sure to be of large immediate value. The fourth part is a handy compendium of the significant statistics of copper and copper mining. The fifth part is a register of the dead copper mines with reference to the earlier volumes in which details will be found. Mr. Weed has wisely continued the policy of including all mines that produce copper even if the latter is incidental. The book becomes therefore, at least in part, a general register of metal mines. While from this point of view it is not complete, as could hardly be expected, it is the best book available in this field. The careful reader will note that the new editor's criticisms, if couched in less picturesque language than occurs in the earlier volumes, is not less penetrating and frank and it is evident that 'The Copper Handbook,' which has become an institution, has fallen into good hands.

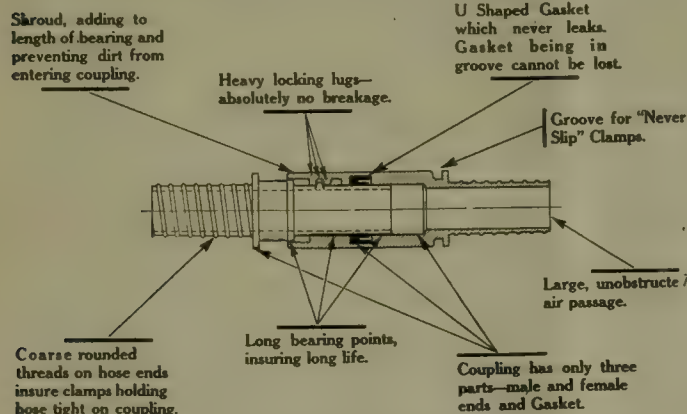
Industrial Progress

The Neverleak Coupling

Air leakage is one of the prolific sources of loss around a mine. At 80-lb. pressure it is calculated that a 1/64-in. hole permits a loss of 0.33 cu. ft. per minute, and a 1/32, of 1.33 cu. ft. An air wastage of 100 cu. ft. per minute, the equivalent of the output of a small compressor, would result from 75 leakages of that size. At the higher pressures now coming into use the leakage would be much greater. In many a



mine the pipes sing constantly and it is, unfortunately, the exception to go into a stope or a heading and not find one or more couplings that leak. The old style malleable iron union depends upon a flat gasket. It must be screwed up tight and the gasket must be in place or there will be leakage. In the hurry of getting work started these simple precautions are often neglected, and if no gasket be nearer than the shaft bottom, the coupling may even be put in service without any. Many attempts have been made to make a simple coupling that would avoid these difficulties, and the Cleveland Rock Drill Co. is now placing on the market a 'Neverleak' hose coupling which, it is believed, does so. The principle in-



DETAILS OF THE COUPLING AND CONNECTIONS.

involved is clear from the attached figure. In place of the plain gasket of the ordinary union, a V-shaped rubber gasket is placed in a groove in such manner that the air which would ordinarily cause the leak, expands the fold, pressing one side against the male and the other the female end of the coupling. Being held in a groove it is secure from loss. The coupling may be put together without a wrench, has no projecting parts to catch as the hose is dragged, and is so made, in 12 sizes, that any male end can be joined to any female end, whether hose or pipe. Construction details are shown in the figure.

RUMSEY & Co., LTD., are distributing a small folder giving details of their power pumps for industrial purposes, including belted and electric-driven triplex types.

Tandem Electric Locomotive

We print herewith a picture of the 4-ton tandem locomotive used by the National Copper Mining Co. at Mullan, Idaho, and described in the *Mining and Scientific Press*, February 21, 1914. The weight of each unit is 8000 lb.; length, 10 ft.



TANDEM LOCOMOTIVE.

5 in.; height, 3 ft. 2 in.; width, 4 ft.; journals, 2 3/4 by 4 in.; diameter of drivers, 24 in.; wheel-base, 3 ft. 2 in.; gage, 2 ft. There are two 901 B Westinghouse motors, running at 250 volts. The locomotive was built by the Baldwin Locomotive Works, and the object of having two units was to get adequate power on a narrow track, distribute the weight on the rails, and furnish the extra power needed on the line outside the mine without increasing the train crew.

The DENVER FIRE CLAY Co. now has ready for distribution its 1914 catalogue, containing complete descriptions and pictures of all the various furnaces and fire-clay goods made by this pioneer firm. In comparing this with older editions, one

is at once struck with the progress made in the use of gas and oil as fuel in metallurgical work. Indeed, the Company advises that "if you are using coal, coke, or wood, you are behind the times and are losing money on your fuel bills." It was but a few years ago that it was unsafe to use an oil furnace because the irregular distribution of the heat made it impossible to secure uniform results. That day, however, seems definitely to have passed, and a bewildering variety of tried furnaces is now offered for sale. Attention is called to the fact that goods sold by the Denver Fire Clay Co. are manufactured entirely by that concern, which not only mines, shapes, and burns the clay, but casts the iron parts as well, and, in short, controls the whole process of manufacture. As no mine is complete without some laboratory, this catalogue will be in wide demand.

RECENT studies of mine-rescue apparatus point to a reaction against the use of the helmet type of pneumatophors. The trouble is that it seems impossible to always make a close and safe connection between the helmet and the wearer's face because of the irregularity in outline involved. In cases where poisonous gases are entered, which are not odorous, there is a constant and unsuspected danger. For this reason the mouth-breathing apparatus is preferred, and in a recent report by Haldane the helmets are severely criticized.

The STEVENS-ADAMSON MFG. Co.'s catalogue, section 3, No. 19, contains useful charts for calculating capacities and horsepower of belt-conveyors, complete descriptions of 'S-A' apparatus, and an impressive set of pictures illustrating the wide variety of uses to which the belt-conveyors built by this Company are put.

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EDITORIAL

COOL, in Eldorado county, California, comes forward with a story of a water can left standing on an ore pile during an electric storm, and which was found, when the clouds cleared, to have become gold plated. Our correspondent vouches for the facts, so we can but pass the matter on to the Electrochemical Society for discussion at New York. We had always understood that clouds were silver lined, but apparently they do things differently in the Golden State.

LITIGATION over rights in disputed ground seems likely to lead to a bitter controversy at Tonopah, Nevada. The question at issue is between the Jim Butler and the West End, and repeated conferences have been held in hopes that a compromise might be effected. Apparently all such expectations have been given up and the courts must decide the matter. It is greatly to be regretted that the long record for harmony maintained at Tonopah is to be broken.

'GOLD is where you find it,' according to the miner's adage, and from Siberia to the Rand the trail of the prospector is marked with mineral locations attesting the truth of this statement. Mr. Douglas Mawson, of Adelaide, Australia, who has recently returned from a two-year exploration of Antarctic regions, reports the discovery of many mineral deposits in this far-off land. While their extent could not be determined owing to the depth of snow and ice, many of them are reported as rich, and a coal bed of large extent was also uncovered. It may be that further exploration will prove that the rainbow does end in the Antartics.

A FIRST regular meeting for the purpose of organization of the Nevada Safety Commission will be held at Reno on April 18. It will be remembered that a Safety First Congress was held at Reno under the auspices of the University of Nevada last January. At this time a committee of nine was appointed by the Governor to consider the advisability of a permanent organization. The meeting on April 18 will be for the purpose of permanent organization and the adoption of the constitution and by-laws. The work of the organization will be directed by a board of 75 directors, which will be subdivided into six committees for the administration of the different branches of the work. The committees will be known as the mining, transportation, agricultural, power, varied industries, and

publicity committees. The subject of proper representation at the Panama-Pacific Exposition will also be discussed at this meeting. From both a humanitarian and efficiency standpoint, the safety-first movement is of prime importance to both employer and employee, and as such it is to be hoped that the work of this new organization will meet with that measure of success which such an organization warrants.

MATTERS of much interest to mining men and metallurgists not directly concerned will be presented at the meeting of the American Electrochemical Society in New York next week. At the Saturday morning session, Mr. E. A. Smith is to give a general lecture on progress in leaching and electrolytic treatment of copper ores in South America. One does not need to be concerned with the technology of electrochemistry to appreciate the importance of the Chuquicamata to the copper market, and Mr. Smith's work in connection with the treatment of Chuquicamata ore is sure to be wide reaching in result. His paper will be followed with a number of others dealing with questions of ore treatment and the advance announcement indicates that the New York meeting of this most excellent society will be quite up to the standard already set.

MINERAL production of Mexico for November 1913, as compiled by the Bureau of Statistics of the Department of Hacienda, shows a material decline in practically all branches of the industry during this period as compared with the same period of the preceding year. Coin silver, minor mineral products, and petroleum showed a slight increase in exports, but these by no means compensated the general decline. The exportation of gold for the month under review amounted to \$2,561,941, while that of the previous year was \$3,561,599, which is a loss of \$999,658. The decline in silver production was even more pronounced, the exports for November 1912 being \$8,158,786, while in 1913 they fell to \$4,432,277, being a decline of \$3,726,509, or about 48 per cent. The decline in copper exports was most significant and due of course to the rebel activity in northern Sonora and Chihuahua. The exports of copper reported for November 1912 totaled \$2,177,654, while in 1913 they fell to \$243,216, a decline of \$1,934,438. The decline in the exports of other minerals during November 1913, as compared with the same month of 1912 was as follows: antimony, \$52,644; asphalt, \$41,526; marble, \$62,500, the total production for November 1913 amounting to only \$2000; graphite, \$42,200, there being no production during November 1913; the decline in lead was \$382,000; and zinc, \$72,323, there being no zinc exported during November 1913. Petroleum showed a gain of \$599,637. The total valuation of the mineral exported during November 1913, according to the government's statistics, was \$9,121,065, as compared with \$16,066,692 for the same period of the preceding year.

GROWTH of the Canadian Mining Institute has necessitated the establishment of a monthly bulletin in order that members may be kept in touch with the activities of the organization. So long as the Institute was small, personal letters and attendance at the annual meetings served this purpose sufficiently; but the Institute is no longer small, its membership is widely scattered, and, as is true of other national engineering societies, only the minority can be expected to attend the meetings in person. Those who have enjoyed the hospitality of the Canadian Institute, while rejoicing in the recognition of success implied by the larger membership, will hardly escape a feeling of regret that the old days of a small circle of friends and men who are more to each other than names has passed. Prosperity has drawbacks as well as advantages.

The Marañon Placers Again

The recently issued first annual report of the Peru Gold Placers, Incorporated, contains a reproduction of the report upon the Marañon placers by Mr. Raymond McCune with various accompanying papers. It gives practically no information not made available months ago, but is prefaced by a letter from the president of the corporation, Mr. David T. Marvel, which contains the statement that "Your directors feel convinced that no question can be raised as to the conservatism, honesty, and substantial accuracy of Mr. McCune's report." This raises a question as to what constitutes "conservatism" and "substantial accuracy" in the minds of Messrs. William R. Bassett, Henry H. Bowman, Alexis L. du Pont, Otto R. Hartmann, David T. Marvel, Charles S. Miller, and John J. Raskob, who are the directors in question. As we pointed out editorially, February 7, the report is the very antithesis of conservative, if judged by the standards of any intelligent engineer familiar with the testing of placer ground, and it is a play on words to apply to it even the elastic term "substantial accuracy." Another interesting feature of the report is the statement that "Mr. Robert S. Miller, of Miller, Franklin & Company, Efficiency Engineers of New York City, went to Peru to check Messrs. McCune, Henry, and Menard, and his report fully confirms their findings." Mr. Miller's own letter, which is published with the report, is obviously that of one totally inexperienced in placer examinations, one who is merely an onlooker. Boiled down to facts, he states that he saw gold in pannings from over 75 per cent of the test holes. So did, it will be remembered, certain investigators in Santa Domingo of whom we had recent occasion to write. This is not "checking" an examination, and Mr. Miller's "belief" that the value of the property will be greater than Mr. McCune has estimated, is deserving of all the weight attached to the belief of any other amateur and no more. Wonderful things are expected of 'efficiency engineers' in these modern times, but some limits must be respected.

The whole matter as heretofore presented to the public is one of belief, not of proof. Furthermore, the basis for the belief as yet advanced is not convincing to men experienced in such matters. Indeed, capable engineers who have made examinations, and thorough ones, in the very district concerned, laugh at the claims made by the Peru Gold Placers company. We are disposed to believe that the directors are allowing their hopes to cloud their judgment, but others are not so charitable and protest that the whole matter is a thinly disguised scheme to milk the public. Certainly any director who cares for his reputation and who does not know better than to allow his name to be used as in this report, would do well to seek advice from some experienced as well as trusted friend.

The Radium Bill

Washington has been much concerned these past few weeks with various proposals to amend the mining law. We have, from time to time, commented on the different bills, and in our 'Special Correspondence' columns this week we present a general summary of the present situation. It now seems certain that the commission to codify the mining laws will be created, that the Alaska coal lands will be leased, and that acts providing the leasing of unreserved coal, oil, phosphate, and potash lands, and the 'radium' bill will be passed in some form. Probably none of these has excited as much feeling as the radium bill. As reported to the Senate in amended form this reserves to the United States a prior right to purchase at market price, radium-bearing ores produced from claims on public lands hereafter located. It also provides funds for erecting and operating a laboratory for treatment of radium ores for the government hospitals. These proposals have called out violent opposition, especially in Colorado, and the proponents have been equally positive that a vital matter was under consideration. We confess that we have been unable to see any adequate reason for all this excitement.

The therapeutic properties of radium are still largely undetermined. In treatment of certain diseases, notably cancer, beneficial results have been obtained, and competent medical practitioners believe that with large quantities to work with, even better results, amounting possibly to cures, could be secured. This, however, is far from being as certain as many have been led to believe by the highly sensational reports that have been printed. If, however, any such benefits are possible it is certainly proper that every effort should be made to realize them. In the meantime private concerns are producing radium, though in small quantities, and the price is both high and speculative. It is altogether probable that the material can be furnished to the government hospitals at lower rates under the terms of the bill through purchase of the ore as proposed than through buying the finished material as now. The existing refineries control their own supplies of ore.

They will be in no way dependent upon the Government in event of passage of the bill. The only harm that can come to them is through the breaking of a potential monopoly, since the Secretary of Interior will have authority to sell any radium or by-products not needed for government use. Lands located prior to the passage of this act will not come under its provision, and, since the matter has been debated for some months, during which time the search for such lands has been active, it may be safely assumed that the known lands are already located. The ore taken by the Government is to be paid for at market rates ascertained (not fixed) by the Secretary of Interior and announced on the first of January and of July for each year. Upon tender of ore by the miner and its refusal by the Department, all the rights of the latter cease. In effect the Government reserves a perpetual option to purchase the ore at the market price. It is hard to see how this can work out to much if any hardship. It is true that it is a departure from precedent, though that alone is not sufficient ground for condemning it. The real value of radium is still largely undetermined and the money appropriated in this bill is properly to be considered as devoted to experimental research. It may turn out well or it may prove to be wasted, but the amount is small in proportion to the possible benefits.

Powdered Coal in Metallurgy

Pulverized coal is to be used as fuel in the reverberatories at Anaconda if all goes well. One of the furnaces is now being fitted for burning powdered coal and it is expected to be in operation by the middle of May. Space has been left for equipping the other furnaces if the firing proves satisfactory. Burning with powdered coal is theoretically a much more efficient method of heat production than burning coarse coal. In cement burning, especially, it has proved possible to realize much of this efficiency, but in that work it is possible to allow for the introduction of the ash into the cement by adding the necessary lime. In general metallurgy the additional ash is not so easily taken care of, and in experimental work conducted some years ago by Mr. L. D. Ricketts, at Cananea, it was further found that the ash formed a blanket over the charge in reverberatories and slowed the work to a point where it was not economical. It is to be remembered, however, that the southwestern furnaces work on a high-ash coal. At Copper Cliff, in Ontario, the Canadian Copper Company, using low-ash coal from Pennsylvania, has used powdered fuel in its reverberatories with marked success for several years. At Anaconda the ash problem will be more serious than at Copper Cliff and less so than at Cananea. There would seem to be excellent promise of success, and doubtless the impetus will carry the process into other plants. In time, possibly, powdered coal will be used under boilers, but the intensity of the heat will require radical reconstruction of the fire-box from present styles.

The Mineral Resources of the Harney Peak Pegmatites—I

By VICTOR ZIEGLER •

The Black Hills consist of a series of uplifted sedimentary formations dipping away radially from a central core of pre-Cambrian metamorphic and igneous rocks. The sedimentary strata represent more or less completely the Paleozoic, Mesozoic, and Cenozoic eras. The pre-Cambrian rocks are a complex of slates, phyllites, graywackes, quartzites, and a great variety of schists, cut by basic igneous rocks now metamorphosed into amphibolites. All are intruded by a much younger, but still pre-Cambrian, series of granites and pegmatites which centre at Harney Peak. Here schists are the more abundant metamorphics, while farther away the slates take their place. The more intense metamorphism of the pre-Cambrian sedimentaries near Harney Peak is probably due, as has already been pointed out by C. R. Van Hise*, to the action of the igneous intrusion.

The general topography of the region is quite rough. The granites and pegmatites when intruded in schists are eroded into picturesque, steep and castellated forms. The quartzites form usually more rounded but still steep hills. The more silicious schists and slates yield steep slopes and, when cut across the schistosity, these are exceedingly rough and craggy, while slopes cut along the bedding planes stand at 60° and 70° angles, and often practically vertical. The streams are only small but have great velocity and as a rule the valleys are narrow, often of cañon like character, and only in the vicinity of Hill City and Custer do they widen sufficiently to yield fair tillable areas.

The Harney Peak granite is rich in muscovite and quartz, and has as the important feldspars orthoclase, anorthoclase, microcline, and albite. Oligoclase and rarely biotite are present in small amounts, while apatite and zircon are the invariable accessories, at times accompanied by titanite, garnet, and magnetite. On the whole, the more typical granite is coarse in texture and shows frequent and irregular gradations into pegmatitic varieties characterized by somewhat coarser crystallization, and by the greater abundance of such minerals as apatite, garnet, tourmaline, beryl, triphylite, lepidolite, cassiterite, and other metallic minerals. In these latter types the individual crystals attain a size sometimes of one to two or even four to five inches in diameter. The granites themselves as well as the surrounding pre-Cambrian schists are cut by a great number of pegmatite dikes and pegmatitic veins. These show all gradations from a typical giant granite into well defined quartz veins. They are variable in composition, showing enrichment in a number of rare minerals and yielding economic deposits of mica, tungsten, tin, lithium, rose quartz, and rare metals, as niobium

and tantalum. Beryl, barite, bismuth, feldspar, and phosphates may prove of economic importance in the future. Some of the gold-bearing quartz veins in the vicinity of Harney Peak, also seem to be genetically connected with this granite intrusion. In the case of the Clara Belle mine the probabilities seem to be in favor of this conclusion. Gold, however, has been found by assays in some pegmatites and tungsten veins. Below is listed the principal minerals, and on the map opposite the more important mineral deposits.

Albite	Leucopyrite
Alkali tourmaline	Lieberite s
Almandite	Limonite s
Amazonite	Magnetite
Amblygonite	Malachite s
Amethyst	Melanterite s
Andalusite	Microcline
Anorthoclase	Milky quartz
Apatite	Molybdenite
Aquamarine	Molybdenite s
Aragonite s	Monazite •
Argentiferous galena	Muscovite
Arsenolite s	Oligoclase
Arsenopyrite	Olivinite *s
Arsenostrengite (new)	Opal s
Autunite	Orthoclase
Azurite s	Petalite
Barite	Purpurite s
Beryl	Pyrite
Biotite	Pyrolusite s
Bismite s	Pyrrhotite
Bismuth*	Quartz, rock crystal
Bismuthinite	Rose quartz
Bismutite s	Rubellite
Black tourmaline	Rutile
Brown tourmaline	Scheelite (also s)
Cacoxenite s	Schorlomite
Caesium beryl	Scorodite s
Calcite (also s)	Sericite (also s)
Cassiterite	Serpentine s
Chalcedony s	Siderite (also s)
Chalcocite*	Smoky quartz
Chalcopyrite	Spessartite
Claudetite s	Spinel •
Columbite	Spodumene
Copiapite s	Stannite
Corundum *?	Stibnite
Cuprocassiterite	Struverite
Diadochite s	Sylvanite
Dufrenite s	Talc s
Epidote (also s)	Tantalite
Fluorite	Tapiolite
Gold (assay)	Tellurite s
Graphite	Tetradymite (auriferous)
Gripshite	Titanite
Grossularite	Torbernite
Hematite s	Triphylite-Lithiophylite
Hübnerite	Triphylite
Ilmenite	Uraninite
Indicolite	Vivianite s
Kaolinite s	Wad s
Lepidolite (lavender, green, yellow, colorless, brown)	Wolfaramite
	Zircon

*Van Hise (C. R.) Geol. Soc. Am., Bull., I., pp. 203-244, 1891.



MAP OF THE HARNEY PEAK DISTRICT, S. D., SHOWING PROMINENT ECONOMIC DEPOSITS GENETICALLY CONNECTED WITH THE HARNEY PEAK GRANITE; BASED UPON U. S. GEOLOGICAL SURVEY TOPOGRAPHIC MAP.

▲ = TIN ● = TUNGSTEN ○ = MICA □ = SPODUMENE ▣ = AMBLYGONITE
 ■ = LITHIOPHYLLITE ⊠ = BISMUTH ⊙ = ROSE QUARTZ ⊗ = BARYTA

- | | | | | |
|---------------------|-------------------|----------------------------------|-----------------------|-------------------------|
| 1. Tin Hill | 13. Tin City | 26. Great Wonder | 38. Wood Tin | 50. Crown |
| 2. Glendale | 14. Naiad Queen | 27. Wolfram (B. H. T. M. M. Co.) | 39. Cobalt (Margaret) | 51. New York |
| 3. Sam-llas | 15. Deacon Wright | 28. Viday May | 40. Dyke | 52. White Spar |
| 4. Cowboy | 16. Tin Queen | 29. Pettit's claims (2) | 41. Equality | 53. Climax |
| 5. Coates | 17. Louis | 30. Wolfram | 42. King Mica | 54. Crooks |
| 6. Garlic | 18. Tenderfoot | 31. Reinbold | 43. Swanzey | 55. Cobalt |
| 7. Carnbray | 19. Old Jeff | 32. Ferberite | 44. Bull Conn | 56. Reinbold |
| 8. Snowshoe and | 20. Annie | 33. Bond (Beecher) | 45. Etta | 57. Lost Bonanza |
| 9. Blue Bird | 21. Tin Boom | 34. Tin Queen | 46. Hugo | 58. Russell |
| 10. Olympbia | 22. Mohawk | 35. Rob Ingersoll | 47. Peerless | 59. Windowlight |
| 11. Tin Plate | 23. Cassiterite | 36. Tiger | 48. Everley | 60. Scott's Rose Quartz |
| 12. Sally Cavanaugh | 24. Black Metal | 37. Nichols | 49. Jenssen | |

Opposite is a list of minerals which were collected from the pegmatites and pegmatic veins. The letter 's' after the mineral denotes that it is of secondary origin. Those minerals starred are included as having been mentioned in the literature, but which were not collected by me. The minerals in italics are or may prove to be of economic value.

The total production from the pegmatites up to 1913

is about \$1,500,000 distributed as follows:

Mica	\$1,167,800
Lithium	143,000
Tin and tungsten	100,000
Miscellaneous	30,000

The Mica Deposits

Most of the important mica deposits occur in the

immediate vicinity of Custer. The position of the more important is shown on the accompanying map. The Lost Bonanza, Climax, White Spar, New York, Me-Macken (or Crown), and Window Light mines near Custer have been the most productive in the past, while many other claims such as the Monarch, Last Chance, Warren, Crook, and also the Christianson (now Hugo), Etta, Bob Ingersoll, Wood Tin, and Everley mines near Keystone have produced smaller amounts.

The mica is muscovite of good transparency and clearness. It is usually pale rose or brown colored and known as 'rum' or, 'wine' mica. This is usually faulty in that the books are commonly 'ruled' and 'wedge shaped.' By 'ruling' is meant that they possess an extra cleavage about perpendicular with the basal cleavage, which causes the mica sheets to split up into thin narrow ribbons. Wedge structure is caused by the thinning out of the foliae in one direction between cleavage planes, yielding wedge shaped sheets instead of those of uniform thickness. The properties about Custer yield the best mica and some good sheet mica has been obtained here. Practically nothing but scrap mica has been produced by the deposits near Keystone. Nearly all pegmatites are intruded with their longer diameter parallel to the schistosity. A number such as the Etta, Peerless, Hugo, Wood Tin, Tin Queen, Amblygonite, and others are roughly equidimensional in shape. The deposits near Custer have been described so admirably by Sterrett† that little can be added to his description.

The mica-bearing pegmatites are mainly coarsely crystallized quartz and feldspar, the individual masses often being several feet across. Large crystals of black tourmaline, irregular masses of blue apatite, and white or green beryl are also present. The muscovite occurs in crystal aggregates spoken of as books, which average about 6 inches in diameter, but occasionally reach a maximum diameter of $2\frac{1}{2}$ or 3 ft. These usually occur in irregular segregated bunches or streaks along the contacts. Frequently they are so spaced that their cleavage planes are perpendicular to the walls, while in some cases the black tourmaline crystals with which they are associated have their longer axis in the same position. Such an arrangement is noticeable in the New York, the Bob Ingersoll, the Everley, and the Hugo mines as well as others. The muscovite also occurs in irregular shoots or pockets distributed through the dike, but even these are more liable to occur close to walls, and in these the books are liable to be of smaller size. The muscovite zones are especially regular and well defined along both sides of the dike of the New York mine.

While the individual mica books in the pegmatite near Custer average larger in size than those near Keystone, the other minerals of the pegmatites in the latter locality, with the possible exception of tourmaline,

greatly exceed in size those from the former. It is also true that practically all of the mica-bearing pegmatites near Custer are very persistent in length and form distinct dikes or elongated lense shaped bodies. Most of the important dikes are narrow, varying from 8 to 25 ft. in thickness. Near Keystone the pegmatites yielding mica are more prone to be irregular stocks or thickened and shortened lenses, attaining a thickness of 100 ft. and more. About Custer accessory and rare minerals are absent in the mica dikes, while about Keystone they are prominent. Tourmaline and apatite are present in about equal proportions in both districts. Spodumene, triphylite-lithiophyllite, amblygonite, beryl, columbite-tantalite, wolframite, cassiterite, and lepidolite are absent from most of the mica pegmatites near Custer, although in some others they occur in small amounts. They may be found in most of the pegmatites about Keystone and often in some abundance. Fluorite is very rare and has been found in only one pegmatite near Keystone.

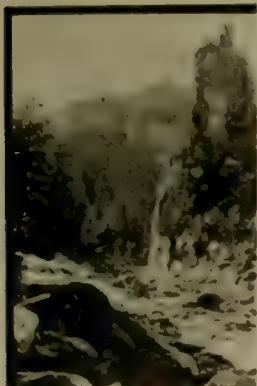
Mica has been produced somewhat spasmodically since 1879. The table below gives the approximate production only, as no definite information is available, but on the whole is believed to be nearly correct. The value has fluctuated as follows: sheet mica from 7.2 to 33.3c. per lb. Scrap mica from \$9 to \$16.71 per ton.

1879-1884	\$ 450,000
1885-1898	80,000
1899	1,800
1900	46,500
1901	23,000
1902	18,400
1903	10,000
1904	3,000
1905	5,000
1906	5,000 (?)
1907	120,000
1908	104,000
1909	100,000
1910	87,000
1911	90,000
1912	5,000
1913	10,000
Total	\$1,168,700

From 1907 to 1911 inclusive South Dakota was second in the United States in the production of mica, mainly due to the activity of the Westinghouse Electric Co. which developed several of the more prominent mines near Custer and especially the New York, White Spar, and Climax mines. In 1912 the Company closed the mines and in that year produced mica only from material on the dumps. The greater part of the production of 1912 and 1913 represents rough mica shipped from mines near Keystone. Renewed activities are assumed for the Custer district for the coming year, as several contracts have been made for mica and as foreign capital has become interested in developing several claims. With some trivial irregularities mining for mica is done consistently but in a small way near Keystone. The mica is shipped in the rough, mostly to Chicago.

†Sterrett, Douglas B., U. S. Geol. Surv., *Bull.* 380, pp. 332-397, 1909.

Tin Deposits



IN THE HEART OF THE HILLS.

Tin first attracted attention in 1876 as stream tin. In 1883 it was discovered in place in the Etta mine near Keystone, which was at that time worked for mica. Much interest was aroused which culminated in the organization of the Harney Peak Tin Co. This Company operated on a very extravagant scale, buying up over a thousand claims, most of them without making any examination to speak of. Mills with large

capacity were put up near Hill City and Keystone, and equipped with costly machinery before much was known regarding the amount of tin ore actually available.

Five thousand tons of ore was broken down without an attempt to keep it separate from a number of different prospects, and was milled in 1892, yielding only 1.4% metallic tin.¹ The general impression throughout the Black Hills is that the operations of this Company were directed, to say the least, in a thoughtless manner. The concern went into the hands of a receiver in 1894 and its properties were tied up by the courts until 1909, when the Pahasa Tin Mining Co. was organized, which took over the holdings of the Harney Peak Tin Co. A number of claims had been meanwhile allowed to lapse, and examinations showed that the tonnage of tin ore available would not make it advisable to resume operations on the scale demanded by the mills and equipment of the defunct Harney Peak Tin Co., or by the capitalization of the Pahasa company, hence the new Company refused to consider further operations and at present is selling off the equipment, and the various claims still in its possession.

There are in this district many tons of easily mined tin ore which will average 1½% of tin and which would repay mining operations conducted on a small scale. The salvation of the district lies in one of two things. As has been pointed out by Hess,² a central milling plant doing custom work, would allow a great number of prospectors to take out the small amounts of tin ore available in their claims, and could also be equipped so as to handle the wolframite ores, and possibly columbite and tantalite. There is no doubt but that a thorough sampling of a number of claims will prove that a small concentrating mill—one of 20-ton capacity—will easily pay for itself and yield a handsome profit besides. The tonnage available is too small, however, to think of maintaining plants of 250 to 300 tons capacity, as has been attempted. On the whole, the activity of the Harney Peak Tin Co. is to

be regretted, as it has done nothing but hinder the natural development of the tin deposits, and through its failure has, to a large extent, brought them into disrepute.

Tin in the form of disseminated cassiterite occurs in most of the pegmatites north and west of Harney Peak. They may be grouped in two districts, centring at Keystone and Hill City respectively. The deposits near Keystone attracted attention first, and more especially the Etta Knob, where the Harney Peak Tin Co. erected a mill costing \$235,000. As far as I was able to ascertain, there is probably as much tin in the Peerless, Hugo, Bob Ingersoll, Wood Tin, Cobalt (Margaret), and some other claims, as in the Etta, and the tin resources of all together would not warrant the erection of such a plant. The Etta deposit carries in addition to cassiterite, a secondary tin mineral, cuprocassiterite, a hydroxide of tin and copper, which is only known from this locality. This is malachite, green in color, has a dull to waxy lustre, and occurs as a staining or as a coating in veinlets. It is formed by the oxidation of stannite (the copper-iron-tin sulphide), which occurs in very small amounts in this pegmatite.

Most of the prominent pegmatites in the Keystone district are thick, stocky lenses or irregular cone-like masses. They are characterized by excessively coarse crystallization and by an enrichment in lithia and beryllium minerals. Thus individual masses of quartz and orthoclase four and five feet across are common. Amblygonite nodules weighing over 1000 lb. occur in some pegmatites, as the Hugo, Peerless, and Bob Ingersoll. Beryl, albite, apatite, triphylite, lepidolite, graphite, and tourmaline occur in masses two to three feet across. Spodumene occurs in crystals like logs, often four to five feet in diameter and over 30 ft. in length. Such giant spodumenes are further mentioned in the summary of lithia deposits. Occasionally milky quartz masses are 20 or more feet wide.

The cassiterite occurs only rarely in coarse masses, or well defined crystals, but usually as pepper tin mixed with little wolframite and fair amounts of columbite and other rarer niobates, such as tapiolite and struverite, disseminated in mica-quartz aggregates which come in irregular pockets in the pegmatites. These aggregates are irregular in distribution and oc-



SHAFT HOUSE, MOHAWK MINE, HILL CITY.

¹O'Harra, C. C., *Bull. S. D. School of Mines*, No. 6, 1902.

²Hess, Frank L., *U. S. Geol. Surv. Bull.* 380, pp. 131-163, 1908.

currence. They seem to favor the contacts. They are usually of small extent. In appearance they suggest a 'greisen' and they are frequently and incorrectly spoken of as such. At times such greisen-like rocks occur in segregations about the spodumene logs, as is well shown in the Etta mine. It may, however, be said safely that the pockets are so restricted and so spasmodic in occurrence that they will probably never be important as sources of tin. The only way in which such ore can ever be utilized commercially is by recovering the tin ore incidentally in the mining of some other minerals. Many tons of good ore could be secured while mining lithia minerals or mica, and some of the foresighted miners in this district are storing up their tin ore in the hope that a future demand may arise due to the establishment of a custom mill. One other objection to the ore of Keystone district, and more especially that of the Etta Knob, is the common association of cassiterite with iron minerals such as columbite, tantalite, struverite, and tapiolite, which will cause impure concentrates. Electro-magnetic separation will probably afford an easy solution of this difficulty.

The more promising tin deposits occur in the vicinity of Hill City and follow in general the course of Spring creek southward and northeastward, as may be seen from the accompanying map. These are almost always in the form of well defined dikes and veins or in highly elongated lenses. The more promising deposits are narrow and veinlike. The large and thicker dikes, such as the Sally Cavanaugh, Coates, Tin Belle, are pegmatitic in character, but they are fine grained, furnishing a marked contrast with those near Keystone. Albite, muscovite of pale green color, and quartz are the most prominent minerals. The individual grains are one-half inch or less in diameter. The muscovite is usually well crystallized, and occurs in especially fine prismatic crystals at the Coates claim. Lepidolite occurs rarely, as well as black tourmaline and fine red and brown garnets (almandite and spessartite). Orthoclase, microcline, and oligoclase are only of very minor importance. Columbite in small amounts is almost universally present. The cassiterite in the larger dikes is black and shiny metallic, frequently prismatic. It usually appears in shoots or pockets which are free from albite. In most cases the whole of the dike would be unsuitable as an ore, but it is certain that in a number of cases there are in sight several hundred tons of good ore, which would easily repay a prospector for a season's work. On most of these pegmatitic dikes little work beyond that required for assessment has been done. There are some notable exceptions, however. The Coates mine has been opened by an incline shaft to a depth of 350 ft. The Snowshoe claim has a tunnel 500 ft. long. Small tunnels are on the Tin Belle and the Tin City claims.

The tin-bearing rock in the other cases, as for example the Cowboy, Cassiterite, Tin Boom, Mohawk, and several other deposits, appears to be a gradation

toward a quartz vein. These are rarely over three to four feet in thickness and are up to 500 to 600 ft. long. They consist of an aggregate of medium-grained quartz and muscovite, frequently with much graphite, and rarely with columbite and wolframite. The muscovite appears to be a sericite variety, and favors, together with the graphite, streaks and seamlets in the quartz along which the cassiterite occurs. The cassiterite in such veins is usually of reddish brown color, and in fairly coarse grains. The Cowboy mine, opened by the Harney Peak Tin Co., shows a lens-like vein 340 ft. long, 300 ft. deep, and from 2 to 4 ft. thick. It is opened by inclined shaft and drifts to the 300-ft. level. A number of similar veins occur about a mile north of the Cowboy, and slightly west of Hill City, chief of which are the Tin Boom, Cassiterite, Mohawk, and Annie. Most of these veins show a quite variable strike, but generally in a northwesterly direction. The majority show a trough-like structure pitching down northwestward. Four such have been observed. This spot appears to be a centre of folding and faulting, and it may be that the veins of one claim are repeated thus in another. Several of these are opened by shafts sunk by the Harney Peak Tin Company.

In practically all of these veins the cassiterite appears to be more uniformly distributed than in the larger dikes, but even here, as must be expected, the distribution is irregular to some extent. Several of these deposits, if worked on a small scale, should support a 10 or 20-ton concentrating plant for a number of years.

Most of the dikes and veins show horizontal offsets on the surface, suggesting somewhat the shingling overlap of the magnetite and pyrite deposits in the pre-Cambrian rocks of eastern North America. Whether this shingling overlap is also present following down the dip remains to be proved, but seems entirely probable, as the dikes and veins must originally have been connected with the main body of the Harney Peak granite, even if only for a short time. Such shingling overlap, not too excessive in amount, might add valuable tonnage of ore to that already in sight in these dikes, especially when we remember that the top of the veins is an especially favorable place for the presence of tin on account of the upward rising mineralizing solution in which the tin is apparently readily soluble.

There was an attempt to mine the ore at the Gertie mine, near Hill City, several years ago. A small mill and a smelter were erected and some ore was concentrated and smelted. There was difficulty in smelting, the methods not being well understood, and after a thorough examination had shown the ore to be of too low grade, mining operations ceased. It was simply another ill advised mining attempt in which a mill and surface improvements were put up before the ore deposit was thoroughly examined, and before the richness of the ore and the tonnage available was known. The total tin production has not exceeded 40 tons of concentrate. It was mainly smelted in England.

Acetylene Lamps for Metal Mines

By FREDERICK H. MORLEY

Not very many years ago the acetylene lamp was a novelty, and little practical use was made of this means of illumination. There was such a general distrust of the innovation that people were afraid to employ the brilliant light which could be so easily obtained from the burning of acetylene, and the fear of explosions kept the carbide lamp in the background for a long time. As improvements were made, and acetylene lamps came to be more generally known, they were found to be excellently adapted for use upon bicycles, so that the 'bicycle lamp' became very popular, and its use spread to other fields. The first acetylene lamps used in mines were probably converted bicycle lamps. I remember seeing one of these lamps used by a mine manager at Aspen, Colorado, about the year 1900, and at that time it was considered a great novelty. A few years later, in Cripple Creek, I purchased an acetylene mine lamp that was merely a bicycle lamp to which had been attached a heavy wire handle and pointed hook. Although somewhat heavy and awkward, it proved to be highly serviceable, but it was later displaced by the light and convenient 'cap lamp' especially designed for mine service.

Discovery and History

During the past ten years the improvements in acetylene lamps for miners have been enormous, and with the gradual dissipation of popular prejudice against them they now bid fair to monopolize the entire field of lighting for metal mines, except where electricity is used in the drifts and shaft stations. Acetylene was discovered in 1836, but it was not until 1892 that its use upon a commercial scale was made possible by the discoveries of T. L. Wilson, in the United States, and H. Moissau, in France, that calcium carbide could be manufactured by the fusion of lime and carbon in the electric furnace. This comparatively simple process was soon adopted, and the manufacture of calcium carbide became a great industry, especially at Niagara Falls, where an abundance of cheap electric power was available. The acetylene lamp was introduced into mines slowly, and with considerable difficulty, partly because of the general dislike for an innovation and partly because of the imperfection of the lamps. At present, however, a number of satisfactory lamps, especially designed for mine use, are being manufactured, and the prejudice of the miners against carbide lamps is rapidly changing into a strong demand for them.

In its general principles the acetylene lamp has undergone few changes, although great improvements have been made in the details. The essential parts of a carbide lamp are: a receptacle for water; a re-

ceptacle for calcium carbide below the water receptacle; an opening or valve through which the proper amount of water flows from the upper into the lower receptacle; and a burner through which the acetylene gas escapes. These parts have, of course, undergone no essential changes; but the lamps have been made lighter and more convenient in shape, practical attachments for carrying or hanging the lamps have been added, and extra carbide containers have been provided so that lamps may be used for eight or ten hours without refilling. To prevent the clogging of the burner by soot, the gas is filtered by passing through a wire screen and a felt pad, and extra air openings are provided in the burner to insure complete combustion. Stoppage of gas may be prevented by the use of a cleaning wire which passes through the water-tube into the carbide. With many lamps a small instrument is provided with which the burner may be cleaned if it becomes choked. In some lamps the flow of water is determined entirely by the size of the water-tube, no valve being used, so that it is impossible to regulate the size of the flame or to stop the flow of acetylene gas. In other lamps the flow of water is regulated by a valve which can be adjusted or closed when required. The modern miner's lamp is made of brass or galvanized iron, weighs from 10 oz. to 2 lb. when charged, and is provided with attachments by means of which it can be carried on a cap, on a miner's candlestick, or with a hook and chain.

A Record of Tests

Tests made at the University of Utah, in 1910, for the United States Smelting, Refining & Mining Co., showed that none of the domestic lamps then tested would burn an entire shift, the carbide being exhausted in from 4 hr. 25 min. to 6 hr. 50 min. Two foreign lamps tested burned for 8 hr. 15 min. and 11 hr. 30 min., respectively, on one charge of carbide. By means of extra carbide containers, the American lamps can be used for an entire shift. The lamps need to be refilled with water every three to three and a half hours. The results of the tests of the candle-power of certain lamps were as follows:

	Lamp No. 1.	Lamp No. 2.	Lamp No. 3.	Lamp No. 4.
Beginning.....	15.60	2.94	5.05	9.40
1st hour.....	15.80	3.18	5.15	10.60
2nd hour.....	16.80	2.95	5.29	2.96
3rd hour.....	17.80	2.53	5.27	0.76
4th hour.....	14.95	4.30	3.13	...
5th hour.....	10.45	2.80	2.11	...
6th hour.....	10.25	...	...	...
Average	14.52	3.11	4.17	5.93

The lamps tested were the Wolf, Baldwin No. 39,

Scranton, and Baldwin No. 32, in the order given. When candles were tested it was found that the average candle-power delivered was 0.85 per candle. Although the candle-power of most of the lamps is fairly low, yet even the smaller lamps give as much light as four or five candles, and the light can be accurately thrown upon the place where it is needed. Since the miner wants a good light at a certain spot, rather than a general illumination, the acetylene lamp offers great advantages in this respect alone. Large lamps for the illumination of stopes have been used in some mines with varying success.

In order to ascertain the extent to which acetylene lamps have replaced candles in metal mines, and to obtain the opinions of mine operators regarding the relative merits of the two forms of lighting, the manager or superintendent of 21 of the principal metal-mining companies of the United States was asked to give his experience with carbide lamps. These opinions are so interesting and instructive that many of them are given below in full. At seven of the properties, acetylene lamps are in general use, and in the remainder they are used to a limited extent. In six of the mines, tests are being conducted preparatory to equipping the mines with lamps as soon as a wholly satisfactory lamp can be secured.

The objections to acetylene lamps are numerous and varied, but many of them can be traced to prejudice and the dislike of an innovation. However, the principal valid objections seem to be: the offensive odor of the gas; the fact that many of the lamps are unhandy for general use; the time lost in filling, cleaning, and regulating; the likelihood of damage to the lamps due to falls, and the difficulty of keeping them in working order. There is a very general complaint that the lamps get out of order too easily, thus causing much loss of time. In many mines carbide lamps are used only by skilled men, such as the superintendents, foremen, bosses, and surveyors.

Disadvantages of Lamps

One mine superintendent in Nevada writes: "From my own experience with acetylene lamps, I have not dared to issue lamps to all the men working underground, as a slight fall or careless handling is apt to put the lamp out of business for some time, or possibly permanently. This would mean that too much time would be lost by the miners in repairing their old lamps or in hunting new ones." The manager of a large Cripple Creek property says: "Acetylene lamps have not as yet displaced candles to any appreciable extent in this mine. Our reason for not using acetylene lamps generally is that so far we have not found a lamp that is perfectly satisfactory. All those we have tried, get out of order too easily, and thus provide the men with an excuse to waste time in fixing or refilling their lamps." In addition to the objections quoted, several operators have found that in many of the mine lamps the gas cannot be turned off, nor is there any means for regulating the size of

the flame. The usual type of lamp has the disadvantage that it cannot be carried on the cap and cannot be stuck into a timber or rock like the ordinary candlestick, but this objection has been overcome by many manufacturers who are now supplying cap lamps and lamps with candlestick attachments.

Advantages of Lamps

In some of the largest metal mines acetylene lamps have been in general use for several years, and have given perfect satisfaction. With regard to the Homestake mine, T. J. Grier writes: "We substituted acetylene lamps for candles about three years ago, and all of our 1025 miners working underground are now using lamps. Allowing for reasonable fluctuation in market prices of illuminants, candles cost about four times as much as carbide. Properly adjusted, the acetylene lamp is less injurious to the health of the operative than smoke from candles. In the big stopes large carbide lamps are used which light up the space remarkably well, facilitating the work and making it possible for the miner to see and avoid rock coming down the slope of the pile at which he may be working." L. S. Cates, manager of the Ray Consolidated, says: "There is no question but that there is a marked increase in efficiency in our workmen due to the use of acetylene, as the illuminating power of the carbide lamp is far in excess of candles. This was forcibly demonstrated recently when one of our carbide shipments was delayed and the miners had to use candles. They complained bitterly while this condition lasted." Out of the 1400 men employed underground at the Ray, 1200 are using carbide lamps. In the property of the Osceola Consolidated Mining Co., all of the 625 miners use lamps, and the use of candles or oil was abandoned years ago. The management believes that the general efficiency of the working force is materially increased by the use of lamps, and there are fewer accidents because the working places can be readily examined and made safe. At the United Verde mine, 575 of the 600 miners use carbide lamps. W. L. Clark, the manager, says: "We have been using various makes of carbide lamps underground for the past two years. Until recently, however, we have not been able to get a satisfactory lamp for our timbermen and have adhered to the candles. We are now using the regular carbide lamp with candlestick attachment, which seems to work out satisfactorily for this class of labor, and many of the miners also prefer the candlestick attachment. For shovelers and carmen we use the Wolf chain lamp, and this lamp is also used by all other employees working where there is much draught." In the Bunker Hill & Sullivan mines, 208 of the 460 men employed underground are using acetylene lamps. The manager of this property, Stanly A. Easton, says that "the efficiency of the miners certainly increases by using carbide. We greatly prefer acetylene lamps to candles because of the lessened danger of fire." Underground fires in mine timbering are generally caused by snuffs and burning candles

carelessly left by the workmen." In the mines of the Ohio Copper Mining Co., where 96 men are employed underground, 37 are using acetylene lamps. The superintendent, F. E. Turner, writes: "We have increased our efficiency very materially, and at the same time have lowered our cost of illumination, by the use of these lamps. Most of the men who use the lamps have to travel about the mine considerably. They can get around faster and more easily with the lamp, as it gives more light than several candles would, and the light is as good while moving as when standing still. As it will burn brightly in places where there is bad air, where a candle would not burn, men using the lamp might work in such places." This last, of course, is a serious objection.

The Test of Experience

The following table gives the essential data regarding the cost of acetylene lighting in ten of the large metal mines whose managers furnished detailed information. In eleven other properties carbide lamps are not in general use, so accurate figures could not be obtained.

Name of company	Number of men employed underground	Number using lamps	Carbide consumption per lamp, oz. shift	Cost of carbide, per lb., cents	Cost per lamp shift, cents	Cost of candles per shift, cents
Homestake Mining Co....	1025	1025	8.0	3.50	1.75	7.00
Ray Con. Copper Co.....	1400	1200	9.0	4.50*	2.50*	5.00*
Quincy Mining Co.....	1389	575	6.7	3.50*	1.46*	...
Osceola Con. M. Co.....	625	625	6.0	3.50	1.38	...
United Verde Copper Co..	600	575	6.5	5.50	2.23	5.40
Bunker Hill & Sullivan Co.	460	208	7.0	5.25	2.30	6.18
Calumet & Arizona M. Co.	1000	60	7.0	5.50	2.40	6.64
Ohio Copper M. Co.....	96	37	8.0	5.80	2.90	...
Nevada Con. Copper Co...	200	20	4.0	4.67	1.12	3.27
Mammoth Copper M. Co...	...	12	10.0	5.86	3.66	5.15
Average .....	...	...	7.22	4.76	2.17	5.52

*Estimated.

It is interesting to note that acetylene lamps are in general use in most of the copper mines, and that other mines have been slow to adopt this means of illumination. In many of the gold and silver mines lamps are being tested or are used only by superintendents, foremen, and surveyors, according to reports received from such mines as the Yellow Aster, Camp Bird, Iron Silver, Tomboy, Liberty Bell, Portland, North Star, Tonopah of Nevada, and others.

The choice of a particular style or make of lamp depends largely upon the use for which it is intended, and upon the experience and judgment of the individual mine superintendent or foreman. The large 'whole shift' lamps, with chain and hook attachment, are usually preferred for carmen and shovelers and for the illumination of large stopes. The small light 'cap' lamps are satisfactory for general use, and the

same lamps with candlestick attachment are well adapted for use by timbermen and miners working in stopes. Extra carbide containers have to be furnished with the smaller lamps. The large Wolf lamp seems to be commonly preferred where a general illumination is desired. The lamps most generally adopted are those known as the Baldwin, Maple City, Justrite and Wolf. The prices vary from about 65c. for the small domestic 'cap' lamps to \$3.75 for the larger imported lamps. Medium-weight lamps of strong construction, designed for superintendents or foremen, cost about \$2 each. All lamps are provided with reflectors of sheet metal or brass, nickel plated on the inside surface, that serve to concentrate the light very effectively. These reflectors are from 2 to 6 inches in diameter.

General Conclusions

In conclusion, it may be said that the principal objections to the acetylene lamp are as follows:

1. Lamps will burn in bad air, thus exposing the miners to a danger which would be avoided if candles were used.
2. The first cost of equipping a mine with carbide lamps is high, involving a large additional expense.
3. Lamps may be injured or broken by careless handling or falls of rock, so that the cost of repairs and renewals may be an important item.
4. Much time may be wasted by the miners in filling, cleaning, and adjusting their lamps, or in replacing damaged lamps.

The advantages resulting from the use of lamps in metal mines are numerous and marked. The most important points in favor of acetylene lighting are:

1. Lamps are not as smoky as oil or candles, and acetylene is not deleterious to the health of the miners.
2. Since they are not easily extinguished, acetylene lights can be used most advantageously in wet and drafty places where a candle could not be kept burning, and by men who have to move about a great deal.
3. One small carbide lamp gives more light than four candles, and the light can be concentrated upon the spot where illumination is most needed.
4. On account of better illumination, the working places can be easily examined, with the result that there are fewer accidents from falls of rocks.
5. The danger of fires in mine timbering is greatly lessened when lamps are used.
6. The cost of acetylene lighting per man per shift is very low, being about one-third of the cost of lighting by means of candles.
7. The use of carbide lamps results in a material increase in the general efficiency of the underground working force.

Vertical depths of shafts at the Calumet & Hecla copper mine, Michigan, are as follows:

	Feet.
Red Jacket	4900
No. 5 Tamarack	5308½
No. 3 Tamarack	5253



Bureau of Mines Building

Plans for the proposed \$500,000 experiment station of the United States Bureau of Mines at Pittsburgh, have been approved by the commission appointed by Congress for that purpose. The federal government now owns the property upon which will be erected a group of buildings, especially designed and adapted for the carrying on of the mine safety work and other investigations in which the Bureau of Mines is interested. Congress a year ago, in the public buildings bill, authorized a new home for the Bureau of Mines to cost \$500,000. It is now expected that Congress, in its present session, will make a specific appropriation so that construction work may begin. It is hoped that contracts may be let by July 1. The Director is hopeful that the buildings may be completed in the fall of 1915, when they will be dedicated with suitable ceremony, including a second national mine safety demonstration, similar to that held at Pittsburgh, 1911.

The commission which has approved the plans consists of J. A. Holmes, D. C. Kingman, chief of engineers of the United States Army, and O. Wenderoth, supervising architect of the Treasury. The state of Pennsylvania has appropriated \$25,000 for coöperation in establishing this experiment station and has appointed a state commission consisting of James E. Roderick, chief mine inspector; W. R. Crane, dean of the mining department, Pennsylvania State College, and W. H. Caverly. This latter commission has tentatively approved the plans.

The buildings which will constitute the experiment station of the Bureau will form a part of a most remarkable and unusual group of monumental edifices devoted to educational purposes. On one side the Bureau's buildings will face the great group of structures of the Carnegie School of Technology. On another side is the Carnegie Institute, in which are the art gallery, museum, and library. Nearby is the imposing pile of buildings of the University of Pittsburgh. Other nearby buildings are the Memorial Hall, Pittsburgh Athletic and University Clubs, and the Hotel Schenley. The site consists of nearly twelve acres of land, part of it on the higher level of the city streets and part of it on the level of the B. & O. railroad, which railroad will furnish adequate facilities for passengers and freight traffic.

The group consists of three main buildings facing

Forbes street and the several street-car lines from the uptown district. The central building of the group, the mining building, will be three stories in height, flanked by two main buildings, one the mechanical and the other the chemical building. In the rear of these and inclosing a court will be the service building. Beyond the service building and spanning what is known as Panther Hollow and thus connecting the Bureau of Mines buildings with the Carnegie Schools, will be two buildings over the roofs of which will pass the roadway from Forbes street to the Carnegie School buildings and Schenley park.

Between the main group and the power and fuel group will be the entrance to a series of mine shafts. One of these will be used as an elevator to carry heavy material and passengers from the lower level to the upper; another will be for tests of hoisting ropes and similar mining appliances; another will be an entrance to tunnels extending under the buildings and in which mining experiments, such as fighting mine fires, will be conducted. The portion of Panther Hollow above the Power buildings will be arranged as a miners' field, the slopes of the ravine being utilized as an amphitheatre which will accommodate 20,000 spectators who may assemble here to witness demonstrations and tests in mine rescue and first-aid.

The main or mining building will contain the administrative offices, and those of the mining force. In it will be an assembly and lecture hall, a library, and smoke and other rooms for demonstrations and training in mine rescue and first-aid. The mechanical building will be for experiments and tests of mining machinery and appliances and the chemical building for investigation and analyses of fuels, explosives, and various mineral substances.

The buildings now used by the Bureau of Mines as an experiment station at Pittsburgh were loaned to the Bureau by the War Department as an emergency measure when the Bureau was created. The War Department has suggested that it now needs these buildings and it is felt the Bureau cannot retain possession much longer. The buildings are very old and are entirely unsuited to the needs of the Bureau of Mines work. It is said that the investigations have been seriously handicapped by the inadequacy of the structures now in use.

Charcoal Burning for Prospectors

By W. H. WASHBURN

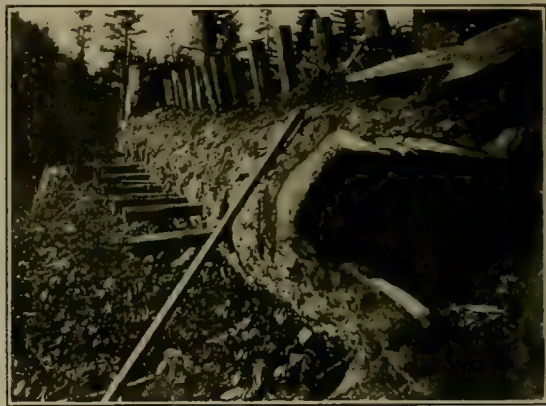
Fuel for tool sharpening and blacksmith work is often an item of considerable expense in the development and operation of mines in isolated districts, where transportation costs are necessarily high. Where suitable timber is available charcoal made on or near the premises is generally used, and is an excellent fuel for this purpose. It is usually burned in heaps (called pits) covered with earth, or in ovens, or kilns, where the demand and conditions warrant the expense of building them. Besides these well known methods, that of burning it in the tree, seems to be not so well known or understood, though it is well adapted to locations where the timber is large enough for the purpose.

While the larger trees may be more economically made into charcoal in this way, those as small as 2 ft. in diameter may be used, with good results; though it would prove more economical to burn several of these at the same time, or at least as many as could be attended to by one man at a time. The tree selected should be sound, and free from wind-shakes, or other flaws, that would allow the fire to find its way to the outside, as about three or four inches of this part of the tree must be preserved to take the place of a kiln, to keep the air from the burning charcoal, except what is admitted under control, through the holes hereafter described. It should be so felled that it will lie about 1 ft. or more from the ground, if possible, so the horizontal holes may be conveniently bored. The top of the tree is also usually left on for this reason. The first hole, about 2 in. diameter, is bored vertically from 3 to 4 ft. from the butt, and to a depth equal to two-thirds the diameter of the tree. If this hole is bored too close to the butt, the fire will eat through, and necessitate banking it up with earth, which is sometimes a troublesome job. A continuous row of holes is then bored of the same size and depth, from 2 to 3 ft. apart, along the tree as far as it is suitable for charcoal.

A corresponding number of holes are bored horizontally, from both sides, to intersect the bottom of the vertical holes. After these holes are all bored, they may be fired, beginning at the butt, by inserting a piece of lighted candle, about an inch long, in a split splinter of pitchy dry wood, lowering it carefully to the bottom of the hole, and adding more splinters until the fire is well started. Repeat this process until all the holes are fired, adding a few splinters here and there to those that seem to need them, to give them all an equal start. They are then allowed to burn about six or eight hours (depending on the size of the tree, and the nature of the wood), care being observed to prevent the fire from burning the holes at their outer ends, for about 3 or 4 in. to deform them, so they could not be tightly plugged. The bark must not be relied on

for this purpose, as it burns too freely to be easily controlled.

A number of plugs should be on hand, ready to plug each hole when necessary to control the fire, and prevent it from eating away the outer end of any of them. Should this happen, however, at any time in the operation, it will be necessary to bank it up with earth, which will have to be held in place against those that are horizontal, by small cribs of boards or shakes. This bother is well worth avoiding, however, by careful attention to each individual hole; plugging those that seem likely to burn through, until the fire is under control, when they may be opened again, though perhaps



LOG ARRANGED FOR CHARCOAL BURNING.

only partly. If they are plugged tightly, too long, so the air is totally excluded, the fire will die out entirely after a while, which is to be avoided until the time for finally plugging the holes to extinguish the fire.

The tree is allowed to burn about six or eight hours according to its size and the progress of the fire. Some of the holes will probably burn faster, and require plugging sooner than others. The object to be gained is to allow the fire in each set of holes to burn until a cavity is formed, about 6 or 8 in. diameter, depending on the size of the tree, and lined with live coals around the original course of the holes, except their outer ends in the sap wood. When this point is reached they are ready to be tightly plugged, and the accumulated heat in the tree will char the wood between them. From the time the fire is started until the holes are finally plugged, the process usually requires from 10 to 15 hours, some of them being ready to plug sooner than others, of course. After the final plugging the fires gradually die out for lack of air—while the wood is being charred. The time required for the fire to completely die out is generally about three days and nights. During this time the tree should be care-

fully watched, to guard against the fire breaking out, and perhaps consuming the charcoal before being discovered.

If more charcoal than one tree will furnish is required, others should be worked at the same time after the first one is safely started. When the fire is entirely out, the charcoal is ready for use, and may be taken out as needed by chopping away the side of the tree, as shown in the cut, leaving the remainder safely housed: unless it is preferred to remove it all, to be stored elsewhere. Charcoal properly made by this method, retains more of the volatile matter of the wood than when burned in pits in the usual way, and so is of better quality.

High Cost of Sand Shafts

One peculiarity of the Lake Superior iron region is the prevalence of thick sand overburdens. For underground mining this makes trouble in sinking shafts through the sand, especially as the material usually contains much water and is often quicksand. This has tended toward fewer shafts and more permanent construction, and has resulted in the number of concrete lined shafts sunk during recent years. At several mines such unusual trouble has been encountered in putting down wood-lined shafts, that a year or more has been consumed in merely getting through the sand to bed-rock. This was the case at the Tully mine at Stambaugh, Michigan, where the shaft twisted and caved so much in the sand that often the work "was not so far along when Saturday night came as it had been on Monday morning." At the Maas mine at Negaunee, Michigan, a wooden shaft was first attempted, using great care and doing prodigious pumping, and it is related that the caving of the surface around the shaft formed a great pit in the centre of which the timbered shaft appeared "sticking up like a smoke-stack." This shaft was at last bottomed in solid rock, but it always gave trouble by getting out of alignment so finally it was replaced by a concrete shaft, the large steel headframe being moved to one side on rollers to permit this.

When such unusual trouble is encountered in sinking a sand shaft, the cost per foot mounts into extraordinary figures. To avoid this chance of getting caught in the quicksand, many of the operators took readily to letting the contract for sinking through a deep overburden to bed rock to the Foundation Company of New York. This Company sinks concrete drop shafts by the caisson method and has a trained organization of 'sand-hogs' accustomed to work in compressed air. A concrete shaft sunk under such conditions is of course permanent and will last as long as the mine, with little leakage, and requires almost no repairing. As the work is dangerous and requires special knowledge, and also because there was no competitor in the region, the Foundation Company charged what seemed to be high prices. An ordinary price for shafts over 100 ft. deep was \$500 per foot, thus a shaft through 150 ft. of sand

would cost as much as \$75,000.

This Company is very secretive about costs and methods, but is believed to have made large profits on almost all its contracts. Outside engineers, who figured on one shaft that gave unusual trouble to the Foundation Company, estimated that the actual cost was \$50,000, while the price received for 140 ft. at \$500 was \$70,000. The time taken on this particular shaft was about eight months; so much trouble was encountered that the general opinion prevailed that the contractors were losing money. For the first four months and until the shaft was 100 ft. deep, everything went well; the estimated cost of this part was about \$50 per ft., including cost of concrete which in the thick walls was a considerable item. From 100 ft. to bed rock at 140 ft., trouble was encountered from a layer of hard pan or broken rock that proved very hard picking for the men who could only work 40-minute shifts on account of the high pressure of compressed air necessary in the caisson to hold back the water.

At this time about 14 shifts were worked per 24 hours, six or seven men going down each shift; every man worked two shifts per day and received \$4 for the 80 minutes of work. In addition several surface men and much coal were necessary, so that the cost was easily \$250 per day. So slowly did the shaft drop down that a foot a week was good progress, and for several feet the cost was several thousand dollars per foot. Even this high cost was probably lower than the amount it would have taken to sink an ordinary wood-lined shaft by pumping methods. However, as the ore body was estimated at several million tons, a good permanent shaft was a necessity.

Estimation of Gold, Silver, and Platinum By Fire Assay

By G. H. CLEVENGER and H. W. YOUNG

The accompanying chart is intended to serve as a general outline of the principal operations involved in the fire assay of ores and metallurgic products for gold, silver and platinum. It is general enough to cover the crucible and scorification method of assaying as well as all individual ideas regarding the application of these two methods.

Platinum so rarely occurs as a payable constituent of ores that ordinarily no effort is made to determine it by the assayer. On account of the increasing demand for platinum, determinations of this metal are now more frequently called for than formerly. Dewey* has described a method which is capable of giving accurate results and is particularly suited to the determination of small amounts of platinum. We have therefore indicated on the chart how this method can be applied to the determination of platinum in conjunction with the ordinary fire assay for gold and silver.

*The Direct Determination of Small Amounts of Platinum in Ores and Bullion, Frederic P. Dewey, *Trans. Amer. Inst. Min. Eng.*, Vol. 43, pp. 578-581.

Mexico and certain other countries; silver is reported in kilos per metric ton of 1000 kilos, gold and platinum in grams per metric ton of 1000 kilos

Work at the Phelps, Dodge & Co. Properties in 1913

*As mentioned in the 'Special Correspondence' pages of this journal of April 4, this concern's subsidiary companies treated a total of 1,978,892 tons of ore yielding 155,665,712 lb. of copper, 5,701,628 lb. of lead, 32,037 oz. of gold and 2,073,376 oz. of silver in 1913. The Phelps, Dodge company received \$9,110,000 in dividends from its subsidiaries and paid four dividends amounting to \$7,425,000 during 1913.

Copper Queen Consolidated Mining Company

The separate reports of the general manager, S. W. French; the superintendent, Gerald Sherman; smelter superintendent, Forest Rutherford; and G. D. Van Arsdale in the experimental plant, contain the following information: Development in the Limestone and Sacramento Hill mines covered 92,780 and 7362 ft., respectively, while churn-drilling amounted to 10,830 ft. In the Copper King group work totaled 5141 ft. Two important orebodies have been discovered, one at the Lowell, the other in the Sacramento division. But the most interesting development, in its favorable bearing on the future of the district, has been the exposure of ore on the Wade Hampton and White Tail Deer, two claims long neglected, but members of large groups owned by the Copper Queen to the west of Bisbee. The policy of increasing reserves and carrying development work well in advance of mining has been continued, with gratifying results. The estimate of ore reserves shows a total of 2,567,928 tons of average grade and 211,199 tons of lean sulphide in the Limestone mine.

Four methods of stoping are practised, the choice depending on local conditions. The comparative costs are:

	Tonnage.	Cost per ton.
Square-setting	612,299	\$2.113
Top-slicing	20,582	1.300
Cut and fill	58,239	1.400
Shrinkage	3,822	.....
	694,942	\$2.028

Electric haulage track aggregates 9.6 miles of main line.

A compound, geared man-hoist at the Sacramento shaft has been added to the hoisting equipment. A fifth compartment is being raised at the shaft, which will be used for air mains, electric cables, etc. There will be room for pump columns when needed. The quantity of water pumped was less than usual.

The additions of two boilers and a 7000-ft. compressor to the plant at the power-house were completed as quickly as delivery of the machinery permitted, but not before they were needed.

A part of the Lowell fire country was opened a short time ago, and it was found that the 12-3-34 raise had been burned out since it was closed. Gas is not now

coming from the bulk-headed area. Work about the fire has been confined to repairing the air course to the surface. The filled and abandoned 450-50 stopes of the Holbrook have been hot for more than a year. In July there was an appearance of gas on the 600-level in which one man was overcome. The fire threatened to be serious, and would have been so but for the efforts to control it by Mr. Hodgson and his miners, who fought it heroically at the risk of their lives. Three men were saved only by artificial respiration and the use of the pulmotor. Another fire in the Czar was due to breach of rules. The eagerness with which all employees respond to the call of rescue-work and fire-fighting has been most gratifying.

Positive ventilation was introduced at the Gardner division, with great improvement in the working conditions. Both temperature and humidity have been reduced. It is believed that economy has already resulted, which will be more clearly shown in the future. Change rooms have been built at the West Atlanta and Sacramento shafts of the same type as the Uncle Sam change room. A 'Safety First' organization was instituted among the employees of the mine department, who meet regularly to discuss means for the prevention of accidents. Frequent bulletins are posted and otherwise distributed, describing accidents and recommending means of avoiding them. This department is under the energetic and intelligent leadership of W. E. McKeehan, as safety inspector for the mine and smelter, and instructor in rescue work and the use of rescue apparatus and helmets.

Bisbee Production

During the year the following tonnages of ore and slag were extracted from the mines and from old Bisbee dumps:

Shipped to Douglas:	Tons.
Ore	712,444
Precipitates	603
Old dump slag	93,578
Old dump slag by lease	634
Ore from lessees	21,524
Flue dust from lessees	44
Ore for experimental leaching plant	4,765
Shipped to El Paso:	
Ore mined by Company	14,800
Ore mined by lessees	773
Shipped to Globe:	
Sulphide ore	18,316
Total	867,481

The ore shipped to El Paso contained 5,701,628 lb. of lead, and that to Douglas and Globe a total of 16,213 oz. gold, 919,138 oz. silver, and 97,181,725 lb. copper.

On the basis of raw ore, Moctezuma concentrates, and secondaries, there was delivered during 1913 to the cupolas and reverberatory furnaces, 1,193,726 tons. Of this total 835,093 tons was ores to blast-furnaces,

*Abstract from annual report.

161,707 tons to reverberatories, 37,556 tons to converters, and the balance, or 179,815 tons were secondaries, retreated by the various departments. The shrinkage at roasters was 20,445 tons.

The bullion produced was 134,513,330 lb., which contained: copper, 133,410,582 lb.; silver, 1,870,162 oz.; and gold, 31,141 ounces.

During the month of September, further experiments on dust losses from the large steel stack, were made, with the view to proving whether the present conditions of operation as compared with those of the year 1909 showed any difference. It was found that the copper loss had been reduced from an average per day of 14,310 to 2286 lb., with practically the same number of furnaces and converters in operation.

Flue dust from the blast-furnace department was 39,748 tons or 3.92% of the charge, against 5.90% in 1912, and 7.59% in 1911. An average of 8.08 furnaces were operated, smelting 343.5 tons per charge per day, using 12.4% coke per ton of charge. The matte-fall was 18.79%, against 20.97% in 1912. An average of 5.97 roasting furnaces were at work, averaging 56.5 tons per furnace day. Flue dust equalled 5.2% of the charge. Three new McDougall furnaces were added. An average of 1.71 reverberatory furnaces was operated, smelting 289.6 tons per furnace day. A third furnace was completed during the year. Part of the lining is of magnesite instead of silica brick. Oil consumed was 0.9 bbl. per ton of charge. An average of 6.5 basic-lined converters was operated treating 206,493 tons of matte.

During the year 12,378 samples were made and 318,507 tons of ore handled by the sample mill forces. There were 101,455 determinations made in the laboratory, of which 95,435 were for the Company and 6020 for the mines at Bisbee.

In the power-plant one 12,000-cu. ft. Nordberg compressor for use on the converters was installed. There was 86,191 bbl. of California oil used at the main boiler-plant and 161,536 bbl. at the reverberatory furnaces and roasters. The cost of a horse-power for the year was \$54.844, or slightly better than last year, and the average daily horse-power developed was 4595.8.

Improvements Contemplated

For 1914 both known and prospective changes are as follows: (1) unloading and spreading device at roaster plant; (2) one large converter stand; (3) seven more roasters, building to cover bins and conveyors, for treatment of excess sulphide ores from Bisbee; (4) skull-cracker for breaking converter slag shells; (5) protection of tracks at ore beds; (6) the erection of a copper casting furnace is under consideration; and (7) tower to remove crane trolleys.

The average number of men per day employed was 1039.

During the year an experimental plant was completed, and experiments were conducted principally with the view of determining the best method of leaching low-grade ores and the tailing from the concen-

trators. A Wedge furnace, of the muffle type, was erected, which produced calcines containing a high proportion of their copper soluble in water, and practically all of the remainder soluble in dilute acid, but with a high fuel consumption. The recovery of the dissolved copper was effected by electrolysis using graphite anodes, and reducing the resistance and increasing the yield of sulphuric acid, by injecting sulphur dioxide into the electrolyte. The results were favorable, but several problems which presented themselves, as the experiments progressed, remain to be solved, as well as a reduction of the high fuel consumption, before definite conclusions can be reached.

Dividends paid by the Company in 1913 totaled \$5,700,000, net earnings being \$6,916,900.

Detroit Copper Mining Company of Arizona

The reports of A. T. Thompson, general manager; M. H. McLean, mine superintendent; and V. P. Hastings, smelter superintendent of this Company, contain the following notes: Development in the Ryerson, Yankie, Copper Mountain, and Arizona Central mines covered 6197 ft., and in outside mines 18,492 ft. Ore mined per foot of development was 28.583 tons. A total of 533,563 tons of ore of all classes, averaging 2.89% copper was mined from all mines. Of this, 518,718 was concentrating ore. A Nordberg compressor was installed to operate a larger number of drills, and new change-houses and other improvements were built. On the outside mines development work was continued on the Esperanza, Santa Rosa, Wattle, Fairbanks, and Summit claims, while exploration was started at the Gem, Summit No. 2, Colorado, and Antietam properties. The installation of new hoisting plants at practically all of these properties, and the enlargement of plants at properties under development, meant very high outlays during the year. Power lines were built to some of these outlying camps.

The concentrating plant treated 517,518 tons of ore averaging 2.785%, yielding 66,928 tons of concentrate containing 15.834% copper. The saving was 73.52% on the ore and concentrate, 75.18% on the ore and tailing, 74.76% on the concentrate and tailing, and 75.27% by assay only. Water used per ton of ore milled was 554.98 gallons.

The blast-furnace treated 141,094 tons of mixed products, using 16,099 tons of coke. The bullion produced was 22,255,130 pounds. For some years past the advisability of changing the method of smelting from cupola to reverberatory practice, has been under discussion, and the old smelting and power plant was not kept up to the standard of perfect repairs and efficiency. On determining to retain the old system, a thorough overhauling of the smelters, including the replacement of silicious by basic converter lining, has been carried on. In re-designing the smelter plant and improving smelting operations the officials were greatly assisted by George B. Lee.

A total of 1510 men were employed, 946 working at the mines. Net earnings for 1913 were \$1,112,870,

while during this period \$780,000 was paid in dividends to the shareholders.

Moctezuma Copper Company

This Company operates at Nacozari, Sonora, Mexico, and the general manager, J. S. Williams, Jr., reported as follows:

The total mining done during the year amounted to 31,292 ft. Of this 8582 ft. was for stoping purposes and the remainder of 22,710 ft. for development work. This is an increase of 40% over corresponding figures during 1912. Thirty-nine per cent of this development work was done in ore. Beside developing ore below the Porvenir adit large stopes of good ore have been opened on two levels in ground that had been abandoned as barren. During the year 1028 ft. of exploratory work was done outside of the Oval, but no success in finding ore rewarded us. The cost of delivering ore to the railroad bins was decreased during the year, although the total cost of mining was slightly increased. This increase was caused partly by higher hoisting costs due to handling heavier tonnage from below the 700-ft. level, but principally to increased activity in exploration and development made possible by the more general use of machine drills.

The concentrating plant treated 603,654 tons of ore assaying 3.557%, and yielded 135,057 tons of concentrate containing 13.376% copper. The tailing averaged 0.67%, and the saving, by four methods of reckoning, was 85%. Fresh water used per ton of ore milled was 1020.72 gallons. Concentrate is sent to the Douglas smelter of the Copper Queen company.

Apart from unavoidable delays, work was suspended for 58 hours on account of a battle between the federals and the state forces, and for 153 hours by a strike of the concentrator men. A series of smokers for the bosses at the mine were held during the year, at which safety measures were discussed. The results have been good. The present power line between Nacozari and Pílares is too small to carry the necessary load. A new transmission line, using heavier wires and steel poles, is in course of construction. It was considered advisable during the year to reduce the working hours of mechanics and laborers from ten to nine hours without any change in wages. Net earnings of the Company were \$2,402,447, of which \$1,950,000 was paid in dividends.

Burro Mountain Copper Company.

This Company's mine is at Tyrone, New Mexico, and the superintendent, E. M. Sawyer, reports that the Niagara haulage adit to deliver the ore from the Burro Mountain claims at the railroad terminus and to explore the intermediate ground, was driven continuously throughout the year and was the most important piece of work. This adit was advanced 3753 ft., making the total length to date 4286 ft. Connections will soon be made with the fourth and fifth levels of the Sampson mine at Leopold for the purposes of ventilation and drainage and for drawing ore from the east orebody

when stoping is recommenced. The bulk of the east orebody lies between the adit level and 180 ft. above. For 2500 ft. from its mouth, the adit passed through solid, firm ground which stands well; beyond this point the ground was somewhat heavier.

Toward the end of the year a prospect drift was driven from the main tunnel at a point about 1200 ft. from the portal and revealed a body of low-grade sulphide ore. A series of cross-cuts and raises in this ore has shown it to be of considerable importance and so far about 50,000 tons averaging 2.35% copper has been added to the known reserve. No other prospect work was done at the Chenung or Sampson mines.

A favorable site for the concentrator designed for 1000 tons daily capacity has been chosen about three miles east from Tyrone. The ample space which this site provided for storage of tailing was one of the elements which determined its selection. A central power-plant, equipped with two 1000-hp. Diesel engines will be built at Tyrone, near the collar of No. 2 shaft.

Stag Cañon Fuel Company

The coal mines are at Dawson, New Mexico, and the general manager, T. H. O'Brien, states that the production was 1,322,813 tons, a decrease of 60,749 tons from 1912. Development totaled 30,226 ft. Concrete portals have been erected at several of the main entries and manways; fire-proof overcasts were also erected, and every provision that could be foreseen was made against accidents. The explosion in No. 2 mine on October 22 resulted in the death of 256 men. The coroner's jury, which exonerated the Company from blame, was satisfied that the ignition of dust occurred during working hours through a badly directed shot, fired against the most rigid rules. The explosion was propagated exclusively by coal dust, and was of such violence that only 29 men in No. 2 mine escaped. Most of those who met their death were killed instantly. To guard against such calamities shot firing was effected by electricity only after every man was known to be out of the mine. In this case a miner connected up his charge by a long copper wire with the current of the trolley system. The coke production was 293,090 tons from 478,473 tons of coal, equal to 61.32%. Net earnings were \$362,564, and \$180,000 was paid in dividends.

Phelps, Dodge Mercantile Company

The general manager, W. H. Brophy, reported that the gross sales and transfers in 1913 were \$6,772,289, showing a net profit of 9.28%. The stores are at Bisbee and branches, Douglas, Morenci, Dawson, Nacozari, and Pílares, and the increase of sales over 1912 was \$628,933. The furnishing of supplies to troops along the border and at Fort Huachuca has also added to the volume of our business at the Bisbee store and branches. There was an average of 490 people employed at the various stores and general office.

Net earnings were \$649,518, of which \$500,000 was paid in dividends.

Cost of Erecting Treatment Plants

By M. W. von BERSEWITZ

In view of the articles* on 'Under-Estimating the Cost of Milling Plants,' by A. Sydney Addison, the following cost of erecting two different types of mills should be of interest. The Commonwealth stamp-mill and cyanide plant, with mine plant, consisting of a crushing plant with No. 6 and No. 4 Gates crushers and revolving screen, etc.; a mill with an 18-in. belt conveyor 300 ft. long 20° incline to mill bins; thirty

automatic tramway from shaft orebins to crusher bin were estimated to cost \$410,000, divided as follows: mill complete, \$239,100; power-plant, \$35,900, and shaft and mine equipment, \$35,000. The daily capacity was estimated at 350 tons.

In several instances, notably concrete work and electrical wiring equipment, the estimates have been considerably exceeded. Nevertheless, the installation as a whole will closely approximate the above estimate, as shown by the table of costs below, taken from the annual report of the Commonwealth Mining & Milling Company:

	A Crusher Plant	B Stamp Mill	C Refinery	D Power Plant	E Mine Surface Plant	F Railway Siding	Undergrd. Plant	D Shaft Equipmt. and Timbering
Excavation	\$ 1,156.16	\$ 7,358.57	\$ 653.71	\$ 712.64	\$ 155.39	\$114.00		\$ 10,180.47
Concrete	2,794.05	25,068.95	179.62	5,479.53	1,655.07			35,177.22
Machinery Cost	5,530.68	78,735.87	15,100.43	33,283.41	8,860.01		\$10,749.74	156,557.90
Machinery Erection	960.00	10,477.74		2,569.87	354.20			14,261.81
Building Lumber	1,695.65	13,172.66	121.81	597.76	703.18			22,747.99
Building Covering	656.81	5,333.21	314.08	549.64	81.56			6,938.30
Doors and Windows	172.61	1,592.07	84.10	236.90	64.06			2,149.74
Tramming and Erection	538.10	6,723.47	59.90	276.16	385.45			7,983.08
Steel Tanks in Place	1,630.56	8,912.48						10,563.04
Wood Tanks in Place		9,788.79						9,788.79
Steel Structures in Place	298.00	365.42	190.57	3,844.43	3,140.14			3,994.13
Piping Cost		15,577.22		2,055.75	165.00		1,159.52	20,581.17
Piping Erection		5,823.22						8,044.97
Electrical Wiring Cost		6,076.70					581.76	6,658.46
Electrical Wiring Erection		2,014.11		303.50				2,317.61
Beltting Cost	165.58	1,902.96		46.54				2,115.08
Launders Cost of Lumber		775.15						775.15
Launders Cost of Erection	197.45	1,378.78						1,576.23
Engineering Office	1,113.99	1,679.99	560.00	1,119.99	1,119.99			5,539.96
Engineering Field	737.87	1,106.80	369.92	737.87	834.23			3,785.69
Overhauling and Repairing E. Plant				2,436.43				2,436.43
Tailings Dam Fence					271.19			271.19
Tools, Etc.					387.02			387.02
Mules							300.00	300.00
	\$19,653.51	\$203,784.16	\$17,633.14	\$54,250.42	\$18,180.49	\$144.00	\$12,871.02	\$8,754.69
								\$335,271.43

1500-lb. stamps, arranged for coarse crushing; three 8 ft. by 30-in. Hardinge conical pebble mills; two 22 by 5-ft. Allis-Chalmers tube-mills; one 20 by 4-ft. old style tube mill (on hand); three Caldecott cones; three Dorr classifiers, latest types; two 38-ft. Dorr thickeners; nine 12 by 36-ft. agitating vats (two on hand); four 42-ft. Dorr thickeners; four 11 by 18-ft. Oliver filters; two Merrill clarifying presses; two Merrill precipitation presses; and two Donaldson melting furnaces; a power-plant with one 22 by 42 by 42 cross-compound Allis-Chalmers heavy duty Corliss condensing engine direct connected to one 750-kva., 3-phase, 480-volt generator with exciter, one C. H. Wheeler horizontal surface condenser, one 12 by 24 Pratt patent rotary vacuum pump, one 7-in. double suction centrifugal circulation water pump, one 8 by 8 vertical enclosed steam engine, direct connected to pump, one 5¼ by 3½ by 5 horizontal steam driven duplex pump, one 1200-hp. Stillwell open type feed-water heater, two 10 by 6 by 12 duplex plunger feed pumps, one 8-in. vertical steam separator, one 10-in. automatic exhaust valve, and one 4-panel switchboard complete with instruments; new 'D' shaft and surface equipment: 47-ft. steel head-frame, 100-hp. double-drum electric hoist, two 3-ton skips; two 2-deck man cages, one 1600-cu. ft. Ingersoll-Rand cross-compound Imperial type X3 compressor; air-drills and cars, telephones, etc.; new blacksmith shop, fitted with No. 5 Leyner drill, sharpening machine, etc.; Hunt

The actual work of erecting this plant was done by contract, by the Concrete Construction Co. of Tucson, Arizona, and Campbell & Kelly, Inc., of Tonopah, Nevada. The time occupied was about one year. Reckoning on a stamp basis, the cost of this mill was approximately \$11.170 per stamp. The ore, according to the annual report, will average about \$5.35 per ton.

At Kalgoorlie, Western Australia, the Associated Northern Blocks Co., in 1903, erected a new plant of 120-ton capacity. The estimate was about \$170,000. The equipment consisted of the following: head-frame, 90 ft. high; two Babcock & Wilcox boilers, feed pump, one Robey 250-hp. tandem-compound engine, one 25-kw. vertical engine direct connected to a dynamo, feed-water heater, Pearn surface condenser, grease separator, main drive shaft and pulleys, and friction-clutch pulley; 400-ton orebin, No. 5 Gates crusher, and Robins belt-conveyor; three No. 5 Krupp ball-mills, Krupp screw conveyor, dust house and connections; belt and bucket elevator, orebin for fine crushed material, push conveyor, five Merton roasting furnaces, flue and stack foundation, 100-ft. steel stack and hot-ore conveyor; six Forwood-Down grinding pans, and Krupp chain and bucket elevator; one set of settlers; five 22 by 6-ft. agitators and gear, and two vertical three-throw 10 by 12-in. Pearn pumps; a vortex mixer and pump; three Dehne 5-ton filter-presses, and fourteen side-tip cars; zinc-boxes, tilting furnace, amalgamating barrel-clarifying press, clean-up press, etc., and solution tanks and Sulzer pumps.

*Mining and Scientific Press, July 16, 26, August 16, 23, and October 18, 1913.

The actual cost was as follows:

Mill-buildings	\$20,640	Roasting furnaces ...	38,900
Head-frame	8,150	Grinding pans	\$9,700
Power-plant:		Settling boxes	2,880
Boilers	12,960	Agitators	8,640
Engine	7,440	Mixer and pump	1,400
Dynamo set	2,880	Pumps for presses	6,250
Heater	1,290	Filter-presses	15,840
Condenser and cooling plant	12,820	Percolation plant (dis-carded)	7,200
Main shaft and pulleys	2,400	Clean-up department ..	4,900
Crusher station and orebin	11,700	Solution tanks	4,950
Ball-mills	12,900	Sundries	3,980
		General charges	5,800
		Total	\$203,620

This plant was erected by day labor under J. H. Dagger in about 150 days. Including some rich sulphotelluride ore shipped prior to 1903, the plant has treated 365,555 tons of ore, and a large tonnage of old tailing, yielding gold worth \$8,300,000, and \$3,485,000 in dividends.

Mineral Production of Broken Hill

The year 1913 proved much better than was anticipated. The industrial trouble expected at the end of the year has not yet occurred. It looks as if the 18 months' extension of the agreement between the mining companies and unions will be accepted without further demur. If the miners and the small portion of them that cause all the trouble are satisfied not to make worry, the prospects for 1914 appear good. During last year there were two strikes which affected work generally, metals averaged a lower rate, and a water trouble caused sundry stoppages, yet, the official figures show an export record in the history of Broken Hill, according to a correspondent in the *Australian Mining Standard*.

Since 1907 the mineral exports of Broken Hill have been as follows:

1907	£3,081,031
1908	2,015,647
1909	2,076,574
1910	2,432,935
1911	3,100,109
1912	4,186,200
1913	4,327,217

One marked feature of mining operations in 1913 was that exploration at depth opened new ore, and the South, North, British, and South Blocks (Zinc Corporation) have all shown highly satisfactory results. Only a few years ago the North and South were regarded as almost worked-out mines; today they are in the forefront. The British, also, was never before in such a strong position. A comparison of the past two years' results is as follows:

	1912.		1913.	
	Tons.	Value.	Tons.	Value.
Crude silver-lead ore..	29,605	£ 39,140	24,754	£ 58,209
Silver-lead concentrate.	279,915	2,769,170	327,431	3,171,433
Zinc concentrate.....	433,054	1,320,666	405,740	1,088,313
Silver-lead slime.....	4,503	7,218	10,036	6,940
Zinc slime			1,606	2,222

Mastic Lining for Acid Tanks

In connection with the operations of the Chile Exploration Co., in Chuquicamata, Chile, there has been developed a new method of lining concrete tanks which are subject to the action of sulphuric acid. The Company's copper ores in Chile are handled by the combined sulphuric acid and electrolytic method. After the ore is crushed it is put into large tanks or vats and then leached with a 10% sulphuric acid solution for 24 hours. The solution containing the copper is led through another process for extracting chloride and then passes to the electrolytic tanks. There the copper is extracted and the remaining solution, which is now increased in sulphuric acid, owing to the copper being separated from its chemical connection with sulphur, is then returned to the leaching vats ready for extracting the copper from a new batch of ore.

It can readily be seen that the large tanks required must be such as will withstand sulphuric acid, which, of course, concrete would not do unless provided with a protective lining. Experiments with tanks of various types were made, but in most instances proved failures. It was then suggested that an especially prepared acid-proof asphalt mastic lining might be used to overcome the difficulties encountered. In coöperation with E. A. Cappelen Smith, consulting metallurgical engineer for the Chile Exploration Co., experimental tanks, among them one 15 ft. high, lined with Trinidad asphalt mastic were built at the research laboratory of the A. S. & R. Co., at Maurer, New Jersey. With these tanks there was duplicated as nearly as possible the operation of extracting copper as it is carried out in Chuquicamata.

Under the direction of Mr. Smith, various other materials were also experimented with at Maurer, but they all proved unsuitable, with the exception of the asphalt mastic. It was on the strength of this material having shown no defects or deterioration after a year's test that the Chile Exploration Co. has placed the contract for lining with asphalt mastic some 150 concrete tanks or vats from 15 to 16 ft. in depth and from 120 to 150 ft. in exterior dimensions. The lining of these tanks in Chile will require from 1250 to 2000 tons of asphalt mastic, which is being prepared here and shipped to Chile. The first cargo of 500 tons was shipped in February, and as soon as it arrives, which will take about three months, as the ship has to go around the Horn, an experienced superintendent and nine mastic workers will be sent to Chile to do the lining of the tanks. The experimental work at Maurer, the preparation of the asphalt mastic, and its application to the concrete tanks was conducted by Henry Wiederhold, manager of the Vulcanite Paving Company.

The Aramayo Francke mines, Bolivia, produced in January 313 tons of black tin, 23 tons of copper, and 24 tons of silver ore.

Discussion

Readers of the MINING AND SCIENTIFIC PRESS are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment. Insertion of any contribution is determined by its probable interest to the readers of this journal.

The Rand Banket

The Editor:

Sir—Permit me to congratulate you on the publication of this excellent series of articles, together constituting a treatise on a subject of immediate interest. Even to those having no first-hand knowledge of the mining geology of the Witwatersrand it has been evident that in the ascertainment of the real structure of the pyrite 'pebbles' would be found the key to the origin of the gold in the conglomerate. Becker recognized this in his able summary of the knowledge extant at the time of his visit to the Rand. De Launay also was 'bankered' by the "rolled pyrite" and the "pebbles of pyrite." Even after two decades of active mining, punctuated by the scientific investigations of sundry distinguished geologists, the origin of these remarkable deposits remained hardly less obscure. In 1907, J. W. Gregory, in his valuable paper on the subject, happens to quote from an editorial article by myself in the *Engineering and Mining Journal* of October 17, 1903, in which I stated that "the origin of the banket still remains the great riddle of modern economic geology." It is true, by that time the placer and the precipitation theories had lost support while the infiltration or lode theory had gained ground, but so long as the 'pebbles' of pyrite remained unexplained, one theory was as doubtful as the other. Despite the early advocacy of the lode theory by J. S. Curtis, followed by a number of mining engineers then resident in South Africa, the riddle remained unsolved. Gregory endeavored vainly to prove that "the placer theory best explains the facts." To explain those facts he had to trespass on the scientific credulity of his hearers. The effect was unconvincing. He also ran against the 'pebbles' of pyrite, only to reject the notion that they were of "concretionary origin." On the contrary he concluded that they were of alluvial character, despite the suggestions, already published, both of Hatch and of Horwood, that they were among the things that "are not what they seem." To the discussion that followed Beck contributed a comment that was brief, but intensely effective; and Maclaren rebutted an argument of Becker's that previously had been a real obstacle to any ordinary lode theory. Becker argued that a conglomerate was less porous than a sandstone, because the interstices of the former would be filled with fine sand, but Maclaren suggested that this involved the assumption, not warranted, that the inter-

stitial sand of the conglomerate was identical in character with the mass of the sandstone, and that the interstitial spaces within the sandstone had not themselves been filled with finer silt. The filling between the pebbles of the banket consists of fairly large grains of quartz with heavy minerals, while the sand of the enclosing quartzite was deposited with mud and feldspathic material, the latter appearing now as kaolinite and sericite. Thus the sand, by pressure, became impervious, while the matrix of the conglomerate "protected largely from pressure by the bridging of the larger pebbles"—as Maclaren aptly phrased it—remained porous and percolable. This helps to explain why the gold-bearing solutions enriched the conglomerate and avoided the intermediate layers of sandstone. It also gives a clue to the reason why the richest ore is now associated with large pebbles. Kuntz drew attention to the fact that not only is the gold restricted to the cement between the pebbles, but that the banket is barren where the interstices between pebbles are filled with sand. The fact that the gold is not concentrated along the former bedrock—now the foot-wall—and that the narrow seams of banket are richer than the wide ones is suggestively against an alluvial origin. Moreover, the effects of dikes and faults in modifying the distribution of the gold and the pyrite associated with it are dead against the 'fossil placer' theory or its ingenious modifications.

One reason why the ordinary lode theory, of infiltration by gold-bearing solutions circulating along the porous beds of conglomerate found so little favor was because it was deemed desirable to mark the Rand deposits as unlike anything else of the kind, as an occurrence beyond the ordinary experience of mining. Either the placer or the precipitation theory, with that hybrid born of an unnatural union between the two of them, namely, Gregory's idea of solution with re-deposition, was regarded in a kindly way because it labelled the Rand as 'extra-ordinary.' Thus Gregory argued that, according to the placer theory, no impoverishment in depth need be anticipated, while if the banket were a lode of infiltration it would necessarily decrease in richness as great depth was attained. If the mining engineers and geologists of the Rand had been frank even at that time they might have spoiled the professor's argument, but they did not care to commit themselves to a statement unpalatable to their employers. In the same way the discussion as to whether the distribution of the gold was in 'patches' or 'shoots' was a mere 'sparring for wind' hiding the disinclination to acknowledge that the gold was distributed in a manner involving uncertainty as to the future of individual mines. The denials that 'ore-shoots' in the ordinary sense are discernible on the Rand are now no longer of any consequence, for ample proof to the contrary exists. Indeed, much of the writing and talking on this subject has to be discounted, from a technical point of view, by the fact, as I have discovered, that the ante-

¹As mentioned in the article to which Mr. Horwood refers and which I translated for the *Engineering and Mining Journal*, while editor.

chambers of the financial houses are ill adapted for the scientific treatment of such a subject as the distribution of gold in lodes. Even Mr. Horwood, with so much more information at hand, treats the subject in a very delicate way; indeed, he drags a palpable herring across the trail by quoting the statistics of gold production, which, of course, in themselves, afford one of the least trustworthy pieces of evidence on the matter. He mentions the Jupiter, the deepest mine on the Rand (5040 ft. vertical) as being "worked at a profit." The Jupiter has now been shut-down for sundry reasons, of which the only one that counts is the relative poverty of the ore. For the same reason, the Cinderella Consolidated (4627 ft. deep) is also idle. However, it is fair to recall the fact that Mr. Horwood controverted Gregory's argument in regard to persistence of richness being allied to an alluvial theory, by quoting De Launay's suggestion that if the blanket were a placer deposit then a diminution in richness would be inevitable as distance from the former shore-line was reached. Mr. Horwood argues that if the blanket be a 'lode formation,' then far greater persistence of ore can be expected; he adduces the fact that the depth of the deepest existing workings is less than one-fiftieth of the length of the lode as measured along its strike, and that owing to the walls being kept apart by the intervening pebble-beds, the extent of profitable ore on the dip is likely to be equal to that ascertained along the strike. This, of course, is a geological inference running counter to established facts. Even on theoretical grounds it is not convincing, for the downward continuity of ore is not determined by structural conditions only. Increase of heat and of pressure are hindrances to that precipitation of metals on which ore deposition depends. The further remarks anent the Rand "developing, more and more, into an enormous, well managed, low-grade goldfield" are not at all to the point. Geologically the persistence of the blanket is an interesting fact; economically the obvious impoverishment of it is a depressing factor. In this part of his treatise, Mr. Horwood speaks with the voice of the geologist, saying smooth things in the house of finance, although his hands are those of an engineer. This is, to criticize frankly, the one weak spot in his treatment of the subject, but I emphasize it more in a spirit of good humor than to detract from the great value of his research.

As regards the placer origin of the blanket, it is interesting to turn to an undoubted fossil placer, in order to see in what respects any resemblance exists. Among several buried deposits of gold-bearing alluvium, I shall refer to the beaches of Nome, which I examined in 1908.

Three such deposits have been traced, besides intermediate patches of minor extent. The First Beach is on the present shore-line; it was discovered in 1899, and has yielded \$2,000,000 in gold. This deposit is still being re-formed by tidal action, but as first discovered it represented the cumulative effect of a continued concentration of gold, garnet, and magnetite in the form of a fringe of heavy sediment at the tidal limit of Ber-

ing Sea. The garnetiferous sand containing the gold is 6 in. to 2 ft. thick, and from 3 to 5 ft. wide, dipping seaward at an angle of 5°. It has been formed by the erosive action of the waves upon the edge of the coastal plain, which terminates in an escarpment 10 to 20 ft. high. The coastal plain is an alluvial delta having a sea-front of 30 miles and a central width, to the foothills, of 4 miles. It represents the detritus brought from the hinterland by a number of streams that deposited the products of erosion upon a bottom that formerly was subsiding but now is undergoing slow elevation.

After the present beach had been successfully exploited, the others were found, partly by accident, partly by aid of geological inference. These other deposits are raised beaches, the Second being 37 ft. above mean tide, and the Third 31 ft. higher or 68 ft. above sea-level. Both of them extend in a sweeping curve so as to form a flat arc of which the present sea-shore is the chord. The Second is half a mile inland, while the Third is 3 miles, as measured northward from the beach at Nome. Both were indicated by mounds of terraces representing the line of former escarpments. The Second is capped by pebbles and gravel containing water-worn fragments of sea-shells. The gold lies on bedrock, which is schist. Fully \$2,500,000 has been won from this marine placer.

The Third Beach is much the richest, having yielded \$15,000,000 in 7 years. It does not always lie on bedrock. The section (Fig. 1) that I sketched in the Happy New

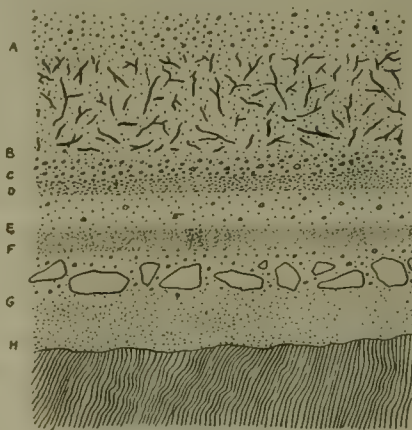


FIG. 1. SECTION OF THIRD BEACH NEAR NO. 2 SHAFT OF THE HAPPY NEW YEAR MINE.

- A-B Two to three feet of gray quicksand.
- B-C Iron-stained pebbles.
- C-D Gray micaceous sand.
- D-E Sand, with pebbles of white quartz.
- E-F The ruby sand, containing gold.
- F-G Boulders of schist and limestone.
- G-H Two feet of fine gray quicksand.
- Below H Schist bedrock.

Year mine showed about 2 ft. of gray quicksand lying upon the schist, then 3 to 4 ft. of boulders with small gravel, underlying the 8 or 10 in. of 'ruby sand' containing the gold, which was readily visible when I examined a handful of this natural concentrate. Above the deposit came sand with pebbles of white quartz, gray micaceous sand, and iron-stained pebbles, making

7 or 8 ft. altogether, these being capped by the roots of the moss that once covered this alluvial deposit, and above that came the coarse gravel of the present coastal plain, all of it frozen solid from surface to bedrock. The gold-bearing layer elsewhere lies on a false bottom of clay or on the bedrock itself. It has an irregular width: 25 ft. in the richest parts, but reaching to 75 to 80 ft. for considerable lengths. For instance, in the May Fraction \$330,000 was taken from a length of 110 ft., 25 ft. at its maximum width, tapering to 5 ft., and 3 ft. deep. The depth or thickness of the gold-bearing layer is usually 3 ft. The productive portions of the deposit yielded gold at the rate of 15 dwt. per cubic yard. The gold is found to have imbedded itself amid the cavities and folia of the soft schist, so that an inch or two of bedrock is always removed with the overlying sediment.

Space will not permit me to go into further details. Such as I have given suffice to show a great unlikeness to the features of the Main Reef series. The concentration of the gold to a narrow band, at most 100 ft. wide, corresponding to 100 ft. on the dip of the blanket, may be imputed simply to the scale of the precedent geological activities, but it appears to me to be more properly assigned to the essential limitations of such a process of mechanical concentration along the sea-front.

Another ore deposit that provokes analogy is the copper-bearing conglomerate of the Lake Superior region. One of the most persistent orebodies ever uncovered by the miner is the copper blanket of the Calumet & Hecla mine, with its deep level, the Tamarack. This blanket is not the only one exploited for copper; indeed the united thickness of the conglomerate beds in this district exceeds 5000 feet. The pebbles are mainly water-worn fragments of quartz-porphry and allied rocks, cemented by calcite, quartz, epidote, chlorite, prehnite, and copper itself. While copper has been won on a large scale from layers of conglomerate in the Calumet, Hecla, Tamarack, Franklin, and Allouez mines, at least one bed of sandstone was rich enough in copper to be exploited, in the Nonesuch mine. However, the more numerous mine workings of the region are in beds of cupriferous amygdaloid, such as have given fame to the Quincy, Atlantic, Baltic, and Wolverine mines. Among the minerals associated with the copper in the matrix of the conglomerate are at least three that are prominent in the blanket of the Rand, namely, quartz, calcite, and chlorite. No effort has been made by any American geologist to establish an alluvial origin for the copper. On the contrary, it was early recognized, by Pumpelly, that an intimate relation existed between the distribution of the copper and the peroxidation of the ferrous oxide in the encasing rock, indicating the precipitation of copper from solution by ferrous oxide, a reaction familiar in the wet metallurgy of copper. As to the source of the solutions, there is less agreement, but it is a recognized fact that the basic lavas of the region generally contain native copper, some of them being rich enough locally to invite mining operations.

Besides the copper in the beds of conglomerate, and in the amygdaloidal rocks, there exist veins formed along lines of fracture. Some of these have proved extremely productive and contained masses of native copper, the largest weighing no less than 420 tons.

The Calumet & Hecla conglomerate is from 10 to 25 ft. thick, and dips from 36° to 39° northwest, the profitable portion having the form of an oresshield that pitches north. It resembles closely the Allouez conglomerate, exploited in the Franklin Junior mine, where I sketched it as shown in Fig. 2.

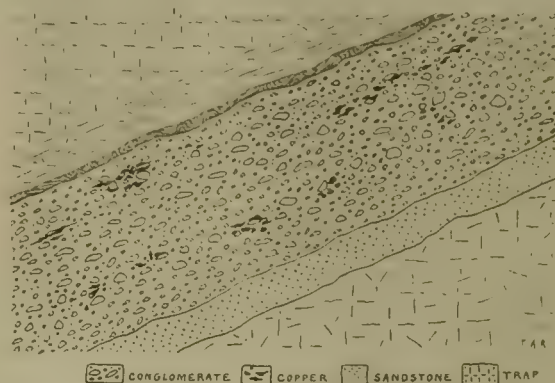


FIG. 2. COPPER BASKET IN THE FRANKLIN JUNIOR MINE, MICHIGAN.

The conglomerate has a chocolate tinge owing to the reddish-brown feldspars of the porphyrite pebbles. These range in size from a pigeon's egg to that of a turkey. No copper is found in the foot-wall sandstone, but in the deeper workings of the mine, where the sandstone has thinned to disappearance, the copper is found extending into the amygdaloidal diabase underneath the conglomerate. It is significant that a copper basket has been formed by infiltration of solutions from which the metal in its native state has been generously deposited, in accordance with reactions suggested by the minerals present. G. Fernekes and H. N. Stokes have made confirmatory experiments.³ It is not necessary to accentuate the suggestiveness of these copper-basket deposits in their analogy to the lodes of the Rand.

T. A. RICKARD.

London, March 9.

The Editor:

Sir—In the part of C. B. Horwood's paper on 'The Rand Basket' appearing in the *Mining and Scientific Press*, November 1, the author proceeds at some length, on page 676, to show that volume changes in the replacement of quartz by pyrite in the formation of the so-called pyrite 'pebbles', did not take place according to the general statement by C. R. Van Hise,⁴ name-

³'The Copper Mines of Lake Superior.' By T. A. Rickard, 1905. Page 103.

⁴*Economic Geology*, Vol. II, pp. 580-584, and Vol. I, p. 648.

⁵'A Treatise on Metamorphism,' U. S. Geol. Surv., Mon. 47 (1904), p. 209.

ly, that "the volume of the original compound is to the volume of the compound produced directly as their molecular weights and indirectly as their specific gravities."

However, in attempting to prove his contention, the correctness of which is not called into question, he wrongly interprets the meaning of the above quotation. This is indicated when he says "the latter part of this statement means that the weight of the compound produced is the same as that of the material that has undergone dissolution," and when further on he considers somewhat in detail, the results to be expected by using each part of the statement as a separate and distinct proposition. The values for the pyrite volumes which he thus obtains are obviously too great in one instance and too small in the other.

The two factors, molecular weight and specific gravity, cannot be considered independently. By definition $v = m/g$ where

v = molecular volume,

m = molecular weight,

and g = specific gravity.

The following operations are evident:

$$1) \quad vq/m = 1$$

$$2) \quad vq'/m = v'q'/m'$$

$$3) \quad v/v' = gm'/mg'$$

These equations hold true in comparing any two solid substances. Substituting the proper values for quartz and pyrite, we have that

$$\frac{\text{the vol. of the pyrite}}{\text{the vol. of the quartz}} = \frac{2.7 \times 120}{60.4 \times 5} = 1.07$$

If, therefore, the replacing pyrite were deposited 'molecule for molecule' its volume would be but 7% greater than the volume of the original quartz.

Having concluded that the principle stated by Van Hise is incorrect, Mr. Horwood says "possibly the molecular volumes of the two substances * * * affect the question. The molecular volumes of quartz and pyrite are 22.8 and 24; there is so slight a difference between them that, judging from the particular occurrences under consideration, it might easily be that the volume of the pyrite is to that of the replaced material either inversely, or directly, as their molecular volumes. If so, the evidence indicates that the changes in volumes are inversely as their molecular volumes."

Now, inasmuch as the molecular volumes vary directly as the molecular weights and indirectly as the specific gravities, the author's statement amounts to precisely the same thing as the quotation from Van Hise, and Mr. Horwood is, in reality, indicating that a possible relation exists, which relation he has just attempted to disprove.

J. S. Hook.

Ithaca, New York, March 14.

A Correction

The Editor:

Sir—I have just noticed in the last number of the

Mining and Scientific Press the account of the presentation function of the Mining and Metallurgical Society medal to Mr. Hoover, in which the sole credit is given to me for the souvenir program. This is entirely wrong, as the credit should be given to James F. Kemp, my part in the work being that of carrying out Mr. Kemp's clever suggestions. Will you please have this matter corrected in your journal, as I do not care to be sailing under false colors.

E. GYBSON SPILSBURY.

New York, March 28.

Agitation at the Nevada Hills

The Editor:

Sir—Mr. Eames has earned our gratitude by his letter in your issue of February 28, in which he comments on the figure of costs which I quoted from Mr. Megraw's valuable article in the *Engineering and Mining Journal* of March 29, 1913. Had Mr. Eames given the detailed figures on which the costs were based when this article first appeared, I would have with pleasure referred to his statement in my 'Annual Review.' As it was, I was anxious to have some such statement as that which Mr. Eames has now given us, as it was difficult to conceive how it could be that the costs of practically the same method at two different mines—I did not refer to the still cheaper agitation cost by a different method at the Goldfield Consolidated or elsewhere—could differ so greatly.

To all of us who have to conduct tests on the treatment of refractory silver ores a scheme of interrupted agitation is apt to commend itself, and we may perhaps have gone so far as to design equipment based on this, but the Nevada Hills figures tended to blight our hopes, the more so as immediately prior to the statement of operating costs was the statement of chemical consumption in detail with no reference to the fact that the costs, for this were included under Settling and Agitating. But we are glad to have Mr. Eames' figures, even though the cost of \$0.167 for power and labor for 48 hours agitation seems heavy when contrasted with, say, the costs of prolonged agitation at the Hacienda, San Francisco, or San Rafael installations.

In pioneering new practice one may not at the outset attain the results readily accomplished when greater experience has been gained, and it is just such new practice as has been carried out by the Nevada Hills company which we anxiously watch in the hope that it may prove a step toward the solution of our difficulties in the treatment of certain ores. But Mr. Eames is silent as to my point that even in spite of the interrupted agitation and the heavy cost of this, the cost for filtration is still abnormal; it has been suggested that interrupted agitation combined with the counter current decantation of the rich solutions should result in rendering possible, if not the entire displacement of filtration, the relegation of this to a secondary place.

ALFRED JAMES.

London, March 18, 1914.

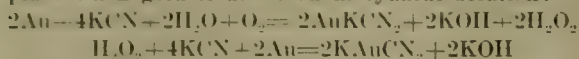
Concentrates

Most of these are in reply to questions received by mail. Our readers are invited to ask questions and give information dealing with the practice of mining, milling, and smelting.

Carbon costs, in diamond-drilling at the Goldfield Consolidated mine last year, were 71 cents per foot drilled.

Sinking the new 18-ft. diameter circular shaft of the Crown Mines, Ltd., on the Rand, covered 187 ft. in January, against 217 ft. in November. It is now 1202 ft. deep.

Bodlanger suggests that the following reactions take place when gold is dissolved in cyanide solution:



Ore broken in the Mt. Morgan mine, Queensland, amounted to 2.5 tons per 8-hour shift during the past half-year. The ore handled per underground employee was 1.32 tons. Miners on contract averaged \$4.17, and shovelers \$3.28 per shift.

Coal resources of Queensland, Australia, are estimated by the government geologist, Benjamin Dunstan, as 409,700,000 tons actual, and 2,201,300,000 tons probable reserves, in the total area of 670,500 sq. mi. Seams not less than 12 in. thick, down to 1000 ft. are included.

The new tube-mill plant at the Knight's mill, on the Rand, consists of five 16.5 ft. by 6 ft. diameter mills fitted with Schmidt feeders and Osborne liners, and driven by motors. The drive end is the discharge end. In December, according to *The South African Mining Journal*, four mills and 220 stamps crushed 38,830 tons of ore, equal to 6.6 tons per stamp day. The full equipment has a capacity of 45,000 tons per month. In September last, before the tube-mills were installed, the residue contained 0.487 dwt. per ton, but this has now been reduced to 0.262 dwt. per ton, at a cost of 12 cents per ton.

Testing cyanide solutions at the Lake View mill, Kalgoorlie, is done as follows, according to J. P. Caddy:

Cyanide: Take 20 c.c. of solution, add 2 to 4 drops of neutral 10% KI solution and titrate with AgNO_3 solution (1 c.c. = 0.01% KCN) to yellow color.

Protective Alkali: Take 20 c.c. of solution, add double the amount of AgNO_3 solution required for the cyanide test, and titrate with N/100 KOH or HCl with phenolphthalein indicator. By this test the solution appears slightly acid, requiring about 1 c.c. N/100 KOH to neutralize. (The addition of excess K_2FeCN_6 before adding AgNO_3 makes a slight difference to the titration, but no protective alkali is indicated.)

As an indication of the amount of magnesium salts in solution, a daily test is made by adding 100 c.c. of saturated lime water to 100 c.c. of the cyanide solu-

tion, and estimating the CaO remaining in solution after the precipitation of the magnesium salts, by titration with acid. The CaO required to precipitate the magnesium salts is about 0.8 lb. per ton of solution.

Gold is used only in a very limited degree to color glass. It may be used according to circumstances to impart either a ruby, carmine, or pink color. It is used in the form of oxide and purple of cassius (a mixture of tin and gold) and sometimes in the form of gold leaf. The metal is added while the glass is in the molten state and on the first cooling the glass is still colorless, and it is only when re-heated that the light red color appears, and it increases in intensity until it finally will turn black. This colored glass can again be rendered colorless by fusion and slow cooling; its color is again produced by a repetition of the heating process. If however, it is suddenly cooled, it cannot again be made to resume its ruby color. This should prove that no chemical change takes place, and that all the phenomena are due to molecular structure alteration. The Bohemian ruby glass is made by melting fulminating gold with oil of turpentine and other ingredients and it has been estimated that about one-twentieth of a grain of gold is combined with about 150 parts of glass ingredients. Copper is more generally employed to color glass red, and the use of this metal for this purpose dates far back into antiquity and all through the Middle Ages it was employed to produce the reds which we see in the fine old windows left by our ancestors for our admiration.

Compounds in cyanide solutions have interfered with the assay of the latter by the lead acetate method, according to G. Simpson, of the Ketahoen mine, Sumatra. J. C. Clennell, when asked to explain this, said that in the case of a solution from Central America, containing copper, ferrocyanide, and molybdenum as the chief impurities, a finely divided blackish brown turbidity occurred on adding zinc dust and lead acetate, and acidulating. This would not settle in a dense form and was extremely tedious to filter, though the precipitation of gold and silver was apparently complete, as re-treatment of the filtrate with fresh zinc dust, etc., gave practically no further amount of precious metal. In using this method, Mr. Clennell never relies on the collection of the lead precipitate by pressing with a glass rod as described in text-books, but always filters off all the insoluble matter, allowing to drain, and scorifying before cupelling. It would be interesting to know who was the originator of this process. It was described to Mr. Clennell in its essential points by H. T. Durant in 1900, long before it became generally known as the 'Chiddey method.' The brown precipitate referred to might be any of the numerous substances precipitable by zinc dust in acid solution under the conditions of the test. If the Ketahoen ore is anything similar to that of Redjang Lebong, also in Sumatra, with which he is familiar, selenium, copper, and perhaps manganese might be looked for.

Special Correspondence

JOHANNESBURG, TRANSVAAL

GOLD PRODUCTION IN JANUARY.—RELATIVE PROPORTIONS OF THE VARIOUS DISTRICTS AND OTHER PROVINCES.—DIAMOND PRODUCTION IN 1913.

Statistics issued by the mines department for January show that, despite the strike, the total value of the mineral output of the Union of South Africa showed an increase of £19,745 over that of December. The total value, excluding diamonds, was £3,136,256, made up as follows: gold £2,774,721; base minerals, £178,417; coal, £174,971; and silver, £8147. It will be noticed how largely gold enters into the value of the mineral production of South Africa, the bulk of which comes from the Witwatersrand fields, as the following figures will show:

District.	Mines.	Stamps.	Tube-mills.	Output, oz.
Witwatersrand	52	9030	277	622,095
Heidelberg	3	105	2	7,337
Klerksdorp	3	69	2	3,257
Total	58	9204	281	632,689

The Heidelberg and Klerksdorp fields, although mentioned separately, are part of the Witwatersrand gold basin, and really ought to be treated as part of the Rand. The insignificance of the other Transvaal goldfields outside of the Rand is shown in the following statement:

District.	Mines.	Stamps.	Tube-mills.	Output, oz.
Barberton	12	202	3	6,795
Pilgrim's Rest	14	151	4	13,557
Pietersburg	2	10	—	174
Total	28	363	7	20,526

Seeing how much the gold production of South Africa is dependent on the Rand, no surprise need be expressed at the unsettled feeling the Chamber of Mines' report, with regard to the life of the Rand and submitted to the Government Economic Commission, has produced both here and in Europe. Some attempts, it is true, have been made in several quarters to minimize the value of this evidence, but in its broad aspect the attempt to gauge the life of the Rand is probably as correct as it is possible to make it, always bearing in mind that the estimate is based on today's conditions, which may or may not change considerably in the immediate future. How unimportant is the gold production of the Transvaal outside the Rand is shown by the fact that it does not represent more than what several single Rand companies are producing. The value of the Cape and Natal provinces as gold producers is shown by the fact that, while the latter did not produce any gold in January, the former only produced 2 oz., which adds still more to the importance of the Witwatersrand goldfields when compared with the few others in the Union of South Africa. Another interesting feature of the figures issued by the Mines Department of South Africa for January is the inclusion of the figures relating to the 1913 production of diamonds in the Union. The total production of diamonds produced last year throughout South Africa is given as 5,163,546 carats by weight, valued at £11,389,897, as compared with 5,071,882 carats, valued at £10,061,489 in 1912, an increase of 91,664 carats, valued at £1,328,318 for last year, due entirely to the better demand and higher prices paid for diamonds in 1913. There were no new diamond discoveries of note during the year, although every effort was made in that direction. The

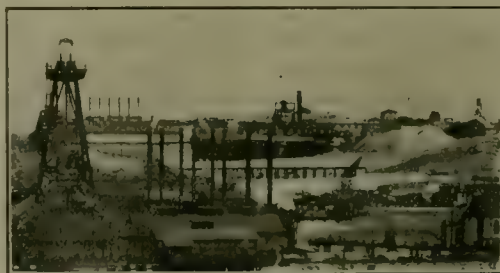
Cape province, including the Kimberley, is above the other provinces as a diamond producer, the total output being 2,461,892 carats, valued at £6,995,438, which practically all came from Kimberley. Next comes the Transvaal with 2,156,897 carats, valued at £2,726,662, nearly all of which again came from the Premier mine near Pretoria. The Orange Free State only produced 544,756 carats, valued at £1,667,706.

BUTTE, MONTANA

'SAFETY FIRST' MOVEMENT AT BUTTE.—THE CITY OF BUTTE.—NEW LEACHING PLANT AT HELENA NEARLY COMPLETED.

The Anaconda Copper Mining Co. has organized a 'Safety First' department with a view to systematizing its efforts for the protection of its employees. The organization of this department has been placed in charge of Charles W. Goodale, who is now visiting various Eastern mines and works with a view to getting ideas for the campaign in Montana. A circular for the guidance of miners, and another with instructions to mine bosses, has been issued. It is thought that many accidents can be averted by carefully instructing employees, and by laying down more definite rules.

Butte refuses to act as a mining camp. In place of the temporary structures which usually satisfy the needs of mining towns, Butte demands, and gets, permanent buildings of both a public and private nature. The railroads are usually slow to build costly depots for mining camps, but not so in Butte. The Northern Pacific and the Oregon Short Line have had for some time a large expensive depot at Butte.



PART OF BUTTE.

The Great Northern railway has just completed a commodious and artistic depot which would be a credit to any city. Now the Milwaukee is preparing to spend \$250,000 in the erection of another depot for Butte. If the confidence of the railroads counts for anything, the future of Butte seems pretty well assured.

The stockholders and others interested in the Northwestern Metals Co. are now to find out whether their dreams will come true. The reduction plant of 1000 tons daily capacity, erected near Helena, Montana, is nearly ready to start. There has been a lot of adverse criticism of this enterprise, whether justified or not I am not prepared to say. Criticism of new metallurgical methods, in these days of rapid advance, is dangerous for any but the most skilled and experienced chemists. The process is one of leaching and is devised to treat complex sulphide ores. The bases of the ores are all chloridized with chlorine gas, and are then precipitated in groups. The iron and manganese are precipitated first by zinc carbonate and sodium hyperchlorite. Then the lead, copper, silver, and gold are precipitated by zinc shaving. Finally the zinc is precipitated by sodium carbonate. The chemicals are practically all made at the plant. The Butte & Pensacola company has acquired six claims adjoining its property in the Carbonite district. The claims now total 500 acres, all of which can be developed by one main adit.

WASHINGTON, D. C.

MINING LEGISLATION BEFORE CONGRESS.—BILL FOR LEASING CERTAIN MINERAL LANDS.—ACTION BY CALIFORNIA MINING MEN.
—REVISION OF THE GENERAL MINING LAW.—THE RADIUM BILL.

In spite of the fact that the action of Congress on the Panama canal tolls question has put everything else in the background, last week was one of busy progress in the proposed legislation concerning the mining industry. Most attention has been attracted by the public hearings before the House Committee on Public Lands in connection with the bill providing a general leasing law for petroleum, gas, phosphate deposits, and coal lands, which was introduced by Scott Ferris, representative from Oklahoma, who is chairman of the committee. The bill has the strong backing of the Department of the Interior, and is pretty sure to pass, though it will probably first be amended somewhat. A good deal of the time of the committee was taken up by the attorneys for California miners, whose efforts to oppose the bill reminded the hearers of the story of the jury that acquitted the accused out of sympathy for him because he had such a poor lawyer. One of the attorneys could not tell how many companies he represented, what their names were, or how many acres of land they held, and when the statement was elicited that companies holding thousands of acres had not attempted to secure patents for more than one claim at most, the situation looked dubious for the oil operators. Later, Clay Talman, commissioner of the General Land Office, was put on the stand and testified that over 300 applications for patents have been pending in his office, some of them since 1910, without being cleared up, and that if more applications had been filed, even less progress would have been made, and the Californians began to cheer up. The testimony of George Otis Smith, director of the U. S. Geological Survey, also helped the California independent operators more than they seemed to be able to help themselves. It is fairly clear that some parts of the original bill will need to be amended. One of the difficulties is what to do with the operators who are on withdrawn lands. While prior rights are bound in the end to be protected, it would simplify matters if some compromise could be effected and avoid litigation. An agreement has about been reached to the effect that such locators shall have preference rights to lease the grounds they occupy and that pending final decision they be permitted to sell oil, a reasonable portion of the returns being impounded to secure the royalties in case any prove collectible.

The limits outside which the prospecting for the discovery of new fields is to be stimulated, by the grant of a larger area, also calls for much discussion, since it depends upon the geological structure, and in some areas wells a few miles away would be as clearly in a new field as though they were 50 miles distant. It is urged that the zones that are 50 miles from any producing well are comparatively few, and of exceedingly dubious value to the prospector; but on the other hand, it is pointed out that the present situation in California does not call for increased production and there is no great desirability for stimulating new discoveries except in remote districts. The question as to what disposition is to be made of the improvements which a locator has made, in case the land is leased to some one else, is also a burning one. It has been suggested that he should be given a patent to part of the ground and required to lease the rest; but as the result of this would be that he would put all his wells and pumps on the patented ground, such an arrangement would not cover the case. Another suggestion is that he be compensated for his improvements, and a third that the Navy Department take these lands for its naval reserve, paying him for his improvements. Some of the more important Californians are quite reconciled to the idea of a leasing

law, since the present arrangement is entirely unworkable. Strong opposition to the leasing of coal lands is manifested by E. T. Taylor, representative from Colorado, who insists that it makes the cost of coal greater to the consumer and retards the development of the western states. When one reflects that coal sells at many mines for about \$1 per ton at the pit mouth, and for several times that to the consumer, a small royalty does not seem so serious a matter to the general public as does the question of freight rates and selling costs. The hearings on this bill will be resumed toward the end of next week.

Some time ago a bill was introduced into the Senate providing for the appointment of a commission of three to consider the general mining law, and draw up a proposed new code for submission to Congress. Unfortunately, the bill provided that these three men should all be mining lawyers. Representatives of the American Institute of Mining Engineers and the American Mining Congress presented their ideas on the subject before the House Committee on Mines and Mining, and E. T. Taylor has introduced, at their instance and with the approval of the Bureau heads concerned, House bill 15288, which provides for a commission of five who shall be chosen for their experience in or knowledge of mining and mining law, and who shall serve without compensation. The provision that the commissioners shall receive no compensation ensures that only high-grade mining men who would look upon the duty as a public service will wish to serve upon the commission. The bill appropriates \$25,000 for the expenses of the commission and the salary of its secretary, and requires that hearings shall be held in Alaska and the western states, and a report made within one year after the passage of the act.

The hearings on the radium bill have been concluded, and in all probability the bill will eventually pass essentially in its present form, as ample opportunity has been afforded to file locations in all the likely ground in Colorado. The bill introduced last December providing for the establishment of 10 mining experiment stations has been lying idle ever since, but will probably soon be taken up again.

NEW YORK

FEELING REGARDING COPPER.—BRADEN SHARES.—GOLDFIELD DISTRICT SHARES, AND OTHER STOCKS IN NEW YORK.—ANOTHER LOW-GRADE PROPERTY.—AHMEEK COSTS.—CALUMET & HECLA SUBSIDIARIES.—MASON VALLEY.—STEWART AFFAIRS.—BINGHAM MINES COMPANY.

The remaining 'bullish' spirit in New York centres around the copper situation. Arguments for and against a betterment in copper prices have been worn somewhat threadbare. As a matter of fact, the general business situation is much more of a controlling factor than any phase of production, consumption, or export demand. The copper producers themselves appear to be more confident of the future than anyone interested, and are predicting higher prices, and a market that is to be more and more in the hands of the producers.

The chief speculative issue for the time being is the Braden Copper Co., in connection with which there are many over-worked market rumors, the latest being that all idea of further financing has been abandoned, that the present mill is to be made to serve by some changes and additions which will give it 35% added capacity. If there was any general market, with enough trend in a given direction to make headway, Braden would undoubtedly be a favorite market counter. As it is, it has been advancing slowly, the shares apparently being picked up by investors.

There has been a little recent effort to revive interest in the Goldfield issues, but what little market traders could make remained so wholly professional in character that quotations meant little. The activity in Goldfields centred around Atlanta. It is said that some months ago a Philadelphia house

bought 100,000 shares of Atlanta from the Company, and that the recent activity was due to a campaign undertaken by the house mentioned for the purpose of distributing this stock. The fact remains that whether one considers copper shares, assured of long life and present or early dividends, or the wholly speculative issues of Goldfield or Tonopah, there is no 'swing' or 'snap' to the market movement, though this is no more true of mining issues than it is of railroad or industrial shares. Except for a very few exceptional mining enterprises, there are no new things going forward in which the public is asked to take a part. Alaska Gold Mines has met with an apparent degree of success, though it is stated now that it will require a considerable length of time to get to the initial dividend, from which cautious statement lower prices should be quite safely predicted. The public likes the promise of early and substantial dividends, better indeed than it does a present dividend of more modest proportions. While it is true that there are few new mining organizations in which the public is asked to share, there is some work being quietly prosecuted. John G. Worth, representing a syndicate of New York people, is examining a property at El Rito, New Mexico, said to be one of the largest low-grade gold deposits ever exploited. The present work is confined to experimental treatment of the ores, on the solution of which is said to depend wholly the measure of success to be attained. The New York people interested are financially strong, and if it is eventually proved that the ore can be profitably treated, Alaska Gold will have a rival, it is said, in the way of immense tonnages and large profits from very low-grade ores.

A forcible illustration of the cost of the strike in the Michigan copper country is shown by the recent report of the Ahmeek company. Comparison is made in copper costs between the first half of the year when the cost was 10.01c. per pound, and the latter half of the year when it rose to 33.5c. per pound. Net earnings for the year were \$207,419 as against \$1,465,000 in 1912. Ahmeek paid dividends of \$17 per share in 1912, but was obliged to cut into its surplus to the extent of \$673,000 to do so. The property is one of the most promising of the newer mines of the Lake Superior region, and it will be recalled that this interest is one which made such a bitter fight against the proposed Calumet & Hecla merger about two years or so ago, and which consolidation was abandoned, largely on account of the unwillingness of the Ahmeek to be included with older properties nearing the point of exhaustion. The Lake Copper mine, which had such a sensational career, being at one time hailed as the long-sought successor to the original Calumet & Hecla, has been wholly shut down since the labor troubles became acute. Regarding the Calumet & Hecla Mining Co., it is somewhat surprising to learn that the present Company's control over its subsidiaries permits a considerable degree of independent action. For instance, in the sales of copper each subsidiary acts for itself independently. Naturally, it would be supposed that concentrating the selling of the entire output of metal in one agency would be a great advantage, and result in better prices. Evidently experience does not justify this conclusion.

The fourth annual report of the Mason Valley Mines Co. has just been mailed to shareholders. It covers operations for the year ended December 31, 1913, and shows a production of 17,166 tons of copper matte, containing 14,601,250 lb. copper, 9923 oz. gold, and 121,835 oz. silver. The report covers the second year of the operation of the Company's plant, the quantity smelted during the year being 227,855 tons, of which approximately half was from the Company's mines and half custom ore. The smelter has proved satisfactory, and is now converting its own matte.

The market position of Stewart stock is being carefully watched by some Western interests, which have been inclined to take a 'short' position on the theory that the stock is selling for more than the net value of its known ore reserves.

The Assets Realization Co. has been known as a heavy

holder of United Copper collateral, including a large block of Stewart, having had a share in the large loan made to the United some two years ago. The disposition of this holding has been the controlling influence in Stewart for some time, but apparently it has not been possible to get up sufficient public interest at any time to permit of distribution.

The Bingham Mines Co., which controls the old Eagle & Blue Bell at Tintic, Utah, is making some good financial progress. On the first of the month the Company paid off \$250,000 first-mortgage bonds of the old Bingham Consolidated Mining & Smelting Co. This completes the retirement of the original issue of \$903,000, in addition to which there have also been retired \$577,789 second-mortgage convertible bonds, the latter issue having been refunded by the issue of \$600,000 first-mortgage convertible bonds. Bingham Mines receives 20c. per share annually upon 694,999 shares of Eagle & Blue Bell, which it holds.

MELBOURNE, AUSTRALIA

AUSTRALIAN GOLD YIELD.—GENERAL DECLINES.—WASTE OF TIMBER RESOURCES.—VICTORIA DREDGING.—BOARD'S ADVERSE REPORT.—QUEENSLAND COAL AREAS.—BROKEN HILL: SOME INTERESTING FIGURES.

The gold yields of the various states are gradually being published, though in most cases the figures are only approximations. The New South Wales yield was 149,657 oz., as compared with 165,295 oz. in 1912, a decline of more than 9%. About the same proportional drop is shown in the case of Victoria, the decline amounting to as much as 45,198 oz., to a total of 434,932 oz. Queensland's fall is much heavier, amounting to 83,047 oz., or nearly 24%, the year's output being only 263,343 oz., as compared with 345,390 oz. in 1912. Tasmania's yield is over 35,000 oz., a decline of more than 7% on the previous year's figures; and South Australia's, 5600 oz., a drop of 15%. The only state where output shows an increase is Western Australia, and even there it is only a little over 2%. The decrease in Victoria alone is more than half as much again as the increase in Western Australia, so that the total Australian figures for the year are certain to be on the wrong side. The Dominion of New Zealand, on the other hand, has done better in 1913 than in 1912, exporting 343,627 fine oz., as compared with 316,671 oz. exported in 1912, an increase of over 8½ per cent.

An editorial in the *Australian Mining Standard* makes a strong statement in regard to the waste of good marketable timber that is going on in Australia. According to the writer, in one portion of the state of Queensland, the Atherton scrub, there was, and presumably still is, lying on the ground, going to waste, cedar worth about \$5,000,000. It seems an excessive estimate, yet it is probably no great exaggeration. Timber is cut down or burnt down to clear land for cultivation, although there are large cultivable areas free of timber absolutely untouched. One of the country's largest assets has been absolutely wasted in this way. New South Wales has recognized her folly in this respect and has taken steps to prevent any extension of the evil, and the sooner the other states follow suit the better it will be for them.

The report of the commission appointed by the Victoria Government to inquire into the damage, if any, wrought by dredging operations in the state is an altogether adverse one. If the report be acted on, the industry, which is not altogether to be ignored, will be wiped out. The report was published in this journal of March 14, 1914.

The Queensland Government geologist has issued a review of the coal resources of the state. He estimates the area of the geologically surveyed coal measure at 73,000 square miles, of which 20,000 are recognized coalfields, the remainder consisting of lands known to contain coal, but not yet found to be valuable for coal-mining purposes. He draws special attention to the basin of the Dawson and Mackenzie rivers,

which contains far more probable resources than all the other parts of the state put together. Conspicuous among the large number of known seams in this basin is the 20-ft. seam in the Mackenzie River area and the 56-ft. seam in the Clermont area, both coals being of good quality. Other noticeable occurrences are 20 ft. of fine coal in the nine seams of the Barrum area, 20 ft. of coal in the Callide area, and a 69 ft. seam at Waterpark Creek. The table given, which has been built upon an estimation of seams not less than 12 in. thick, and not more than 1000 ft. below the surface, the estimation of quantities below this depth being found to be impracticable at the present time, shows an actual reserve tonnage of 109,700,000 and a probable reserve of 2,201,300,000 tons.

The following interesting facts regarding the great New South Wales field, the Barrier, or Broken Hill, were included in a report presented by E. R. Bowring to the Dominions Trade Commission, which recently visited Australia, and has recently been published. It states: (1) that the Broken Hill field is the largest mining district in Australia; (2) that it produces practically all the zinc, and about 85% of the silver-lead obtained from mines in the Commonwealth of Australia; (3) that the value of the metals produced from the mines up to the end of 1912 was over \$300,000,000; (4)



MOLDING MARKET LEAD, BROKEN HILL PROPRIETARY REFINERY,
PORT PIRIE, SOUTH AUSTRALIA.

that the dividends and bonuses paid by the various Broken Hill mining companies, with an authorized capital of between \$2,000,000 and \$25,000,000, up to the end of 1912, were over \$75,000,000; (5) that the Port Pirie works are said to be the largest lead-smelting works in the world, and produce an output of lead which has exceeded and now approximates 10% of the world's total supply of that metal; (6) that the Broken Hill mines produce about 20% of the world's production of lead and zinc; (7) that the iron ore deposits at the Iron Knob constitute the most extensive known deposit of any metal ore in Australia, and comprise one of the largest, if not the largest, known iron ore deposits in the world. Mr. Bowring further gave the total output of the smelters at Port Pirie and Broken Hill, up to May 21, 1913, as: lead, 1,354,034 tons; silver, 158,408,072 oz.; gold, 98,303 oz.; antimonial lead, 11,869 tons; spelter, 6584 tons; lead concentrates, 1,261,980 tons; and zinc concentrates, 573,606. With respect to the Iron Knob and its proposed development, Mr. Bowring says: "The extent of the deposits has for some time been known to be considerable, and although the full area of the lode has not been tested, it extends for at least a mile in length, and the reserves have been estimated to comprise as much as 150,000,000 tons. The existence of this immense lode led the Broken Hill Proprietary Co. to decide some time ago on the establishment of steel works at Newcastle, in New South Wales, and to utilize the iron ore at the Iron

Knob for the manufacture of steel. The ore appears to be suitable for the manufacture of high-grade steel, containing a low percentage of phosphorus—namely, from 0.03 to 0.05%, and about 65% of iron."

TORONTO, CANADA

NIPISSING DIVIDEND—McKINLEY-DARRAGH IN 1913.—HARGRAVE AND RIGHT OF WAY MINES.—BONUS FOR RADIUM ORES.

As was anticipated, the Nipissing company has reduced its returns to shareholders by abandoning the bonus of 2½%, which has been paid for some years along with the regular quarterly dividend of 5%. The yearly statement of the McKinley-Darragh-Savage Mining Co. shows a considerable falling off in profits and a decrease in the ore reserves. The output was 2,214,383 oz. as compared with 2,717,383 oz. in 1912. The net profits were \$771,487, a decrease of \$382,361; and the ore reserves have fallen from 5,368,500 oz. to 3,210,000 oz. At the Right of Way, where work has been resumed, a vein on the 120-ft. level, 2 to 2½ in. wide, which has been driven on for 50 ft., is yielding 3000-oz. ore. The annual meeting of the Temiskaming on March 9 resulted in an entire change of the directorate, following a vigorous campaign to oust the old board. The new directors represent the interests controlling the Beaver mine. The Ontario Government has introduced in the provincial legislature a bill providing for a reward of \$25,000 to the first person who discovers radium ores in commercial quantities. The bill also authorizes the Government to reserve all radium in crown lands, and work the deposits, and to purchase private lands containing radium. Similar legislation has been introduced in British Columbia. The action of the Government has been influenced by the proposals before the United States Congress for the acquisition of all radium-bearing ores for the public benefit. Another legislative measure under consideration deals with the fixing of the boundaries of mining claims, giving to the prospector the area actually staked out. Owing to topographical difficulties, it has often been found difficult to describe the claim accurately by measurements, which has frequently resulted in confusion and litigation as to titles. In case of a deliberate intention to include more than the area allowed for a claim, the department is authorized to cut it down to the correct size.

CALGARY, ALBERTA

COAL MINING IN THE PROVINCE: COMPANIES OPERATING, OUTPUT, AND PROSPECTS OF THE INDUSTRY.

The rapid development of coal mining in the province of Alberta is evidenced by the statistics given in the annual report of the Mines Branch of the provincial Public Works Department for 1913. There were in that year 289 companies operating in the province. Thirty-nine of these have a total capitalization of \$107,450,000, without including the Canadian Pacific mines at Lethbridge and Bankhead, the capitalization of which is not given. The total amount of capital invested in the coal-mining industry is estimated at over \$150,000,000. The amount of coal produced during last year was 4,306,346 tons, of which 2,374,401 tons was bituminous, 1,763,225 tons lignite, and 168,720 tons anthracite. Coke was produced to the amount of 65,167 tons, requiring 104,012 tons of coal. The exports of coal from Alberta were about 1,000,000 tons. The output has grown rapidly year by year since the creation of the province. In 1905 it was 811,228 tons, so that the increase during eight years has been approximately 500%. With the growth of population and the opening of the country by railways, affording access to a steadily increasing market, and the introduction of new capital for the opening of additional mines equipped with modern machinery, the industry may be expected to show still greater advances in the near future.

General Mining News

ALASKA

CHISANA

At the Revenue claim, sinking is under way, this being the only shaft on Skookum, except that of Doyle on No. 2 Creek claim, where this work is being done. The latter is down 25 ft. in good gravel, under 18 ft. of muck. Smith and Badden, at the Jumbo, are down 100 ft. in thawed ground, dry and solid, but have found nothing. There is more activity in prospecting now. On the Wilson side everybody seems disappointed. Gold Run is the most favored creek. Prospecting so far has been scattered over a big area of unlikely ground, and only two shafts are down to bedrock, according to L. Lake, of the Revenue claim. E. J. Ives, who is interested in the James claims, has left Cordova for Chisana.

JUNEAU

The report of the Governor of Alaska, J. F. A. Strong, to the Secretary of the Interior, for the fiscal year ended June 30, 1913, has recently been published at Washington, D. C. It covers a great deal of interesting matter dealing with mining, fishing, commerce, and game, etc., in the territory. Several pages are devoted to a complete list of domestic and foreign companies of all kinds operating in the country.

The Sheep Creek tunnel of the Alaska Gastineau company made connection on April 1. The tunnel is 8 by 10 ft. in section and 10,497 ft. long.

KETCHIKAN

(Special Correspondence.)—There is going to be considerable activity in mining here this year on account of the fine results at Juneau, this being a similar belt of country. At Smugglers Cove a number of men are employed, and a large stamp mill is to be erected. The Goldstream, across the bay, has been bonded to an English company. The Gold Standard, at Helm bay, is under bond. King and Elliot have bonded their mines at Helm bay, and at Dolomi several mines will be started in the spring. More men are to be employed at the Valparaiso mine at Dolomi, according to B. A. Eardly, the manager.

Ketchikan, March 20.

NELCHINA

There are about 200 men in this district at present. On 40 creeks about 450 claims have been staked. The ground is wet, and sinking to bedrock is difficult. One hole on Eureka creek showed the ground to be 25 ft. deep. Three drills are going in from Chitina and several boilers from Knik. The Nelchina country is about 3400 ft. above sea-level.

ARIZONA

COCHISE COUNTY

There is considerable activity at Bisbee at present. Seven new McDougall furnaces are to be added to the Copper Queen plant, making a total of 16. Electric hoists are being installed at the Czar and Uncle Sam shafts of the Copper Queen group, while a new head-frame will be erected at the latter shaft. Forms for concrete for the test mill below the Sacramento shaft are being put up. It is said that the Calumet & Arizona company may buy the Wolverine mine.

GILA COUNTY.

(Special Correspondence.)—Erection of steel at the Inspiration Consolidated concentrator building was started on March 31, and the total weight for this structure will be about 3000 tons. The American Bridge Co. is now on the last half of its contract. Foundations for the machine tools at the shops are practically complete. There are to be 18 power-driven tools and five large machines in the forge shop. There

will also be woodworking machines installed. To handle heavy gear, etc., there will be glib cranes and a 40-ton overhead traveling crane. An excellent system of transferring machine parts from and to the concentrator and machine-shops has been devised. MacArthur Bros. have nearly finished excavating for the power-plant and cooling basin near the smelter site. The plant will have a capacity of 18,000 kilowatts. Concrete is being poured for the 58-ft. diameter foundation for the 20 by 300-ft. steel stack for the smelter. At the Southwestern Miami, churn-drilling is still under way.

Miami, April 2.

Carnotite ore has been opened in fair quantities in the Vanadinite group of claims, three miles north of Globe. They are owned by the C. W. Patterson company. Samples have returned 40% lead, 10 oz. silver, 81 oz. gold, 3.33% of vanadium, and 0.7% uranium.

It is announced that the Cottrell process of electrical precipitation is to be used for fume precipitation at the new smelter of the International Smelting & Refining Co. being built to treat the Inspiration concentrate. While the process will be applied at first only to the fume from the dryers and roasting furnace, rights for the entire plant have been purchased for a lump sum said to be \$45,000. The particular point in the adoption of the process here is to prevent any loss of fine dust which may, in this case contain considerable copper. It is also announced that Wedge furnaces are to be used, and other points are being rapidly decided.

YAVAPAI COUNTY

(Special Correspondence.)—The Ora Bella and Oro Bonita mines, which have been idle for some time, are to be operated again. The two properties are contiguous, and lie in the Bradshaw mountains, a few miles northwest of Cherry Creek district. A long lease has been secured from the owner, Richard S. Barnes, of New York, by Dan A. Bessler and John O'Dell, both practical miners. The two properties were operated a few years ago by the latter, with John Seiss, and gave satisfactory returns. The mines are situated to the west on parallel veins of the Gray Eagle, and have had some work done on them by the Tiger Gold Mining Co. The ore is to be treated at the Company's mill, and work will begin the latter part of April. A new hoist is in operation at the Poorman mine at Walker. Sinking the main shaft is to be resumed as soon as the water is lowered, and from the 200-ft. level a cross-cut will be driven to cut a parallel vein. The Gold Note mine, in the Black Rock district, has been sold by M. H. Ryan to H. W. Flentke and W. H. Temme of Evansville, Indiana. Mr. Ryan has owned and operated the property for some years, and has carried out a practical scheme of development at depth, and the property is well thought of. A large dump has been made, and with the favorable situation of the mine, there being on the ground plenty of timber and water, work can proceed uninterrupted. Black Rock, March 26.

Under the editorship of Aaron H. Powers, the first number of *Yavapai* has made its appearance. It is a monthly magazine devoted to work done in this county, especially at mines. The Verde Tunnel & Smelter railroad, 7 miles long, has been completed and handed over to the United Verde Mining Co. At the Fortune Mining Co.'s property the adit is in 900 ft., and has opened a good shoot about that length.

YUMA COUNTY

(Special Correspondence.)—Henry K. Preston and other Philadelphia people have acquired an interest in a placer property in a basin in the Dome Rock mountains near Quartzite and known as the Middle Camp ground. Extensive tests have been made, and it has been decided to work the gravel by a dry process, using steam-shovels, Quenner disintegrators, and Stebbins dry concentrators.

Philadelphia, Pennsylvania, March 28.

CALIFORNIA

Hugh Wolflin, one of the most experienced mining engineers in the U. S. Bureau of Mines, has been engaged by the State Industrial Accident Commission to assist in its work of safeguarding the life and limb of the mine workers of California. He is at present engaged in a tour of investigation of conditions in the mines of San Bernardino, Kern, San Diego, and Inyo counties for the purpose of conferring with the mine operators regarding ventilation, first-aid to the injured, and safety appliances. Mr. Wolflin's services have been secured with the consent of the federal government, and he will visit every mining district of the state for the above purposes. Proper ventilation and measures to prevent accidents will be thoroughly explained to the employers and employees, and first-aid to the injured, which has never been given much consideration in many of the larger mines of California, will also be dealt with. One of the seven exhibit cars, which the U. S. Bureau of Mines keeps moving about the country to teach 'Safety First' to both employers and workmen, will probably be brought to California and sent into each mining district.

AMADOR COUNTY

The property of the Clinton Consolidated Quartz Mining Co., estimated to be worth \$25,000, and on which no taxes have been paid to the state for 21 years, will be sold by an order of the state controller, John S. Chambers. The amount due to the state is about \$7000. Forty of the eighty stamps at the South Eureka are hung up on account of repairs to the main shaft. An employee at the Kennedy mill fell into No. 18 ore-chute, which delivers ore to a battery feeder, last week, and was suffocated by the ore.

BUTTE COUNTY

W. C. Pershbaker, of Oakland, has started suit for \$50,000 against the P. B. Steifer Mining Co., which owns the Steifer mine near Coutolenc. The Dix or Strauss mine, 23 miles above Chico, has been bonded to G. Henderson and Z. T. Corbett.

ELDORADO COUNTY

Eight men have been sampling the Blue Gauge quartz mine at Ely Park. It is said that the United States Smelting, Refining & Mining Co. had this work done.

INYO COUNTY

Apparatus for the Wilshire Bishop Creek cyanide plant is ready for shipment from Denver, Colorado. On the road near the mine there is 10 ft. of snow at present. A Tetrault 2-stamp mill is to be erected at the Chuckwalla mine by J. B. Evans and associates. The mine has been opened by an adit to 400-ft. depth, and a small vein yields about \$55 per ton in gold, silver, and lead.

LOS ANGELES COUNTY

(Special Correspondence.)—The Western Precipitation Co. has completed arrangements whereby it has obtained complete management of the Slater process for extracting copper ores. A short description of this process was published in this journal of January 24. The reconstruction of the laboratories is under way to accommodate this department of the work, and it is expected to make the equipment sufficiently large to enable all necessary research work to be done at the Los Angeles headquarters. The main work, of course, will be conducted in the field.

Los Angeles, April 1.

NEVADA COUNTY

The report of the North Star Mines Co., operating at Grass Valley, for the year ended December 31, 1913, has just been published, and contains the following data: Mainly from stopes above the 3400, 3700, and 4000-ft. levels, the North Star mine produced 106,090 net tons of ore yielding \$11.312 per ton, or \$1.049 per ton over that of 1912. Development work on and above the lowest level consisted of extending the

5900 and 5300-ft. drifts, and the connection of various levels by raises. What appeared to be the eastern limits of the shoots was reached, and work was stopped. The raises have further developed ore of about average value on and above 5300 ft., and estimated to last for several years. In September, sinking of the main shaft was resumed, and was down 5850 ft. on the incline, equal to about 2200 ft. vertical, at the end of the year. Sinking costs were \$31 per ton. It followed a good-sized but barren vein. A level is to be opened at 5600 ft. Total development covered 3158 ft. against 4601 ft. in 1912, at a cost of 48c. per ton milled. The mill produced a total of \$1,200,096, of which \$938,262 was by amalgamation, \$71,090 from 1629 tons of concentrate, and \$190,744 from the tailing. This is equal to 78.18% by amalgamation and 21.82% by cyanidation. The large tube-mill at the Central cyanide plant, which had been used for grinding concentrate, was in December made into two smaller mills, each being installed in the North Star and Central mills. In future the yield from concentrate will not be shown separately. The residue from the cyanide plants was 28c. per ton.

In April the Company completed payment of \$217,823 on



CHAMPION MILL, GRASS VALLEY.

its purchase of the Champion mines, and did 5901 ft. of development. Work on the bottom levels of the Ural and Merrifield veins was rather disappointing. A raise from the 1000-ft. level of the Ural mine to connect with old workings, opened a promising shoot; and a drift at 1350-ft. in the Merrifield has also disclosed encouraging prospects. The Champion 40-stamp mill treated 26,850 tons of ore yielding \$124,179, but the costs of operating the mine and mill were \$241,338. Added to the payment, the outlay on this property last year was \$487,148, and \$858,101 to date, against an output of \$154,529. Better results are expected in 1914.

In accordance with the new income tax, a depreciation of the property amounting to \$60,005, or 5% of the yield of \$1,200,096, has been written off for 1913, while depreciation on equipment was at the rate of 7½%. The year's results are as follows:

North Star production	\$1,200,096
Champion	124,179
Interest and dividends	35,757
Balance from 1912	907,305
Total revenue	\$2,267,337
Operating the North Star mine and mill.....	\$ 551,998
Improvements, etc.	13,301
Champion mines account	486,507
Dividends paid	300,051
Balance (cash, \$213,149; investments, \$581,975, etc.)	915,480
Total expenditure	\$2,267,337

Costs at the North Star in 1913 were as follows: development, 48c.; mining, \$2.895; milling, 47.6c.; concentrating, 11.5c.; cyaniding, 54.2c.; bullion, 3.1c.; miscellaneous, 25.3c.; New York office, 15.4c.; taxes, 26.7c.; and accident and benefit,

NEVADA

ESMERALDA COUNTY

During February the Jumbo Extension produced 1279 tons of ore yielding \$16,659. The mill in 20 days treated 765 tons at a cost of \$2.01 per ton, and 517 tons was sold to the Western Ore Purchasing Co. Net earnings were \$9080 against \$11,553 in January. Development totaled 309 ft. at a cost of \$5.83 per foot. In March, 14 cars of ore was sold and the gross value of this and the ore milled was \$32,900, and net profits \$24,400. The estimated March production of the Goldfield Consolidated is as follows: Ore mined, 30,351 tons; gross value recovered \$337,000; operating expenses, \$175,000; and net realization, \$162,000. So far, the quartz vein opened at 500 ft. in the Silver Pick has been cross-cut for 90 ft., with no walls showing.

MINERAL COUNTY

On April 2 the new leaching plant of the Wagner Azurite company, at Luning, was started. The mill has a capacity of 200 tons per day, and will treat ore containing 2 to 6% copper and \$20 per ton gold and silver. The plant is the first one in the state to use this process, and cost \$60,000. Michigan capital is interested in the property. Frank Everett is manager. After being shut down for 22 years, the Holmes silver mine is to be reopened, under the management of G. E. Hirefall.

NYE COUNTY

The agreed time for not mining ore in the disputed ground between the West End and Jim Butler mines having expired, the former Company has resumed breaking ore. Suit has been started by the Jim Butler company against the West End company for \$250,000 for alleged wrongful extraction of ore from the former's vein. The Belmont company will pay an extra dividend of 10c. per share or \$150,000 on May 1. The total for 1914 so far is \$900,000. On No. 15 level of the Belmont mine, a pump with 300,000 gal. capacity per day is to be installed. The North Star produced 928 and treated at the MacNamara mill 847 tons of ore averaging \$21.91 per ton with a profit of about \$6000. A heavy earthquake shook Tonopah April 6, but no damage was reported.

WASHOE COUNTY

The Copper Lode Mining Co. has acquired the Copper Queen group of claims four miles from Reno. California people are interested in the deal. There is an orebody 10 ft. wide, and some rich ore was extracted last year by lessees. W. J. Thomson is manager.

A meeting of the Nevada Industrial Safety Association has been called at the University of Nevada, Reno, for April 18, by the Governor, T. L. Oddie. The purpose is to effect a permanent organization. Co-operation of the U. S. Bureau of Mines has been secured and good results are expected.

WHITE PINE COUNTY

Development is being steadily done on the sulphide ores in the Emma Nevada and Watson claims, next to the Liberty pit of the Nevada Consolidated, by the Consolidated Copper Mines Co. Five churn-drills are working two shifts, drilling up to 50 ft. each per day. The holes are from 500 to 700 ft. deep. Native copper ore was recently found in the Ora claim.

NEW MEXICO

SOCORRO COUNTY

(Special Correspondence.)—Twenty men are employed by the Alberta Development Co. The vein is from 4 to 5 ft. wide. The property includes 200 acres. At the Socorro, 1200 tons of ore is treated per week. During the first half of March 1½ tons of gold and silver bullion was sent to the mint, also to the smelters several tons of high-grade concentrate. In the Lincoln the vein is 4 ft. wide. Rich ore is still coming from the Pacific. From the Little Charlie the daily output to custom mills is 20 tons of ore. Both the

east and west breasts of drifts at bottom of winze from adit 'C' of the Oaks mine show good ore. The shaft has been started near the portal of adit 'B.'

Mogollon, March 23.

OREGON

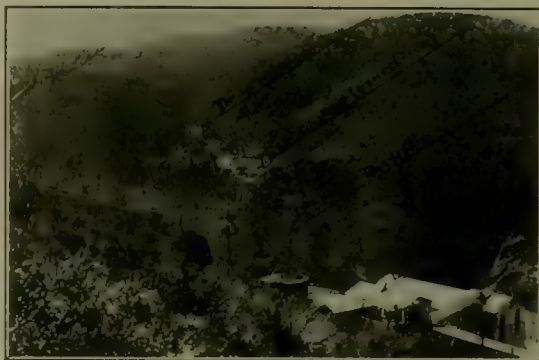
BAKER COUNTY

Rich ore has been developed by a raise in the North Pole mine, near Sumpter. Tests are being made at the Ben Harrison to see whether a cyanide plant would be beneficial to ore treatment. Prospecting is under way at the Helen E., Gold Nugget, and Red Boy mines. The latter's mill is crushing ore for lessees.

UTAH

SALT LAKE COUNTY

Foundations for the new crushing plant at the Lark mill of the Ohio Copper Co. are being prepared. Three 24 by 60-in. rolls have been ordered. On March 27 the mill treated 2860 tons of ore which was softer than usual. Three feet of ore assaying from 40 to 50% lead has been opened at 800



THE MOGOLLON DISTRICT, NEW MEXICO.

ft. in the Yosemite mine of the Bingham Mines Co. The manager, Imer Pett, has miners prospecting at 500, 800, and 1100 feet.

SUMMIT COUNTY

In 28½ days, of two shifts each, in March, the Snake-Creek tunnel at Park City was advanced 298 ft. It is fitted with electric light and telephone. The Daly-Judge company did 1100 ft. of development in March, with satisfactory results.

WASHINGTON

SPOKANE COUNTY

Transactions on the Spokane Stock Exchange in March totaled 737,221 shares, worth \$67,820. These covered mining companies in this state, Idaho, and British Columbia.

CANADA

BRITISH COLUMBIA

The Standard Silver-Lead Mining Co., a Spokane concern operating near Silverton, has paid a dividend of 2½c. per share, or \$50,000. This makes the current year's total \$200,000.

ONTARIO

The Keely mine, at South Lorrain, now owned by the Huronian Belt Mining Co., is being unwatered. The balance of the purchase price, about \$200,000, of the Burnside claims at Kirkland Lake, has been paid by the Kirkland Lake Proprietary. At 400 ft. in the McIntyre mine there is 200 ft. of \$23 ore, the width being 6 ft. The cross-cut under Pearl lake has been driven 900 ft. The mill is treating 125 tons of ore per day.

10.4c.; less sundry receipts, 2.4c.; making a total cost of \$5.203 per ton milled. The output since May 1884 is 1,141,284 tons, yielding \$15,245,189, and \$4,087,040 in dividends.

PLACER COUNTY

It is said that an English company has taken an option on the Oroflua gravel mine, south of Shingle Springs. Floods in the American river have enriched the gravel bars and miners near Idaho Hill are recovering from \$2 to \$5 per day by rockers and sluicing.

PLUMAS COUNTY

New equipment is being added to the Antlered Crest drift-gravel mine, where a lower adit is being driven to cut the lower portion of the Mooreville channel. Gravel yielding good gold content was recently opened in the Bastillon claim, adjoining the Antlered Crest.

SACRAMENTO COUNTY

The real estate and personal property, including a 9-cu. ft. dredge, of the Union Dredging Co. will be sold at public auction April 28 at 11 a.m. on the premises near Folsom, California.

SHASTA COUNTY

The Balaklala Copper Co. is being sued for \$25,000 damages by E. Laudawick, who alleges he was struck by a projecting rock in the transportation tunnel, when he was employed as a motorman on an electric locomotive.

SIERRA COUNTY

Some ore containing gold and arsenical pyrite has been extracted from the Wyoming mine's long adit, near Alleghany. This property is west of the Sixteen-to-One, and is on the serpentine contact. At the El Dorado, a pocket of rich ore, worth \$10,000, was opened last week. The concentrate, weighing 156 lb., returned \$3200 from the Selby smelter. The Mt. Alta gravel mine, on Oregon creek, continues to be a good gold producer. Gravel worth \$1.75 per ton has been opened in the lower adit. Pike City men are interested in the mine. C. N. Chatfield is manager. The Dreadnaught, owned by Owen T. Owens, near Forest City, is opening in a promising manner.

SISKIYOU COUNTY

(Special Correspondence).—John B. Farish, of New York, has been unable to arrange for another year's extension upon the extensive copper group of Davis and Howard at Clear Creek, near Happy Camp, and has therefore dropped his option upon this property, although his full time has not quite expired. Davis and Howard have begun patent proceedings upon their extensive group of copper claims near Happy Camp, in this county.

Happy Camp, March 28.

COLORADO

THE SAN JUAN

The Denver & Rio Grande railroad has issued an interesting map of this mining area, which includes Mineral, Hinsdale, La Plata, San Juan, Ouray, Montezuma, Dolores, and San Miguel counties. It also gives the value of the gold, silver, copper, lead, and zinc production from 1880 to 1912, inclusive, as published by the U. S. Geological Survey. The respective totals are as follows: \$37,121,674; \$9,004,680; \$3,722,250; \$53,205,787; \$64,570,309; \$68,581; \$11,880,144; and \$66,369,471. Ore shipments from Ouray during the past three months totaled 7608 tons, of which 1287 tons was from the Camp Bird, 4500 tons from the Wanakah, and 667 tons from the Atlas. Prospects for lessees during the coming season appear to be good.

TELLER COUNTY (CRIPPLE CREEK)

Rumors are again afloat in Colorado Springs that a consolidation of several mines at Cripple Creek is being made in Paris. The deal will involve the Golden Cycle, El Paso, Vindicator, Granite, and others. The output of the district for March was estimated as follows:

Plants.	Tons.	Average.	Total val.
Smelters	3,965	\$55.00	\$ 218,975
Golden Cycle	30,000	20.00	600,000
Portland	9,520	20.00	190,000
Portland	16,800	2.67	44,856
Stratton's Independence	10,990	2.96	32,530
Ajax	4,000	6.80	27,200
Wild Horse	1,300	3.40	4,420
Jo Dandy	2,000	1.40	2,806
Isabella	750	2.00	1,500
Total	79,325		\$1,121,381

Rich ore, supposed to be the Victor oreshoot, has been opened by lessees in the Isabella property, at a depth of about 500 ft., and is considered to be an important find. The first part of the Free Coinage aerial tramway is in operation. Suspensions being entertained that high-graders were in the Vindicator mine, all exits were guarded on April 2 for their capture. It is said that about \$100,000 will be spent in enlarging the Colburn-Ajax mill. The Golden Cycle main shaft is now 80 ft. below the 1650-ft. level. It will be continued to 1850 feet.

IDAHO

LEMHI COUNTY

The Gilmore mine has been shipping 20 cars of ore per month during the past two months, but in April this may be increased to 30 cars. A rich pocket was opened last week assaying \$900 per ton.

SHOSHONE COUNTY

The Federal Mining & Smelting Co. reports an income of \$1,096,662 from its lead, silver, and zinc during the last four months of 1913. The cost was \$953,413. There were charges of \$317,237 against the income of \$315,051, leaving a deficit of \$2786.

MISSOURI

JASPER COUNTY

During the week ended April 5, production of the Joplin district was as follows: blende, 8,680,670 lb.; calamine, 677,100 lb.; and lead, 1,311,430 lb.; averaging \$37.09, \$21.37, and \$44.68 per ton respectively. For the past 14 weeks the output totaled: blende, 137,917,510 lb.; calamine, 9,085,120 lb.; and lead, 25,553,160 lb.; having a total value of \$3,369,026.

MICHIGAN

HOUGHTON COUNTY

The report of the Ahmeek Mining Co. for 1913 shows that at No. 1 shaft all openings north and south show ground of average quality, save No. 17 level south, which is poor. The same may be said of No. 2 shaft. Mules are used for tramming on No. 12 and 14 levels. Work is proceeding on the additional four stamps, also six boilers and a 2000-kw. low-pressure steam turbine. 'Rock' crushed was 283,749 tons, as against 652,260 in 1912, yielding 9,220,374 lb. of copper. Of this, 9,044,166 lb. was sold for \$1,394,876. The profit was \$176,919, and dividends \$850,000, this reducing the previous surplus to \$706,128. The cost per pound was 13.30c. During 1913 the Keweenaw Copper Co. drilled 14 holes, with a total length of 7911 ft., on the Ashbed lode.

MONTANA

SILVERBOW COUNTY

Ore shipped from the Butte-Ballaklava mine's 1400-ft. level to the Washoe smelter has varied recently from 4 to 6.94% copper and 7.2 to 8.8 oz. silver per ton. About two cars per day were shipped in March. The Bullwhacker Copper Co. has ordered a Kelly filter-press of 460 sq. ft. filtering surface, to be used in its electrolytic process. Presses are being installed at the Butte-Duluth leaching plant and the Butte & Superior flotation plant.

Personal

EDMUND JUESSEN is at Tonopah.

P. R. BRADLEY has arrived at Juneau.

C. W. MERRILL is at Los Angeles this week.

T. A. RICHARD will visit New York in May.

THOMAS T. READ was at Cincinnati last week.

W. L. SAUNDERS was in Washington last week.

F. B. WEEKS is at Park, Eldorado county, California.

E. A. JULIAN and S. J. KIDDER are in San Francisco this week.

ROBERT SCOTT has returned from the Sunflower quicksilver mines in Arizona.

RICHARD PHILLIPS, of Oroville, has gone to New York for two or three months.

DONALD F. IRVIN has returned to El Tigre, Sonora, from a trip along the western coast.

COURTENAY DE KALB has completed a mine examination near Nacozari and is returning to Tucson.

W. G. ANDERSON has gone to Northbrook, Ontario, as mine manager for the Ore Chimney Mining Company.

H. W. HARDINGE has returned to New York from a two months' trip through the western mining districts.

J. H. MEANS, who has been in charge of operations at the Mawchi tin and wolfram mines, Burma, is in London.

T. N. STANTON has recently been appointed superintendent of mines for the Cananea Consolidated Copper Co., at Nacozari.

AUGUSTUS D. COX has been appointed superintendent of the Nevada Packard Mines Co. of Rochester, Nevada, of which he took charge April 1.

H. A. J. WILKENS, president of the Mines Management Co., will be in London until the latter part of April, in connection with the work of that Company.

KIRBY THOMAS, of New York, has concluded an extensive sampling of the old Phoenix gold mine in the Cave Creek district, north of Phoenix, Arizona.

E. HOGAN TAYLOR, formerly of Kalgoorlie and recently at Redjang Lebong, Sumatra, has been appointed general manager at the Great Cobar copper mine, New South Wales.

J. N. HOUSER, former manager for the American Zinc, Lead & Smelting Co.'s Joplin property, has been transferred to Mascot, Tennessee, where he is manager for the American Zinc Co. of Tennessee.

The U. S. CIVIL SERVICE COMMISSION, at Washington, D. C., announces competitive examinations on May 11 for the following positions with the U. S. Bureau of Mines: Coal-mining engineer, salary from \$2400 to \$4000; assistant engineer of mine tests, salary from \$1800 to \$2400; and mine statistician, salary from \$1800 to \$2400 per annum. The subjects include education, professional experience, and publications or reports.

Utah members of the AMERICAN INSTITUTE OF MINING ENGINEERS are organizing a local section, headed by R. C. GEMMELL, of the Utah Copper Co. A petition is to be sent to the directors in New York City for a charter. This is also to include members in Nevada, if they join the Utah men, and the headquarters will be at Salt Lake City. ERNEST GAYFORD, of Salt Lake City, was made secretary of the meeting, and the following engineers were present and signed the petition to the executive board of the national body: R. C. GEMMELL, C. H. DOOLITTLE, DUNCAN MACVICHIE, ALBERT FRANK, ERNEST GAYFORD, B. L. LEWIS, A. C. NEBEKER, WALTER FITCH, B. F. TIBBY, FRANK ANDERSON, STANLEY B. SEARS, E. R. ZALINSKI, A. K. TIERNAN, H. HILL, J. C. DICK, R. C. BRADFORD, W. A. WILSON, J. C. MCHRYSTAL, A. H. BARDWELL, and L. S. AUSTIN. GEORGE F. WADDELL was also present. The formation of this branch will be of great assistance in entertaining the visiting engineers in August, toward which the mining companies of the state have contributed \$10,000.

Society Meetings

APRIL

Name.	Date.
American Chemical Society	8-11
American Institute of Electrical Engineers	10
American Electro-Chemical Society	16-18
Institution of Mining and Metallurgy.....London....	16

MAY

American Iron and Steel Institute	22
Geological Society of America (Cordilleran Section), Seattle	21-23
Institution of Mining and Metallurgy.....London....	21
Mining and Metallurgical Society...San Francisco....	4
National Fire Protection Association	5-7

JUNE

American Institute of Electrical Engineers	22 or 26
American Society for Testing Materials	23-27
American Society of Mechanical Engineers.....end of June	
Colorado Scientific Society, Denver.....	6
Franklin Institute	Philadelphia.....end of June
Society for the Promotion of Engineering Educa- tion	29 to July 2

AUGUST

American Inst. Mining Engineers..Salt Lake City....	10-14
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SEPTEMBER

American Chemical Society	9-12
American Institute of Electrical Engineers.....not fixed	
Colorado Scientific Society, Denver.....	3

OCTOBER

American Institute of Electrical Engineers.....	9
American Iron and Steel Institute	23-24
Colorado Scientific Society, Denver.....	3

NOVEMBER

American Institute of Electrical Engineers	13
Colorado Scientific Society, Denver.....	7

DECEMBER

American Institute of Electrical Engineers	11
American Society of Mechanical Engineers	7-8
American Museum of Safety	11-20
Colorado Scientific Society, Denver.....	5 and 19
Geological Society of America, Philadelphia.....	29-31
Society of Gas Lighting (annual meeting).....	10
Society of Naval Architects	11-12

SEPTEMBER 1915

American Institute of Mining Engineers, San Francisco	27-30
Engineering Congress, San Francisco.....	20-25

Schools and Societies

The CHAMBER OF MINES AND OIL of Los Angeles held a 'Safety First' luncheon during the last quarter, according to *Bulletin* No. 21. The guests were members of the Industrial Accident Commission of California. John R. Brownell, superintendent of safety, addressed members on methods used for the prevention of accidents in manufacturing establishments, and explained the ideas of the commission concerning certain portions of the new Workmen's Compensation Act. Early in March members were invited to hear B. M. Buck, chief chemist of the American Sheet & Tin Plate Co., deliver a lecture on the use of copper in steel as a preventative of corrosion. Both lectures were well attended.

The Metal Markets

LOCAL METAL PRICES

San Francisco, April 9

Antimony	9 — 9½c
Electrolytic copper	15¼—15½c
Pig lead	4.05 — 5.00
Quicksilver (flask)	\$39.00
Tin	40½—42 c
Spelter	6½— 6¾c
Zinc dust, 100 kg zinc-lined cases, 7½ to 8c per pound.	

EASTERN METAL MARKET

(By wire from New York.)

NEW YORK, April 9.—The market for copper, lead, and zinc is quiet and featureless. The first named metal showed a tendency to rise during the week, but fell back again. In spite of an increased production in March, the Copper Producers' report again shows a decrease in stocks. The Braden output for March was 1,801,000 lb. Business on the Stock Exchange has been extremely dull. Bar silver is 58½c. per ounce. In London silver is 26.94d. per ounce. Lead and spelter show no change.

SILVER

Below are given the average New York quotations in cents per ounce, of fine silver.

Date	Average week ending
Apr. 2	58.37
" 3	58.50
" 4	58.37
" 5 Sunday	58.04
" 6	58.37
" 7	58.82
" 8	58.50
Feb. 25	57.53
Mch. 4	57.72
" 11	58.23
" 18	58.04
" 25	58.06
Apr. 1	58.02
" 8	58.45

1913.	1914.	1913.	1914.
Jan. 63.01	57.58	July 58.70	...
Feb. 61.25	57.53	Aug. 60.53	...
Mch. 55.87	58.01	Sept. 60.88	...
Apr. 59.26	...	Oct. 58.76	...
May 60.21	...	Nov. 57.73	...
June 59.03	...	Dec. 57.73	...

COPPER

Quotations on copper as published in this column represent average wholesale transactions on the New York market and refer to electrolytic copper. Lake copper commands normally 1-5 to 1-4c. per lb. more. Prices are in cents per pound.

Date	Average week ending
Apr. 2	14.40
" 3	14.45
" 4	14.60
" 5 Sunday	14.50
" 6	14.40
" 7	14.40
" 8	14.40
Feb. 25	14.31
Mch. 4	14.22
" 11	14.04
" 18	14.01
" 25	14.18
Apr. 1	14.28
" 8	14.46

1913.	1914.	1913.	1914.
Jan. 16.54	14.21	July 14.21	...
Feb. 14.93	14.46	Aug. 15.42	...
Mch. 14.72	14.11	Sept. 16.31	...
Apr. 15.22	...	Oct. 15.08	...
May 15.42	...	Nov. 14.25	...
June 14.71	...	Dec. 14.25	...

COPPER PRODUCERS' ASSOCIATION REPORT

The Copper Producers' Association statement for April shows an increase in production and decrease in stocks on hand. The details are as follows:

	Pounds.
Stocks of marketable copper of all kinds on hand at all points in the United States, March 9, 1914	78,371,852
Production of marketable copper in the United States from all domestic and foreign sources during March	145,651,982
Deliveries for consumption, March	69,852,349
Deliveries for export, March	89,562,166
Stock of marketable copper of all kinds on hand and at all points in the U. S., April 2	64,609,319
Recent changes in surplus have been as follows, in pounds.	
	Increase. Decrease.
March 1913	18,032,928
April	28,720,162
May	8,074,883
June	14,569,619
July	690,330
August	15,230,908
September	8,531,043
October	2,773,288

November	15,363,947
December	43,509,438
January 1914	4,142,182
February	8,924,833
March	13,762,533

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date	Average week ending
Apr. 2	3.80
" 3	3.80
" 4	3.80
" 5 Sunday	3.80
" 6	3.80
" 7	3.80
" 8	3.80
Feb. 25	4.00
Mch. 4	4.00
" 11	4.00
" 18	4.00
" 25	4.00
Apr. 1	3.80
" 8	3.80

1913.	1914.	1913.	1914.
Jan. 4.28	4.11	July 4.35	...
Feb. 4.33	4.02	Aug. 4.60	...
Mch. 4.32	3.94	Sept. 4.70	...
Apr. 4.36	...	Oct. 4.37	...
May 4.34	...	Nov. 4.16	...
June 4.33	...	Dec. 4.02	...

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending	Mch. 26.
Mch. 12	38.50
" 19	39.50
Apr. 2	39.00
" 9	39.00

1913.	1914.	1913.	1914.
Jan. 39.37	39.25	July 41.00	...
Feb. 41.00	39.00	Aug. 40.50	...
Mch. 40.20	39.00	Sept. 39.70	...
Apr. 41.00	...	Oct. 39.37	...
May 40.25	...	Nov. 39.40	...
June 41.00	...	Dec. 40.00	...

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date	Average week ending
Apr. 2	5.10
" 3	5.10
" 4	5.10
" 5 Sunday	5.10
" 6	5.10
" 7	5.10
" 8	5.10
Feb. 25	5.20
Mch. 4	5.15
" 11	5.13
" 18	5.10
" 25	5.10
Apr. 1	5.13
" 8	5.10

1913.	1914.	1913.	1914.
Jan. 6.88	5.14	July 5.11	...
Feb. 6.13	5.22	Aug. 5.51	...
Mch. 5.94	5.12	Sept. 5.55	...
Apr. 5.52	...	Oct. 5.22	...
May 5.23	...	Nov. 5.09	...
June 5.00	...	Dec. 5.07	...

TIN

New York prices control in the American market for tin, since the metal is almost entirely imported. San Francisco quotations average about 5c. per lb. higher. Below are given average monthly New York quotations, in cents per pound:

1913.	1914.	1913.	1914.
Jan. 50.45	37.85	July 40.70	...
Feb. 49.07	39.76	Aug. 41.75	...
Mch. 46.95	38.10	Sept. 42.45	...
Apr. 49.00	...	Oct. 40.61	...
May 49.10	...	Nov. 39.77	...
June 45.10	...	Dec. 37.57	...

The production of Netherlands Indies Government Banca tin during 1913 amounted to 253,533 piculs (34,481,168 lb.), against 183,790 piculs (24,995,440 lb.) in 1912.

According to L. Vogelstein & Co., New York, the March tin statistics show the following: monthly supplies from all sources to England, Europe, and the United States, 10,333 tons; monthly deliveries to all points, 10,586 tons; and visible supplies (stocks at points, afloat, and landing), 18,190 tons. The respective figures in February were 8766, 7493, and 18,443 tons; and in March 1913, 9932, 11,030, and 12,312 tons. Average prices in London and New York in March and February 1914 and March 1913 were as follows: £173.25, £180.5, and £216.5 per ton; and 38.11, 39.885, and 46.835c. per pound respectively.

The Stock Markets

SAN FRANCISCO STOCKS AND BONDS

(San Francisco Stock and Bond Exchange.)

April 9.

BONDS

Listed	Bid	Ask	Unlisted.	Bid	Ask
Associated Oil 6s	\$ 97	98½	Natomas Consol. 6s.	—	26
Unlisted.			Pac. Port. Cement 6s.	100	—
Ass. Oil 6s	—	81	Santa Cruz Cement 6s.	43½	—
General Petroleum 6s.	39½	41	Union Oil	—	88

STOCKS

Listed.	Bid	Ask	Unlisted	Bid	Ask
Amalgamated Oil	77	—	General Petroleum	1½	—
Associated Oil	39½	40½	Noble Electric Steel	85c	—
Giant	—	86	Natomas Consol	50c	—
Pac. Oil 6s	—	57½	Pac. Port. Cement	90	94
Pacific Crude Oil	—	30c	Riverside Cement	—	63
Sterling O. & D	—	1.25	Santa Cruz Cement	43	46½
			Stand. Port. Cement	19	—

NEVADA STOCKS

(By courtesy of San Francisco Stock Exchange.)

April 9.

Atlanta	\$ 31	Montana-Tonopah	\$.44
Belcher	.32	Nevada Hills	.30
Belmont	2.00	North Star	.34
Con. Virginia	.21	Ophir	.40
Florence	.60	Pittsburg Silver Peak	.32
Goldfield Con.	1.42	Round Mountain	.28
Goldfield Oro	.12	Sierra Nevada	.16
Halifax	.80	Tonopah Extension	1.90
Jim Butler	.95	Tonopah Merger	.60
Jumbo Extension	.33	Tonopah of Nevada	7.00
MacNamara	.08	Union	.11
Mexican	1.10	Victor	.32
Midway	.34	West End	.84
Mizpah Extension	.45	Yellow Jacket	.25

CALIFORNIA STOCKS

(Latest Quotations.)

Bid.	Ask.	Bid.	Ask.
Argonaut	\$2.75	Central Eureka	\$0.60
Brunswick Con.	\$1.05	Mountain King	0.35
Bunker Hill	1.90	South Eureka	1.50

COPPER SHARES—BOSTON

(By courtesy of J. C. Wilson, Mills Building.)

April 9.

	Bid	Ask		Bid	Ask
Allouez.....	\$ 41½	42	Mohawk.....	\$ 43	43½
Ariz. Commercial.....	41	42	Nevada Con.....	15½	16½
Butte & Superior.....	34½	35½	North Butte.....	27	27½
Calumet & Arizona.....	68	68½	Old Dominion.....	50½	51
Calumet & Hecla.....	416	418	Osceola.....	78	79
Copper Range.....	37½	38	Quincy.....	61	62
Daly West.....	2½	2½	Shannon.....	5½	6
East Butte.....	11½	11½	Superior & Boston.....	2½	2½
Franklin.....	6½	6½	Tamarack.....	35½	36
Granby.....	87½	88	U. S. Smelting, com.....	38½	39
Greene Cananea.....	37	37½	Utah Con.....	11	11½
Isle-Royale.....	19	19½	Winona.....	3½	3½
Mass Copper.....	3½	4½	Wolverine.....	46	46½

NEW YORK CURB QUOTATIONS

(By courtesy of E. F. Hutton & Co., Kohl Building.)

April 9.

Bld.		Ask.		Bld.		Ask.	
Braden Copper...	8 3/8	9 1/2		La Rose	4 1/2	4 3/4	
Braden 6s	165	175		Mason Valley.....	1 1/2	2 1/2	
B. C. Copper.....	1 3/4	1 7/8		McKinley-Dar.	76c.	79c.	
Con. Cop. Mines ..	2 1/4	2 3/8		Mines Co. Am.....	3/8	5/8	
Davis-Daly	7/8	1 1/8		Nipissing	6 1/4	6 1/2	
Ely Con.	4	6		Ohio Copper	1/4	3/8	
First National....	2	2 1/4		Stand. Oil of Cal.	313	314	
Groux	3/4	1		Tri Bullion	1/4	1/2	
Hollinger	15 1/2	16 1/2		Tuolumne	1 1/2	3	
Iron Blossom.....	1.29	1.32		United Cop. com. ..	1 1/2	3/4	
Kerr Lake	1 1/2	1 1/2		Yukon Gold	2	2 1/2	

NEW YORK STOCK EXCHANGE

(By courtesy of J. C. Wilson, Mills Building.)

April 9.

	Bid	Ask		Bid	Ask
Amalgamated.....	8 76½	78	Miami.....	23½	24
Anaconda.....	31½	32	Nevada Con.....	15½	15½
A. S. & R. com.....	68½	69	Quicksilver, com.....	1½	2½
Calif. Pet., com.....	24½	25	Ray Con.....	21½	22
Chino.....	41½	41½	Tenn. Copper.....	34½	34½
Guggenheim Ex.....	5½	66½	U. S. Steel, pfd.....	110½	110½
Inspiration.....	17½	17½	U. S. Steel, com.....	62	62½
Mexican Pet., com.....	65½	65½	Utah Copper.....	56½	56½

LONDON QUOTATIONS

(By cable, through the courtesy of Catlin & Powell Co., New York.)

April 9.

£	s.	d.	£	s.	d.		
Alaska Mexican.....	1	7	6	Mexican Eagle, com.....	2	1	0
Alaska Treadwell.....	8	5	0	Mexico Mines.....	5	5	0
Alaska United.....	3	2	6	Messina.....	1	11	3
Arizona.....	2	0	0	Oroville.....	0	13	9
Camp Bird.....	0	12	6	Pacific Oilfields.....	0	2	6
Cobalt Townsite.....	2	2	6	Rio Tinto.....	73	0	0
El Oro.....	0	16	0	Santa Gertrudis.....	0	15	0
Esperanza.....	0	17	6	Tanganyika.....	2	2	6
Granville.....	0	10	0	Tomboy.....	1	1	3
Kern River Oilfields.....	0	8	9				

AUSTRALASIAN

April 9.

	£	s.	d.		£	s.	d.
British Broken Hill	2	1	3	Mount Elliott	3	13	9
Broken Hill Prop.	1	18	9	Mount Lyell	1	6	3
Golden Horse-Shoe	2	11	3	Mount Morgan	3	3	9
Great Boulder Prop.	0	15	0	Wahli	2	5	0
Ivanhoe	2	13	9	Wahli Grand Junc.	1	6	3
Kalgurli	1	17	6	Zinc Corporation, Ord.	1	1	3
Mount Boppy	0	12	6				

Aluminum Ore Production

The production of aluminum ore in 1913, according to final figures of the U. S. Geological Survey, was 210,241 long tons, valued at \$997,698, an increase of 50,376 long tons, or 31.5% and \$228,766 or 29.8%, respectively, over the figures for 1912. The states which produced bauxite were, as usual, Alabama, Arkansas, Georgia, and Tennessee. Arkansas led in 1913, its output exceeding that of the previous year. The average price of bauxite per long ton at the mine for 1913 was \$4.75, which differed by only a few cents from the prices recorded for the three previous years. There was more aluminum consumed in the United States in 1913 than in 1912, but the figures showing this consumption cannot be published at the present time, as the import figures are not yet available.

Australian Gold Production

Following are the January returns, in fine ounces, as officially published:

State.	1914.	1913.
New South Wales	15,769	17,083
New Zealand	29,640	29,404
Queensland	14,914	20,591
Victoria	23,140	25,066
Western Australia	112,023	104,706

New Zealand produced gold worth £1,459,499 in 1913, and the average for 57 years is £1,439,623. The mints at Sydney, New South Wales; Melbourne, Victoria; and Perth, Western Australia, received 56,680, 45,372, and 125,542 fine oz. respectively in January.

THE United States Smelting, Refining & Mining Co. reports as follows for 1913:

	1913.	1912.
Earnings	\$4,555,122	\$5,497,965
Profit	3,585,586	4,232,965
Surplus after dividends	830,121	1,418,083
Surplus at end of 1913	4,478,843	3,648,722

Company Reports

MT. BISCHOFF TIN MINING COMPANY

This Tasmanian property is one of the most noted in the world, and has paid to the end of 1913, \$12,307,200 in dividends, \$172,800 of which was paid during the second half of 1913. Ore reserves are estimated at 2,176,000 tons of tin-bearing ore. During the last period, 122,601 tons was stamped and concentrated, yielding 600 tons of tin oxide. The smelting works at Launceston treated 619 tons of Company product and 1567 tons of custom product, yielding 399 and 1093 tons of 99.88% tin, respectively. Costs of mining, aerial ropeway, milling, power, and administration, etc., totaled \$1.15 per ton of ore treated. The revenue for the half-year was \$330,000; net profit, \$111,000; dividend, \$172,800; carried forward, \$432,000; and surplus over liabilities, \$153,000.

NUNDYDROOG COMPANY, LIMITED

This is one of the Indian mining companies, operating at Kolar, in the state of Mysore. The superintendent, Charles H. Richards, reports as follows for 1913: A total of 3564 males and 444 females was employed at the mine, 3770 of whom were natives. An average of 33.39 machine-drills was used underground. Water amounting to 152,840,000 gal. was pumped from the mine. Development to 3200 ft. totaled 12,524 ft., 3396 cubic fathoms of stoping, and 240 cubic fathoms of other work. Ore reserves are 150,650 tons, an increase of 12,210 tons. An average of 76.42 stamps was in operation, crushing 3.25 tons per head per day through wire screening. The tonnage milled was 90,650 tons, yielding 73,046 oz. bullion. The cyanide plant treated 94,665 tons, yielding 7332 oz. bullion. The total recovery was \$17.64 per ton. Costs were \$7.28 per ton. The revenue was \$1,584,000. Dividends last year were \$475,200, and \$9,610,000 to date from an output of 1,526,554 tons yielding \$25,297,000.

HEDLEY GOLD MINING COMPANY

This Company operates a mine and mill in British Columbia, and the report covers the year 1913. A total of 70,796 tons of ore was treated, yielding \$656,541 by concentration and \$145,789 by cyanidation, a total of \$802,330. The recovery was 94%. The tonnage was 341 more than in 1912, worth \$12.03 against \$11.19 per ton. The superintendent, Ganer P. Jones, states that the Dickson incline, 8 by 16 ft. in the clear, is down 700 ft., where drill-holes have cut \$20 ore, but another hole from the bottom of No. 5 incline gave only \$7 per ton. Four drill-holes proved a large shoot of \$8 to \$9 ore northeast of No. 5 incline. In the stopes are 10,000 tons of broken ore. Reserves are estimated at 413,000 tons, averaging \$10 per ton. Since the report was prepared, another hole west of the 600-ft. level has passed through 32 ft. of good ore, checking the holes drilled in 1912. An all-the-year-round water-power plant is being constructed at a cost of \$200,000. Dividends totaled \$360,000, and the undivided profits amount to \$272,096.

SOUTH AFRICAN GOLD TRUST, LIMITED

This is a large holding company, having shares in 57 different mining companies operating in South Africa, West Africa, Rhodesia, Brazil, Yukon, California (including Oroville, Natomas, and Yuba dredging), and Mexico. The holdings are not limited to gold mines, but include tin, oil, electric power, and cyanide production. The Company's ordinary share capital stands at £500,000, and the preference share capital at £500,000. During 1913 the sixteenth drawing of £10,000 debentures for redemption, in terms of the issue, has taken place, leaving £90,000 outstanding. The realized net profits on the year's operations, almost entirely derived from

dividends on investments and interest on loans, after deducting debenture interest and all charges, amounts to £99,129, from which the dividend on the preference shares and French Government taxes has been deducted, leaving £68,397, which, with the amount brought forward from last year, namely, £63,444, makes a total of £131,841, subject, however, to depreciation. The directors regret to have to report that the total depreciation amounts for the year to £286,396. This amount has been provided for by charging £150,000 against the wasting assets account, £30,000 against a credit reserved in previous years for unforeseen contingencies, and the balance of £106,396 against the profit and loss account, leaving the sum of £26,445 to be carried forward. The directors regret, under these circumstances, that they are unable to recommend the distribution of a dividend on the ordinary shares. As was the case last year, the depreciation exceeds the declared profit, and the Consolidated Gold Fields of South Africa, Ltd., is, therefore, not entitled to any percentage on the declared profits, and as the directors undertook to be governed by what applied in this respect to the Consolidated Gold Fields of South Africa, Ltd., neither do they get any benefit by way of commission.

AMERICAN SMELTING & REFINING COMPANY

In view of the very unfortunate condition of affairs in Mexico, by reason of which so large a part of the Company's property is at present unproductive, according to the president, Daniel Guggenheim, the directors feel that the shareholders have reason to congratulate themselves on the fact that the earnings of the common stock for 1913 equal 7.47%. The earnings of the Company from mines and from smelting and refining are \$3,570,532 less than during the previous year. Assets at the end of last year amounted to \$189,843,782, made up as follows: Property account, \$140,906,799; investments, \$1,183,653; net value of stocks of ore, bullion, and factory products on hand and in transit, \$26,481,002; working assets, \$3,587,433; current assets, \$16,601,092; and cash and securities in funds, etc., \$1,083,803. Apart from the capital stock and bonds, the current liabilities include: accounts, drafts, and wages payable, \$6,427,880; deferred payments on mining properties, \$330,000; interest on bonds, \$380,100; dividends payable and unclaimed, \$2,045,897; accrued taxes not due, \$321,674; creditor accounts, \$1,307,788; and profit and loss surplus, \$18,495,943. At the end of 1912 the last item was \$16,759,402. Results of the past two years are as follows:

	1913	1912.
Income:		
Net earnings of smelting and refining plants	\$10,926,254	\$12,568,835
Net earnings from mines.....	1,185,153	3,113,105
From interest, rents, dividends, etc.	1,318,525	1,077,559
Total gross income	\$13,429,933	\$16,759,499
Expenditure:		
Administration	\$ 896,639	\$ 758,176
Taxes, including income tax.....	210,698	123,917
Interest on bonds	824,961	872,926
Depreciation	1,525,518	3,013,543
Other charges	215,576	236,692
Total expenditure	\$ 3,673,392	\$ 5,679,824
Net income	9,756,540	11,079,675
Surplus at beginning of 1913.....	16,759,402	13,699,726
Gross surplus	\$26,515,942	\$24,779,402
Dividends:		
On preferred stock	6,020,000	6,020,000
On common stock	2,000,000	2,000,000
Total dividends	\$ 8,020,000	\$ 8,020,000
Surplus	\$18,495,942	\$16,759,402

Decisions Relating to Mining

PLACER CLAIM—SURVEY FOR PATENT

When a placer entry of part of a regular shaped lot composed of legal subdivisions is described in terms of the public surveys as a legal subdivision and may be readily identified by that description, a special mineral survey thereof will not be required.

Archibald McNabb, 42 Land Decisions, 413. September 13, 1913.

PLACER CLAIMS—RULE OF APPROXIMATION

The rule of approximation permitted in entries under the homestead and other public land laws, permitting an entryman to take and pay for a legal subdivision of surveyed ground although the precise area of said subdivision may be found to vary to a small extent from the standard area because of unavoidable variations in the public survey lines, applies also to placer claims but in dealing with placers the rule should be applied on the basis of ten-acre subdivisions.

Ventura Coast Oil Company, 42 Land Decisions, 453. October 3, 1913.

MILLSITE—PROOF OF NON-MINERAL CHARACTER

A millsite claim may be patented where it adjoins the end of a lode claim, provided it be clearly shown that the lode or vein along which the mining location is laid either terminates before the end abutting upon the millsite claim would otherwise be reached, or that it departs from the side-line of the mining claim, and that the ground embraced in the millsite claim is non-mineral in character. A higher degree of proof may be required where the millsite adjoins the lode claim on the end than where it adjoins it on the side.

Montana-Illinois Copper Mining Co. 42 Land Decisions, 434. September 27, 1913.

TUNNEL SITE—NOT BASIS FOR PATENT

Section 2323 Revised Statutes, confers upon tunnel site claimants merely the preference right as against a subsequent lode claimant, to appropriate in the manner provided by other provisions of the mining laws, any vein or lode, not appearing on the surface, which may be discovered in a tunnel projected under the provisions of said section within 3000 ft. from the portal thereof, provided the work thereon be prosecuted with reasonable diligence; but said section does not authorize the sale or patenting of any ground on the exclusive basis of the tunnel location, whether the tunnel be run for the development of veins or lodes already located or is projected for the discovery of 'blind' veins or lodes.

Letter, 1st Asst. Secretary Jones, 42 Land Decisions, 456. October 9, 1913.

PLACER MINING CLAIM—COMMON IMPROVEMENT

Where a deep quarry has been excavated upon one of a group of placer mining claims held in common for the purpose of developing a deposit of marble existing within the group, and has been projected to within a few feet of another claim of the group, and the topographic conditions are such that the marble within such claim can be more economically removed through the existing excavation than through an independent plant of development, a proportionate share of the cost of such improvement is applicable to such claim in satisfaction of the statutory requirement concerning expenditure as a basis for patent. However, the excavation was not allowed as common improvements for other claims situated from 600 to 1200 ft. distant.

American Onyx & Marble Co., 42 Land Decisions, 417. September 17, 1913.

Recent Patents

1,079,786.—PROCESS OF HARDENING COPPER. James A. McLarty, Toronto, Ontario, Canada.

He proposes coating the copper with a material including a compound containing both hydrogen and carbon, and thereafter heating said copper to a temperature of about 1600° F. and then allowing to remain out of contact with air until cold.

1,080,747.—METAL CONTAINER. Thomas J. Buckley, New Brunswick, N. J.

A device of the character described, comprising a hollow contained proper, a hollow neck, a plug, or stopper extending therefrom and a weak portion connecting the stopper and the neck and disposed at an angle to the longitudinal axis of the stopper.

1,081,164.—SMELTING OR REFINING OF METALS AND THE LIKE IN CRUCIBLES. Henry G. Solomon, London, England.

An induction furnace comprising a transformer the secondary of which is formed by an annular crucible, a casing surrounding the transformer, a movable device adapted to close said casing and a bridge-piece for the transformer connected to and movable with said movable device.

1,079,787.—PROCESS OF TREATING METALS. James A. McLarty, Toronto, Ontario, Canada.

This consists of subjecting metals in a heated state to the action of gases and vapors produced by heating a mixture including a carbohydrate and a fat to a temperature below that necessary to produce material amounts of carbon monoxide, said mixture being out of contact with said metal.

1,080,912.—METHOD OF ELECTRICALLY SMELTING VOLATILE METALS. Woolsey McA. Johnson, Hartford, Conn.

The method of smelting ores yielding a volatile metal which consists in electrically heating a charge proportioned to yield a fusible slag, conducting the volatile reaction products into contact with carbon heated to its temperature of maximum reductivity, continuously replacing the carbon and condensing the metal, substantially as described.

1,081,116.—SMOKE SEPARATOR. Clayton Floyd Holmes, Beaumont, Tex., assignor of one-half to Joseph Friebls, Beaumont, Tex.

A smoke separator for smelter furnaces and like apparatus, comprising a cooling flume connected at one end with the apparatus, a suction fan connected with the other end of the said cooling flume, a series of connected and vertically extending cooling coils arranged transversely within the said flume to retard the passage of the smoke and gases through the flume and to cool the said smoke and gases, and a precipitating tank charged with a cooling medium and into which discharges the said suction fan.

1,080,862.—ELECTRIC ZINC FURNACE WITH INTEGRAL CONDENSER. John Thomson, New York, N. Y.

An electric furnace having a horizontal carbon resistor, two sets of terminals each comprising a plurality of carbon terminal members the inner ends of said terminal members being on contact with the resistor and located within the walls of the furnace, the outer ends of said terminal members being located in the walls of said furnace, and two sets of metallic strips which protrude from the walls to the exterior of the furnace, one set of said metallic strips connecting the outer ends of carbon members constituting one set of terminals and the other set of metallic strips connecting the outer ends of carbon members in the other set of said terminals.

Recent Publications

MINING LAWS. United States and California. Bulletin 66. California State Mining Bureau. P. 89. Sacramento, 1914.

CARNOTITE, THE PRINCIPAL SOURCE OF RADIUM. By Thomas F. V. Cuffan. P. 28. Ill. Cuffan & Hudson, New York, 1913.

A LEGISLATIVE PROGRAM TO RESTORE BUSINESS FREEDOM AND CONFIDENCE. An address at Chicago by Samuel Untermeyer of New York. P. 40.

ORIGIN OF THE BIGHORN DOLOMITE OF WYOMING. By Elliot Blackwelder. Reprint from the *Bulletin of the Geological Society of America*. P. 19. Ill.

UPWARD SECONDARY SULPHIDE ENRICHMENT AND CHALCOCITE FORMATION AT BUTTE, MONTANA. By Austin F. Rogers. Reprint from *Economic Geology*. P. 14. Ill.

THE DARWIN SILVER-LEAD MINING DISTRICT, CALIFORNIA. By Adolph Knopf. U. S. Geological Survey, *Bulletin* 580-A. Contributions to *Economic Geology*, 1913, Part I-A. P. 18. Ill. Washington, 1914. An abstract of this paper was published in this journal of April 4.

MINING AND MINING METHODS IN THE SOUTHEAST MISSOURI DISSEMINATED-LEAD DISTRICT. By H. A. Guess. Reprint from *Transactions of the American Institute of Mining Engineers*. P. 19. Maps. From 1869 to 1912, inclusive, this district has produced lead worth \$118,783,614, and the work done is described.

ON INCLUSIONS OF ANTHRAXOLITE (ANTHRACITE) IN IGNEOUS ROCKS OF CRIMEA. By W. W. Arschinow. P. 15. Petrographical Institute, Moscow, Russia, 1914.

ON LÖWIGITE AND OTHER MINERALS FROM NEAR MT. KINJAL IN THE DISTRICT OF THE PIATIGORSK MINERAL SPRINGS IN THE CAUCASUS. By W. W. Arschinow. P. 11. Moscow, Russia, 1913.

METAL STATISTICS. Compiled by B. E. V. Luty and C. S. J. Trench. P. 287. Published by *The American Metal Market and Daily Iron and Steel Report*. This is the seventh annual edition of a useful pocket-size publication covering the production of metals during 1913, compared with former years, and their prices. There are also railroad data and duties on ores and metals.

PROCEEDINGS of the Lake Superior Mining Institute, 18th annual meeting, at the Mesabi Range, Minnesota, August 1913. P. 245, with an appendix of 63 pages. Ill., plans, maps. Ishpeming, Michigan, 1913. When published in pamphlet form, abstracts were made in this journal from time to time. The papers and general compilation are full of interest, covering this great mining district.

University of California publications, Berkeley, 1914:

NOTE ON THE FAUNAL ZONES OF THE TEJON GROUP. By Roy E. Dickerson. P. 9. Ill.

PLEISTOCENE BEDS AT MANIX IN THE EASTERN MOHAVE DESERT REGION. By John P. Buwalda. P. 22, with 25 plates.

THE PROBLEM OF AQUATIC ADAPTATION IN THE CARNIVORA, AS ILLUSTRATED IN THE OSTEOLOGY AND EVOLUTION OF THE SEA-OTTER. By Walter P. Taylor. P. 30. Ill.

PRELIMINARY CONCENTRATION TESTS ON MESABI ORES. By William R. Appleby and Edmund Newton. *Bulletin* No. 2. Minnesota School of Mines Experiment Station. P. 126. Ill., plans, tables. Minneapolis, 1913. The iron ranges contain a large quantity of low-grade non-merchantable ore which can be made of commercial value by concentration. This is shown

by large plants now at work. The School of Mines has investigated the problem, and this volume contains a great deal of interesting reading.

University of Illinois publications, Urbana, 1913 and 1914:

THE MORTAR-MAKING QUALITIES OF ILLINOIS SANDS. By C. C. Wiley. Bulletin 70. P. 38. Ill., and 11 plates. This bulletin discusses the effect of the characteristics of the sand upon the quality of mortar.

ILLINOIS MINERS' AND MECHANICS' INSTITUTES. R. Y. Williams, director. Bulletin 2. Outline of proposed methods. P. 27.

Missouri Bureau of Geology and Mines publications, Jefferson City, 1914:

BIENNIAL REPORT OF THE STATE GEOLOGIST, H. A. Buehler. P. 54. Maps.

GEOLOGY OF THE ROLLA QUADRANGLE. By Wallace Lee. P. 111. Ill., maps, charts, index.

GEOLOGY OF THE TITANIUM AND APATITE DEPOSITS OF VIRGINIA. By Thomas Leonard Watson and Stephen Taber. Bulletin 111-A. Virginia Geological Survey. P. 308. Ill., maps, index. Charlottesville, 1913.

Canadian publications:

THE CANADIAN OYSTER. Its development, environment and culture. By Jos. Stafford. Commission on Conservation. Canada, bulletin. P. 159. Ill., maps, index. Ottawa, 1913.

Department of Mines, Mines Branch, Ottawa, 1913 and 1914:
PRODUCTION OF CEMENT, LIME, CLAY PRODUCTS, STONE, AND OTHER STRUCTURAL MATERIALS. 1912. P. 64.

MINERAL PRODUCTION OF CANADA, 1913. Preliminary report. Prepared by John McLeish. P. 21. Estimates of the output were published in this journal of March 21.

MINERAL PRODUCTION OF QUEBEC, 1913. Preliminary statement. Compiled by Theo. C. Denis. P. 7. Department of Mines, Quebec, 1914.

MINERAL PRODUCTION OF BRITISH COLUMBIA, 1913. Preliminary review and estimate. Bulletin No. 1, 1914. By Wm. Fleet Robertson. P. 35. Victoria, 1914.

MAGNETITE OCCURRENCES ALONG THE CENTRAL ONTARIO RAILWAY. By Einar Lindeman. No. 184. P. 23. Ill., 18 maps.

AUSTIN BROOK IRON-BEARING DISTRICT, NEW BRUNSWICK. By Einar Lindeman. No. 105. P. 15. Ill., maps, plans.

United States Bureau of Mines publications, Washington, 1913 and 1914:

THE USE AND MISUSE OF EXPLOSIVES IN COAL MINING. By J. J. Rutledge, with a preface by Joseph A. Holmes. Miners' Circular 7. P. 52. Ill.

ERRORS IN GAS ANALYSIS, due to assuming that the molecular volumes of all gases are alike. By George A. Burrell and Frank M. Seibert. Technical Paper 54. P. 16. Ill.

THE ACTION OF ACID MINE WATER ON THE INSULATION OF ELECTRIC CONDUCTORS. A preliminary report by H. H. Clark and L. C. Hlsley. Technical Paper 58. P. 26.

MUD-LADEN FLUID APPLIED TO WELL DRILLING. By J. A. Polard and A. G. Heggem. Technical Paper 66. Petroleum Technology 14. P. 21. Ill.

PRODUCTION OF EXPLOSIVES IN THE UNITED STATES, 1912. Compiled by Albert H. Fay. P. 7.

FUEL-BRIQUETTING INVESTIGATIONS. By C. L. Wright. *Bulletin* 58. P. 277. Ill., plan, index. This covers the work done from July 1904 to July 1912. The amount of lignite coal in the United States, easily mined and suitable for briquetting, is estimated at 389,534,000,000 short tons, while the total easily mined and briquetted with difficulty is 1,087,514,400,000 tons. Briquetting has been done with great success in Europe for 30 years. Tests by the Bureau of Mines were made on lignite and other coals from several states. The machinery used, weathering tests, the fuel value of the products, and considerable other information, comprise a valuable record of the work done on this subject.

Industrial Progress

The Meridiograph

By LOUIS ROSS

Nearly all surveys of mines or claims require the determination of an accurate north line for reference, one that is more reliable than that given by the magnetic needle. The method of obtaining such a true meridian has been shrouded in a haze of technical mathematics and astronomy, requiring the services of a skilled surveyor; and to him this determination meant an evening's work in observing the North Star, or the solution of complex problems in spherical trigonometry. The costly solar attachment made for this purpose encumbers the transit and is none too accurate; therefore, engineers usually prefer to undergo the labors of star observations rather than trust to the attachment.



THE MERIDIOGRAPH.

I have devised an instrument which obviates all the difficulties mentioned, and have named it the 'Meridiograph.' With its aid a true meridian may be determined in a few minutes, at any convenient hour of the day, no computations, knowledge of astronomy, or the use of any tables or books being required. It is only necessary to measure the sun's altitude. Its declination is taken from the Ephemeris which accompanies the Meridiograph, and the latitude of the place is obtained from a map. The Meridiograph will then give directly the true bearing of the sun to an accuracy of about 1 to 2 minutes of arc, varying according to the time of day. In shape and operation the Meridiograph is like a circular protractor, seven inches in diameter. It consists of two discs rotating with respect to each other, and a reading arm. The data are set off on the proper scales by means of the reading arm, just like setting off angles on an arm protractor, and the true bearing of the sun is read directly. There are no mechanisms to get out of order. The general instructions provided will enable anyone who can read an angle on the transit to determine an astronomically true reference line at any time of the day. The skilled engineer will find in the Meridiograph a computing instrument which will accomplish in two minutes what would otherwise occupy an evening's work, or require the solution of a laborious problem in spherical trigonometry.

American-Ball Four-Cylinder Triple-Expansion Engine

A new high-speed engine for driving centrifugal pumps, built by the AMERICAN ENGINE & ELECTRIC CO., is of the triple-expansion type with four cylinders. A 1000-hp. engine using 250 lb. steam and 25-in. vacuum, of the double angle type, was recently built. In it the high-pressure cylinder and intermediate pressure cylinder are horizontal, and the low-pressure cylinders are vertical. This construction is claimed to give large ratio of expansion and therefore high economy, and to eliminate an enormous low-pressure cylinder with massive reciprocating parts. With a single large low-pressure cylinder, the speed would have to be materially reduced, and this would increase the size, weight, and space required by the engine. The increase in weight would, in turn, necessitate decrease in speed, so that if a three-cylinder triple-expansion engine is to be operated at high speeds usually desired for driving pumps, the size of the low-pressure cylinder must be reduced, with corresponding reduction in expansion ratio and economy. The difference in economy amounts to several pounds of steam per horse-power hour.

According to the manufacturer, the higher speeds may be used with the four-cylinder construction, because of the smaller size of the two low-pressure pistons and rods and because the inertia forces of the vertical reciprocating masses are opposed and balanced by equal and opposite forces from the horizontal cylinders. This advantage of the angle construction is now very well known, from the wide use of the American-Ball angle compound engine for driving high-speed electric generators, also the double-angle type of engine, especially adapted for direct drive of paper machines at high speeds. The four-cylinder triple-expansion engine is another application of the same design.

The speeds at which these engines are operated are considerably higher than those of three-cylinder engines in which economy is sacrificed to reduce the size of the low-pressure cylinder. Vibration and pounding are eliminated even at very high speeds, so that the foundations may be light and inexpensive. When this engine is installed on a dredge-boat, for instance, no special stiffening of the dredge is necessary, the engine being simply supported on a cradle of I-beams. For stationary plants, a simple block of concrete is all that is necessary, and this is far less expensive than the foundations needed for a compound Corliss engine of equivalent power. It is estimated that a 1000-hp. four-cylinder triple-expansion American-Ball engine would require about 25 cu. yd. of concrete for its foundation, while a compound Corliss engine of equal power would require 125 yd. of concrete, a difference of 100 yd., which at \$10 per yard would represent a saving in favor of the American-Ball angle-type four-cylinder triple of \$1000. The design of valves, pistons, cross-heads, rods, etc., of these engines is similar to that of the American-Ball angle compound engines.

The L. C. TRENT ENG. CO., INC., has issued Catalogue No. 2 containing complete descriptions of the cyaniding machinery made by this firm. Especially interesting data are given regarding the L. C. Trent underfeed agitator, which is to be known hereafter as the 'Carpenter type,' being named for J. A. Carpenter, superintendent for the Nevada Milling Co., who perfected the machine.

The Webster Method for March is devoted to coal-handling equipment, but this includes many devices that could be used to advantage around any large mine, mill, or smelter; picking belts, conveyors, bucket elevators, dust jackets for screens, cooling belts, unloading machines, and chain elevators especially.

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EDITORIAL

WAGES in Australia still appear to be on the upward move. During 1913 there were 319 changes in all classes of trade, affecting 163,132 employees, who secured an average increase of \$1.08 per week per person. During the past 10 years or so, wages have been increased 15 per cent; but the cost of living has moved up about 25 per cent in the same time.

'MOTHER' JONES is reported as having recently smuggled out a message to 'General' Villa from the Walsenburg jail, where she is being held incommunicado. Whether this was an appeal for help in the settlement of the Trinidad affair or regrets for being unable to be present and take part in the Torreón campaign is not stated. However, this secret message to Francisco is undoubtedly like that to Garcia, of great import, and the public will watch the Constitutionalist leader's movements with added interest.

AN automobile whip is being successfully operated in northern Nevada. The whip is arranged just as it would be for a horse. However, this 'whip,' or 'whipsy' as the device is sometimes called, is for hoisting rather than for increasing acceleration. It consists of the usual overhead and ground pulleys through which the rope runs from shaft to roadway. When the hoisting signal is given, the car runs straight away from the shaft; when lowering, it backs until the rear wheels strike a bumper near the collar. Incidentally, the car is used for transportation to and from the mine.

UNION MINERA DU HAUT-KATANZA is again reported as about to embark upon elaborate improvements for increasing the smelter capacity and conducting operations on a greatly increased scale. Plans for four additional furnaces are being considered and with the general increase in scope of operation it is expected that the annual output will be over 30,000 metric tons of copper, which will place the property among the big copper producers. The holdings of the Company include one of the most extensive mineralized tracts which the industry knows, and, according to a recent report, ten mines have been sufficiently developed to prove 10,000,000 tons of 10 per cent copper ore. The concession comprises a district which is about 200 miles long and contains upward of 100 mineralized outcrops. Tin, gold, and platinum are also reported

in the district in profitable quantities. The difficulties encountered in the development of this tract were numerous, due chiefly to its remoteness from all bases of supply, but with the advent of railway transportation, development of fuel supplies, installation of coke-making equipment, and reduction plant the outlook is brighter. While there is no doubt but that the holdings of the Katanza company include many valuable mineral deposits, there have been many reports circulated regarding the status of the Company, some of which have been exaggerated and unduly auspicious. It will, therefore, be a relief to record the large production which is now anticipated.

MINING is considered a public use in various states, as a consequence of statute enactment. As a result, mining companies have the right to exercise the right of eminent domain and to condemn and purchase property for specific purposes as granted. The matter recently came up in Nevada in connection with the desire of the Goldfield Consolidated company to condemn land belonging to the Old Sandstorm Annex Gold Mining Company, for storage of tailing. In Utah, the case of Strickley *versus* Highland Boy Gold Mining Company was taken up to the United States Supreme Court and decided favorably to the right.

Progress of Flotation Litigation

Litigation has marked every step of progress in connection with flotation. Considering the complexities and uncertainties of the patent laws of this and British countries, and keeping in mind the probable value of monopoly patents for the next ten years, this is not surprising. Great inventions are not usually the result of one man's activity, nor are they accomplished by a single step. They mark the culmination of much experimental work on the part of many men, and in a sense they express the *zeitgeist* of the moment. Just as a great occasion has always, historically, seemed to find a fit man at hand, so a great metallurgical or mechanical need seems at the right time and place to call out the primitive spirit of invention that has brought man out from the stone age. There is always a final step, but under such conditions it requires nice judgment to apportion the credit, and the courts have a difficult task in determining the equities involved.

The ancients appreciated the affinity of oil for metallic minerals, though no serious effort to make use of this property in ore-dressing in a large way was made until well on in the nineteenth century. In 1860, the Haynes patent described a definite process for separating gangue from mineral by means of fatty or oleaginous material, but apparently the process was never applied. In 1886, Miss Everson proposed to make use of acid to intensify the differences in affinities of mineral and gangue for oil and water. It was not, however, until late in the nineties that serious and successful efforts to use flotation became general. Then there was a large crop of processes and patents, and in Aus-

tralia, especially, the competition between processes became keen. Fights, judgments, and compromises have succeeded, until now the situation is beginning to clear. A decision recently given by the Judicial Committee of the Privy Council, noted in our issues of March 14 and 28; establishes certain important boundary lines, and another decision, probably to be handed down next month at San Francisco by the Circuit Court of Appeals, is expected to set up other important guide posts. Unfortunately, owing to the fact that decision by a Circuit Court is not absolutely final, the American judgment may not end matters. In view of the importance of the case, the defeated party will naturally use every effort to bring the matter before the United States Supreme Court, and, while in patent cases that is not often accomplished, there is a possibility of such review. This is a less probable cause of trouble than the fact that another infringer, in another district, could precipitate another fight practically *de novo*.

Speaking in general terms, there are three classes of flotation processes now before the public; (1) film flotation; (2) bulk-oil rafting; (3) agitation-froth flotation. There are cross-divisions based upon heating or not heating the solutions, use or non-use of acid, the method of introducing air or generating gas in the mixture, and other minor points. There are also other processes, such as the Cattermole and the Potter, that apparently are applicable in special cases. There is, too, the ingenious Murex process which, while it uses some of the methods of flotation, introduces a wholly different principle and stands by itself. The Murex, by the way, is about to be introduced in North America by Mr. James M. Hyde, the designer and builder of the Butte & Superior mill, and one of the notable figures in the flotation litigation now under way.

Film flotation is simple in principle but difficult in practice. It depends upon delivering the finely ground gangue and metallic minerals upon the surface of the pulp by such a method that the valuable mineral does not break through the thin surface film, while the gangue does. It is in successful use in the Morning mill of the Federal Mining & Smelting Company in the Coeur d'Alene, where the Macquisten tubes are the particular apparatus adopted. There is little controversy about this process. Its failure so far to achieve wide use is due to the limited capacity of the necessary machinery and its limitations in treating slime. A slowly moving, little disturbed current of water is necessary, which seems incompatible with high capacity.

The oil-rafting processes are best exemplified by the Elmore, which was used in several countries and has found a number of applications. The Elmore vacuum process now in use involves different principles. In the oil-rafting process the metallic minerals are entrapped in a body of oil and are supported by it. The low specific gravity of the oil offsets the weight of the mineral, and the whole mass floats over a lip or other device to an outlet. It is the patent on this that has just been held valid by the highest British court upon appeal from New South Wales. As the question arose

over claimed infringement by Minerals Separation, operating the 'agitation-froth' process, it is interesting to note that the decision sustained the contention of the respondents that the expression in the patent at issue "the selective action of oil" was referable only to conditions in which the oil is present "in sufficient quantities to entrap or coat or absorb the metallic particles, and is of sufficient tenacity to carry these particles in the process of separation, whether by buoyancy or in the form of oil globules." This was held to be true whether the process be carried out in any of three sets of apparatus described. The importance of the latter lies in the fact that one apparatus described, provided for removal of the floated material by means of an oiled belt, and distinctly called attention to the fact that separation in this instance does not depend upon the buoyancy of the oil. The judgment of the British court apparently leaves the Elmore and Minerals Separation each free from the other, though it is to be noted that the Elmore vacuum process was not before the court. The processes adjudicated are held to be independent and, by inference, mutually non-infringing, so that competition must be upon the merits of each to meet particular situations that arise.

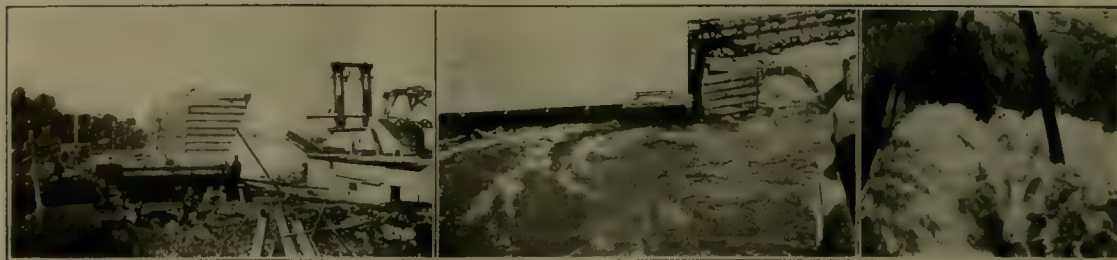
The agitation-froth process depends upon the lifting power of air bubbles whose walls are composed of particles of the mineral to be recovered, bound together by an extremely thin envelope of oil. Its utility rests upon the fact that large quantities of material can be rapidly and cheaply handled by simple machinery and that it is applicable to the fine slime that is lost in all forms of water concentration. Minerals Separation claims that its patents on this process are basic, and this, and the claim of infringement as against Mr. James M. Hyde and his associates at the Butte & Superior mill, were upheld by the District Court at Butte last fall, as we noted at the time. It was this case that was recently heard on appeal at San Francisco and decision of which is anticipated next month.

In the hearing, Mr. Hyde and his associates held that they were but using the knowledge of the prior art with skill and metallurgical knowledge. They cited particularly the Froment, Everson, and Kirby patents, and made demonstrations before the court, using amounts of oil varying from a fraction of one per cent to 25 per cent in treatment of Butte & Superior ores and producing in each case a froth. It was claimed that these demonstrations were under the terms of the Minerals Separation, Froment, Cattermole, and Kirby patents, and it was pointed out that the amounts of oil used were too small to cause bulk-oil rafting. To this, objection was entered on behalf of the Minerals Separation that the demonstration did not in fact reproduce the conditions defined by the patents cited, and furthermore that the froth produced, where the conditions departed from those of the Minerals Separation process, was not a true 'agitation-froth' but a different phenomena. It was conceded by all that the affinity of oil and oily substances for sulphides had been long known, and there seemed no disposition to

question the fact that Miss Everson discovered the usefulness of acid in intensifying the selective action of the oil. There was also no controversy over any form of film flotation or bulk-oil rafting. In the lower court much had been made of the Everson and Froment patents by Mr. Hyde and his associates. At the San Francisco hearing the Kirby patent was strongly urged as anticipating the Minerals Separation patent. This was taken out by Mr. Edmund Kirby shortly before the patent in litigation, and was based upon work done by him in British Columbia. The essential novel features were that he proposed to use a light oil, that it should be heated, and at one stage of the process he bubbled air into the mixture. He also specified violent agitation, and it is contended that this could not have been done without producing a froth, which is admitted to be the peculiar and distinctive characteristic of Minerals Separation flotation. It was also brought out that an excess of oil, in certain cases at least, did not prevent formation of a froth. They, therefore, contended that in the work at the Butte & Superior mill at Butte the metallurgists were merely using the common knowledge of the prior art with due effort to decrease consumption of oil. It was urged that in decreasing the amount of oil, Minerals Separation had not produced a new result, but had merely striven for economic efficiency, hence could not claim invention.

In reply, Minerals Separation presented an excellent and instructive history of the art. It was urged that the froth of 'armored bubbles' first produced by Mr. A. M. Higgins was a wholly new thing and not to be confused with the incomplete formation of bubbles in an excess mass of oil that was the best that could result from the Kirby process. The Froment process was illustrated, but held to be worthless, and the various bulk-oil processes were held to be uneconomical and proved by experience to be worthless in actual practice. As to the possible formation of a froth with large quantities of oil, it was urged that the so-called froth was not a true 'agitation-froth'; that it was a mass of oil in which bubbles were entrained and entrapped rather than a mass of air bubbles of which the walls were formed by sulphide particles and in which the oil was so small an element as not to be determined except by analysis. Strong emphasis was also placed upon the fact that prior art had not in fact resulted in the treatment of ore in quantity, while the Minerals Separation process went at once into actual use and had resulted in establishment of a new industry. Incidentally, it was brought out that the earlier processes made no attempt to treat slime.

It will be extremely interesting to see how the Court of Appeals rules upon this case. While minor points have been raised as to the validity of the patent, apparently the decision must rest in the main upon the court's determination whether as a matter of fact the 'agitation-froth' of the Minerals Separation process is different from the oil 'magma' of the Froment or the aerated oily mass of the Kirby and similar processes.



BUILDING THE PONTOON.

PONTOON IN PLACE.

SWIFT CURRENT.

Levee Building With Bucket Elevator Dredge Equipped With Stern Delivery Stacker

By C. G. LEESON

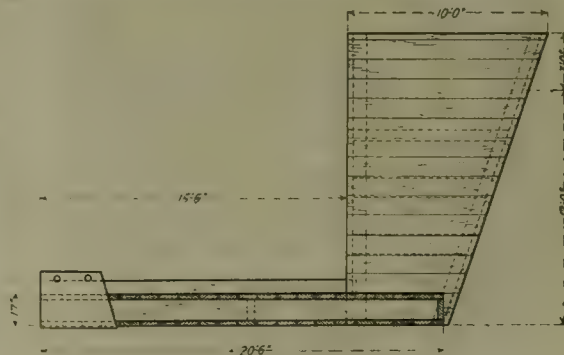
The Oro Water, Light & Power Co.'s 5-ft. gold dredge *Hunter* has just completed a strip of tailing bank 1700 ft. long on the Feather river about five miles below Oroville. The Feather at this point makes a long bend and the erosion of the south bank, due to very swift water, has encroached upon the Marysville and Oroville county road to such an extent that it had been necessary to rebuild the road close in and skirting the high bluff which borders the river. A bulkhead made of piling and three-inch plank, 20 ft. high by 800 ft. long had been built by Butte county in an attempt to turn the current away from the road. During the high water of this year this bulkhead was washed away and the bank had caved to the edge of the roadway. Another high water period would have destroyed the road and necessitated a new road on top of the bluff with consequent heavy grades.

The Oro company was moving the dredge *Hunter* to a property lower down on the river and by an agreement between Butte county, the Anti-Debris Association and the Company, an arrangement was made to dredge the bed of the river, with the understanding that all gravel recovered was to be piled upon or close to the road side of the river. It was expected that the gold recovery would pay for the operations so that

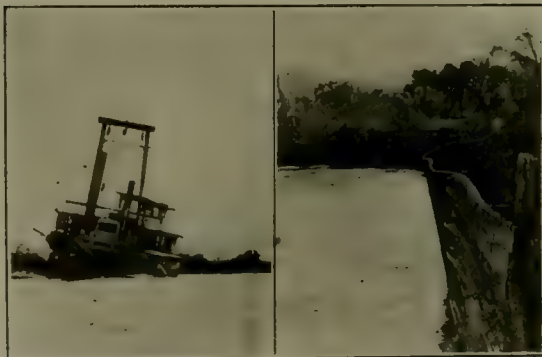
the work could be done without expense to the county. Incidentally the gold failed to materialize in paying quantity. The work was, however, done free of all charge to the county.

The original plans were made so that this work in the current would be done during low-water time, since at the point where the river approaches and parallels the county road the current becomes in flood times very swift and very dangerous. During the January flood of this year, just prior to commencing the work, the river rose 20 ft. The dredge was delayed in its progress and did not enter the river until February 1.

Due to the probability of extreme current and to the fact that the flotation of the dredge had decreased due to age and concrete repairs to the hull, so that in certain conditions of operation the free board at the stern was entirely lacking, it was decided to build a pontoon to increase the stern flotation and to decrease the current resistance of the stern. The figure below



SECTION THROUGH PONTOON.

DREDGE IN DANGER FROM
CURRENT.WOODEN BULKHEAD BUILT
TO PROTECT ROAD.

shows this pontoon as constructed. It contained 12,000 ft. of lumber and figured net 54 tons flotation. When placed and the water pumped out it raised the stern of the boat 2 ft. above its previous position. The design is such that the battered back, when the current pressed,



LEVEE AS BUILT ALONG COUNTRY ROAD.

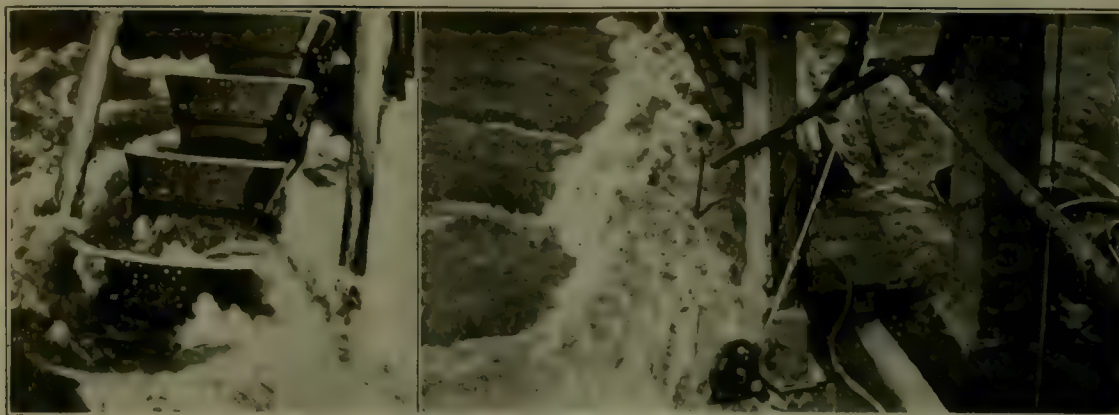
tended to elevate rather than to depress the stern. The portion which went under the hull was of such capacity as to balance the upright portion around the stern bottom corner of the hull. The width of the portion going under the hull was 7 ft. greater than the upright portion. This shelf was utilized in sinking the pontoon under the dredge. Ten tons of sand in sacks was loaded on each of these projections. The whole structure

was then pumped full of water and floated under the dredge and when in place the sand was dumped and the pontoon then hugged closely the bottom of the hull. It was leashed with cables as safety precaution.

During the high water of February 17 and 18, the river came up $13\frac{1}{2}$ ft. in 24 hours. The dredge was caught at that time in a most disadvantageous position. The current was such that the water piled up



TAILING PILE LEVEE AS COMPLETED.



BUCKETS AND DREDGE BOW OPERATING IN SWIFT CURRENT.

behind the pontoon approximately 2 ft. Had it not been for the protection and the additional flotation provided by the pontoon, it is believed by the operators, the dredge would have been swamped. A view herewith, showing the very precarious position of one of the Guggenheim dredges when moving in the current of the river and when the current rushed over the deck, is shown as of interest in this particular point.

The method of operating the dredge to build the levee or protection bank is new. The work done proves that a side delivery stacker is not necessary for work of this character. Advantage was taken of the fact that the water was of such depth on the bank side that it was unnecessary to dig flotation clearances on that side. The dredge was operated on the single-cut side-step principle. Spuds were used. The out-swing was made to a position at right angles to the bank; the in-swing to a position parallel to the bank. Bedrock was reached at varying depths from 22 to 37 ft. Under ordinary river conditions the depth of water before digging varied from a sand bar showing above water to 15 ft. deep. The dredge was 40 days in making the passage. This time included, however, seven days' shut-down while the boat was tied up, stern up stream, because the current was so swift that the side-line winch was unable to swing the boat against it. During the 40 days the dredge handled 135,000 cu. yd. Figures herewith show the character of the bank before dredging commenced: the pontoon, the swift current encountered, and the very effective protection levee built.

A new mining law has been discussed by the New Zealand Government, which includes regulations on the following: ventilation; strength of ropes used in hoisting; safety cages; the use of explosives; supply of water for laying dust made by drilling or blasting; change houses with hot and cold water, baths to be installed when demanded by a certain percentage of men; additional powers to be given to employees' inspectors employed by any miners' union at the expense of the union, such as reporting on the dangerous parts of mines; men must be immediately withdrawn from

workings containing gases; miners who have contracted fibrosis or lung troubles from dust shall be entitled to benefit from the miners' relief fund equally with men who have suffered injuries from accident; hoisting engineers must be examined annually by a medical man; and the Minister of Finance in the government is empowered to obtain not over \$96,000 per year and advance this money to mining companies for development work.

Accidents and Personal Injuries*

1. In case of accident, however trivial, or of personal injury, however slight, received or sustained in the course of duty, an injured employee must give immediate notice, or cause immediate notice to be given, to the Company. Such notice may be given by an employee to his foreman, or to the Company's surgeon, and must be given at the time of or immediately after the happening of the accident, to enable the Company to investigate the causes and circumstances of the injury, to determine whether it is accidentally inflicted, and that it renders the employee unable to perform his duties in the service of the Company.

2. All employees injured in the service of the Company must obey the surgeon's instructions in reporting for examination, using the remedies and following the treatment prescribed, and going to the hospital if directed.

3. All employees who are disabled but not confined to the house, must report in person at the surgeon's office, from time to time, as reasonably requested.

4. Failure on part of an employee to give immediate notice, as above directed, or refusal to obey the surgeon's instructions, will be deemed sufficient cause for dismissal.

Copper production of Peru in 1913 was 27,940 metric tons, made up as follows: bars, 20,340; matte, 4462; and shipping ores, 3138 tons. This is an increase of 100 long tons on the previous year.

*From the book of 'Rules and Regulations' of the Nevada Consolidated Copper Company.

Electrical Driving of Winding Engines

By C. ANTONY ABLETT and H. M. LYONS

*The use of electrical machinery for driving hoisting engines in mines and reversing rolling mill plants in steel works is comparatively recent, the first winders of importance having been introduced in 1902. The earlier winding engines were extravagant in power and had the disadvantage of drawing very heavily upon the source of electrical supply at the moment of starting. It was, therefore, impossible to use them on systems where the supply of current was limited, and even on comparatively large plants their use resulted in serious interference with other machinery. These disadvantages were, however, practically done away with when the Ward Leonard system and Ilgner's adoption of the flywheel to this system were introduced, but the past few years have seen greater improvements in the Ward Leonard and the Ilgner system. The present paper will deal chiefly with the developments of these systems by the various Siemens companies, who have installed about half the total plants in existence, and with whom the authors have the honor to be associated.

Ward Leonard System

In this system, Fig. 1, a direct current motor is used to drive the winding engine or rolling mill, the motor

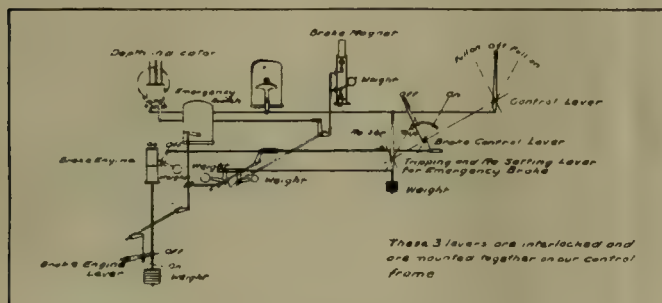


FIG. 1.

being supplied with power from a direct-current dynamo, and the essential feature of this system is that the voltage supplied to the motor, and consequently the speed of the motor, is controlled by controlling the field current of the generator, instead of by varying the resistance in the armature circuit of the motor. Thus, as the field current of the generator is increased from nothing to a maximum, the motor speeds up from standstill to full speed, and if the field current of the generator is reversed, the motor reverses its direction of rotation.

This system enables a very exact control of the

speed to be obtained, because the speed of the motor is practically proportional to the strength of the generator field, whatever the load on the motor may be, while with any control system where resistances are inserted into the armature circuit of the motor, the speed would vary within very wide limits with a change of load, rendering the exact speed control quite impossible. The control of the dynamo field involves scarcely any waste of electrical power, but where resistances are inserted into the armature circuit the loss of power may be, and usually is, very great. The field currents of the generator are small, so that the control mechanism is small, compact, and very easy to handle, the armature currents are perhaps fifty times as great, so that any control mechanism which varies the resistance of the armature circuits is large, clumsy, and difficult to handle, in fact a complicated relay system is often necessary to enable it to be handled at all.

The dynamo used to supply the motor in the Ward Leonard system is usually driven by a motor supplied from the available power circuit, forming a motor generator set, and this motor may be either direct current or three-phase, according to the power available. The dynamo may be and sometimes is driven by an engine, water turbine, or other prime mover, if this happens to be more convenient.

The main control lever for operating the winding engine is coupled to the regulating resistance in the field circuit of the generator, so that when this lever is in the mid-position there is no current in the generator field. As the lever is moved in one direction the generator field current increases, and as it is moved in the other direction the generator field current is also increased, but in the opposite sense. From what has been said in the introductory remarks it will be seen that when the lever is in the mid-position the winding engine is at

a standstill, and that it starts and speeds up as the lever is moved from the mid-position in one direction, while if the lever is moved from the mid-position the other way the winding engine increases in speed in the other direction, and that the speed of the winding engine is practically proportional to the displacement of the lever from the mid-position, and is not affected by the weight of material being hoisted.

The driver does not have absolute control over the speed, for two cams are provided on the depth indicator, one for each cage, which operate levers coupled to the control lever in such a way as to prevent the cages being accelerated at too rapid a rate, and to slow up the winding engine at the proper point so that the top is approached at a crawling speed. Pro-

*From a paper on 'Electrical Driving of Winding Engines and Rolling Mills,' read before the Canadian Society of Civil Engineers and the Canadian Mining Institute.

vided that these limits set by the cams are not exceeded, the speed of the wind is entirely within the driver's control. To slow up the winder and bring it to a standstill, the control lever is brought back toward the mid-position, thereby reducing the field current of the generator, and reducing its voltage below the voltage of the winding motor, so that the current between the motor and the generator reverses and the winding motor gives back power to the generator, thus producing a strong electric braking effect. The more rapidly the lever is moved backward toward the mid-position the stronger the electric braking effect will be.

The kinetic energy of the moving parts of the winder is converted to electrical energy and returned to the system. The lever may be brought toward the mid-position to produce this electric braking effect, either by hand or automatically by the cams, as mentioned above. The depth indicator and the cams are positively driven from the drum of the winding engine and the cams are so geared that they make less than one revolution per wind.

Fig. 2 shows the typical horse-power diagram for a

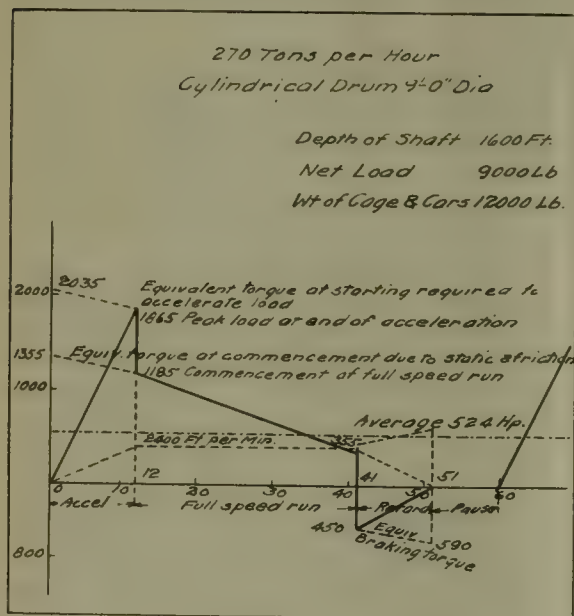


FIG. 2.

winding engine. The inertia of the drums, cages, head sheaves, material wound, and the ropes, which altogether weigh about 60 tons in this particular case, necessitate a horse-power at the end of the acceleration period of each wind of 1865, which is about three and a half times the average power demand of the winding engine, in this case 524 hp., and it is found that the maximum acceleration peak is usually between three and four times greater than the average demand.

The consumption of energy for this Ward Leonard control rises gradually during the starting period, and

the maximum is only reached at the end of the time of acceleration, from 10 to 15 seconds after the start, because the speed of the winding motor is increased while it is giving the requisite turning moment by increasing the field of the generator, and consequently there is no loss of power in starting. Since this acceleration peak is of short duration and only comes on gradually, it is possible to supply Ward Leonard winders from power stations of comparatively small total output, provided that the machines in the power station have a sufficient overload capacity to maintain their speed during peak loads, as is usually the case with steam turbo-generators where the generators are provided with modern voltage regulators.

Where, however, this is not the case, and the acceleration peaks of the winding engine are large compared with the average demand on the power station, or where the winder is supplied through a long transmission line from a distant power station, it is sometimes necessary to couple a flywheel to the motor generator set. In this case provision must be made so that during a peak load the motor generator falls in speed, enabling part of the stored energy of the flywheel to be used to supply the heavy demand, and when the load is small the motor generator set is speeded up again, the surplus power being taken to restore the energy of the flywheel, so that the demand from the power house or supply system is maintained at about the average. This is the Ilgner system, so-called after the engineer who first used it in practice.

Fig. 3 illustrates the effect of the flywheel in equal-

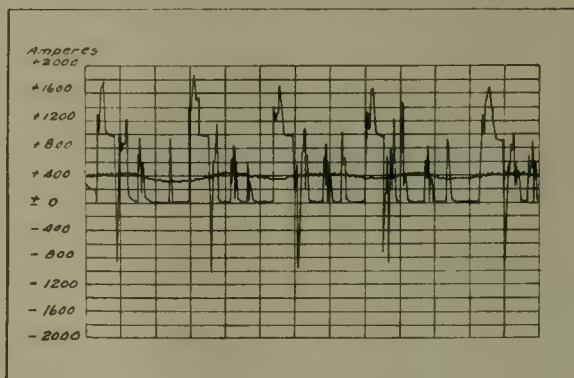


FIG. 3.

izing the load taken by the winder, where it will be seen that the current taken by the winding motor varies between +1900 and -1000 amperes, while the current taken from the supply system is maintained practically constant at 400 amperes, the maximum voltage supplied to the winding engine and the supply voltage being the same.

Three-phase motors are usually used to drive the motor generator sets supplying winding engines, and their speed can only be conveniently varied by inserting resistance into the rotor circuits, which causes a loss of power. In addition to this a certain power is

required to drive the flywheel to overcome the friction and windage loss, so that while the use of the Ilgner system prevents peak loads being taken from the supply system or power house, it entails a certain loss of power. In many cases the cost of this loss of power, which is justified by the benefit of the steady load to the supply system, which improves the economy and voltage regulation of the power house, may avoid the installation of extra plant in the power house, or where the winding engine is being supplied through a long transmission line, will enable a cheaper transmission line to be used than would otherwise be the case, and will improve the voltage regulation of this transmission line.

The Ilgner System

The following example will give an idea of the power taken by the Ilgner system under practical working conditions with a winding engine arranged to wind 240 tons per hour from a depth of 1960 ft., making as a maximum $44\frac{1}{2}$ winds per hour, where the flywheel is used whenever the full output is being wound at the full speed, but where a lesser output is being wound at reduced speed, so that the acceleration peaks become less serious, the flywheel is uncoupled to save power. These results are conveniently expressed in terms of the kilowatts taken by the electric winding engine plant per shaft horse-power.

	Output in tons per hour.	Kw. per shaft horse-power.
With flywheel	240	1.49
" "	160	1.60
" "	108	1.77
Without flywheel	160	1.35
" "	108	1.48

It will thus be seen that when working the winding engine on the Ilgner system there is an increased loss of power of from 16 to 17%, as compared with the Ward Leonard system, and naturally with the latter, where the flywheel is uncoupled, the resistances are cut out of the rotor circuit of the three-phase motor to avoid loss of power.

To avoid misunderstanding of the above results, it should be specially pointed out that shaft horse-power is taken to mean the actual work done in raising the load, that is, if the actual weight of coal or ore, expressed in pounds, which is raised per minute is multiplied by the depth of the shaft in feet, and divided by 33,000, the shaft horse-power is obtained. The shaft horse-power thus does not include the mechanical friction of the winding engine, the sheaves, the guides, or the rope losses, and the figure of the kilowatts divided by the shaft horse-power brings in the mechanical efficiency, as well as the electrical.

To enable the speed of the motor generator set to be automatically reduced so that the flywheel may give up part of its stored energy, the three-phase motor of this motor generator set must be of the slip-ring type. The slip-rings are connected to the automatic or intermittent slip regulator which inserts resistance into the rotor circuit when the speed is to be reduced. This

slip regulator usually consists of liquid resistance in which are immersed plates connected to the slip-rings, and it is operated by means of motor relay supplied by current from a series transformer connected in the circuit of the main three-phase supply, so that when the speed is to be reduced, the immersion of the plates is decreased, increasing the resistance between them, and when the speed is again allowed to rise, immersion of the plates is increased.

The series transformer is usually supplied with tapings connected to a dial switch so that the average load maintained by the slip regulator can be adjusted to the work which is being done by the winding engine.

Flywheels are usually designed to equalize the load by falling in speed from 15 to 20%, and it is found that this entails a loss of power in the slip regulator of about $7\frac{1}{2}$ to 10%. The flywheel is usually coupled to the motor generator set by means of flexible coupling, though in some very recent Ilgner motor generator sets, where there happens to be no advantage in running with the flywheel uncoupled, the electrical machines and the flywheel are arranged to be carried by two bearings only, reducing the first cost and the friction losses.

Capital Cost

Of recent years the capital cost of Ilgner plants has been greatly reduced, owing to the adoption of higher speed for the motor generator sets and to the improvements in the manufacture of such flywheels, which enable them to run at very high peripheral speeds compared with those used in the earlier winding engines. For example, the provision of flywheel capacity to equalize peak loads of 60,000 hp. seconds, in the early days of Ilgner winding, where peripheral speeds of 15,000 ft. per minute were used, would require two flywheels of a total weight of about 80 tons, the friction and windage loss of which would be about 150 hp. Under modern conditions where the regular peripheral speeds are 27,000 and 30,000 ft. per minute a single flywheel of 22 tons weight would be used, instead of the two flywheels having a total weight of 80 tons, and the friction and windage losses would not exceed 100 horse-power.

A sheet metal casing is usually placed outside the rims of the flywheel to reduce the windage loss of the flywheel to a minimum, and this is found to be sufficient for the purpose, because practically all the windage loss is caused by the outside surface of the rim, the web producing very little windage. This can be shown in a striking manner by holding a handkerchief against the web near the inner surface of the rim while the flywheel is running, there being scarcely enough wind to blow the handkerchief out.

The Ilgner system was used on practically all the early European winding engines, but as at the present day power stations are being installed of much greater capacity than those of a few years ago, and high-speed turbo generators of large overload capacity are being adopted, the Ward Leonard system at the present time

is being used to a much greater extent than the Ilgner system for winding engine work. Generally speaking, the Ilgner system of winding may be preferable to the Ward Leonard system in the following cases: (1) when the time occupied by the wind is short; (2) for vertical shafts; (3) for large outputs; (4) where the winding speed is very high.

Comparisons

The above conclusions may be considerably modified by the nature of the electrical supply. Where the power station is small or the winder is supplied through a transmission line of considerable length, the Ilgner system will be more suitable, but where the power station is large and near the winder, the Ward Leonard system is the better. Where power is being purchased from a supply company the choice of system would be very greatly influenced by the method of charging adopted by the supply company and by their regulations as to the permissible overloads and the amount of disturbances which they will permit to the regulation of their system. It is always advisable to consider each case on its own merits. Where there are a number of winding engines supplied from the same power station the Ward Leonard system would prove very suitable, because the combined effect of these winding engines working together will be to reduce the percentage of fluctuations on the power station load.

The mechanical brake is so arranged that when it is required to bring it into action it is actuated by a weight at the end of a lever, but it is normally held off the drum by an air cylinder. Under normal conditions the cams on the depth indicator actuate the control lever, so that the cages approach the top at a very slow speed. When they reach the top the driver brings them to rest by means of his control lever, and then puts on the mechanical brake to hold the cages in position by means of the brake lever. The brake lever is interlocked with the control lever, so that the driver cannot put on the brake by means of the brake lever until the control lever is at about the middle position, that is, unless the cages are moving at a comparatively slow speed.

To enable the driver to stop the winder in case of any emergency arising, a third lever, the emergency lever, is placed on the driver's platform and if this is operated it puts on the mechanical brake through the emergency gear and at the same time cuts off the excitation from the dynamo of the motor generator set. A throttle valve is fitted to the air cylinder to prevent the air from escaping too rapidly, so that if the mechanical brake is put on through the emergency gear it takes a second or two to apply it with full force, and damage would not be caused by the winding engine being pulled up too rapidly.

From what has been said above, it will be seen that the brake is applied by the positive action of the weighted lever, and if the air pressure should fail the brake is promptly put on. The armatures of the wind-

ing motor and the generator are permanently connected by heavy cables, and there are no cut-outs or switches in this circuit, so that the circuit between the armatures cannot be interrupted; electrical braking is always available as well as the mechanical brake, unless the excitation should fail. To protect the electrical machinery and the winding engine against undue overloads an overload relay is connected in this circuit between the armatures, which if brought into operation cuts off the excitation from the dynamo and puts on the mechanical brake through the emergency gear.

As mentioned above, cams are provided on the depth indicator which keep the acceleration within safe limits, and the cage is brought gradually to a slow speed by the time it reaches the top. An overwind device is provided, usually both on the depth indicator and in the shaft, which puts on the mechanical brake through the emergency gear and cuts off the excitation should the cage overwind the bank, thereby bringing the winding engine instantly to a stop. Should the air pressure or the excitation fail, the mechanical brake is put on by means of the emergency gear. If the motor generator set should speed up when a load is being lowered and energy is being returned to the system by the winding motor, either owing to the circuit breaker in the supply system coming out or to the demand for power from the system being insufficient to absorb the energy being returned to the system by the winding engine, then the excitation is cut off and the mechanical brake is put on through the emergency gear. When men are being hoisted the throw of the main control lever is limited by means of a switch on the bank, so that the winding engine cannot be run above a certain speed.

Safety Devices

Where electrical driving is adopted it is very easy to provide safety devices, and all those mentioned are designed to protect the plant against careless handling, but if the majority of safety devices were dispensed with, the Ilgner and the Ward Leonard winder would still be better protected against careless handling than the steam winder. The fact that it is impossible for an Ilgner or a Ward Leonard winder to race or run away makes it inherently safer than the steam winder.

Gold output of Indian mines in January was as follows:

	Tons.	Value.
Balaghat	3,600	\$1,424
Champion Reef	18,070	11,520
Hutti (Nizam's)	3,100	1,610
Jibutal (Anantapur)	1,010	245
Mysore	25,850	19,562
Nundydroog	7,500	6,715
Ooregum	12,908	7,758
North Anantapur	2,000	934

The output of zinc concentrate at Broken Hill, New South Wales, by flotation processes, was responsible for nearly 90% of the gain in the world's production of spelter from 1906 to 1911.

Properties of the Russian Mining Corporation

The organization of the above Company was explained in a London letter in the 'Special Correspondence' portion of this journal of February 14, 1914, and further information has been given out to the press by the directors, dealing with the properties to be developed. Among these, the Company has acquired an option on one-half of an anthracite coal mine in Central Russia, which is now being worked at a profit. It has also secured from Prince Alexander of Thurn and Taxis an option to purchase the rights of two concessions, and is at present directing operations at the two principal mines. Two engineers are now on their way to the property to decide on the first work to be done in the way of unwatering and opening the lower levels, and starting drilling work. Diamond-drills will be sent in after the opening of navigation on the Irtysh river in May; and it is anticipated that valuable information as to the extensions of ore-bodies can be obtained more quickly by boreholes than by underground prospecting. The nature of the ore-deposits lends itself to satisfactory exploration by drilling, as proved by the excellent results quickly obtained by the Russo-Asiatic Corporation on the Riddersk mine. A full geological examination of the concessions in connection with the ore occurrences will be started in May.

The Altai concessions were also described, the notes having been compiled partly from official records of

There are three principal mines of the country which give their names to the three original concessions, namely, the Zminogorsk, the Riddersk and the Zeranovsk. These, though a long distance apart, are in one general line of occurrence, northwest and southeast, and seem to exist under nearly identical geological conditions. A great number of smaller mines and prospects occur on the same general line of country. There are a number of abandoned copper mines in another parallel line nearer the Irtysh river and on the Zminogorsk concession. The ores of the mines mentioned are similar in general character and geological occurrence, but with local variations in the form of orebodies.

Zminogorsk Mines.—This property is probably the oldest, and was the most important in the country; and it is at present being worked as a gold mine. Full descriptions of this, and of some of the other mines to be mentioned, are to be found in a report made in 1869 by Von Cotta, the well recognized authority on the occurrence and origin of ore deposits. Von Cotta draws favorable conclusions as to persistence in depth of the ore-bearing vein from the fact of its proved length of over $5\frac{1}{2}$ miles. One barite body was 300 ft. long, varying from 50 to 250 ft. in thickness and worked on to over 600 ft. in depth. More recent development has shown that the underlying hornstone carries finely divided galena, zincblende, and iron and copper pyrite, with gold in profitable amount. At one time more than 1000 miners were working in one large open-cut. The portion of the ore treated for gold is reported to have yielded \$8 to \$10 gold per ton of ore by a simple process. With depth, difficulty in treatment arose; and at present a 15-stamp mill is in operation, with an experimental cyanide plant, to improve extraction, which was of late unsatisfactory, although giving returns above actual working cost. Reports of late results are encouraging. On the Zminogorsk vein about 25 mines have been worked at different times, and it seems evident from the records that on the dumps and developed underground there must be large quantities of ore, which, with an economical mining plant and modern metallurgical methods, would yield profitable returns. Recently some engineers have considered that the important ore-shoots have direct relation to certain anticlineals in the folded strata.

Zeranovsk Mines.—This group is about 150 miles south-east of Zminogorsk. It was opened in 1791, and in fifty-eight years had produced about 400 tons of silver and 10,000 tons of lead. After 1850 the production increased largely for some years. This was a very important mining centre, and had an established School of Mines at one time. The principal mine is developed quite extensively underground, where complex ores are found in depth. Estimates made in 1904 for the Rus-



the district, and partly from reports of several mining engineers, who have examined the various mines from time to time since 1845. It is stated that the original grant was of three separate concessions, covering the Zminogorsk of about 12,292 miles, the Riddersk of about 3073 square miles, the Zeranovsk concessions of about 2195 square miles. About two years ago the Riddersk was relinquished by the concessionaires, and has since been granted by the Russian government to the Russo-Asiatic Corporation, so that the property now under consideration consists of the Zminogorsk and Zeranovsk concessions.

sian government show about 150,000 tons developed and 50,000 tons on the dump. The ores were reported to contain about 22% zinc, 12% lead, 2% copper, 15 oz. silver and \$5 gold, equal to a total gross metal value of about \$48 per long ton. All the richer oxidized ore had been worked out to a depth of about 300 ft. but developments extend to 700 ft. in depth. The occurrence of the ore in the upper workings seems to have been in large lenses; but it is reported that at the bottom of the mine there are two well-defined veins of the base ore, each about 7 ft. thick, and proved over a length of fully 2000 ft., with ore at both ends. Occasional branches of rich gold-bearing quartz run off from these veins. The country rock is reported to be crystalline schist. Ore-bearing hornstone also occurs. In the neighborhood of the Zeranovsk mine there are a number of others, some carrying silver and gold, others producing more copper. There are occurrences of copper in porphyries, which may be of great value as concentrating propositions. There are more than ten abandoned copper mines in the Zminogorsk concession running in a general line northwest from the Irtysh river. They were worked irregularly during a great many years, and the ores had to be transported by horse conveyance to Barnaul, a distance of about 250 miles, in order to be smelted. All the evidence available seems to show that changes in conditions and cost of working led to stoppage of these mines, so that their reopening and development would be very advisable if smelting works are established on the Irtysh river, as is possible now that coal and coke supply is being provided for by new railway transport. Reports recently received from Zeranovsk state that the Putinzeff and Buchtarminsk mines can, with little development, be made to yield sufficient rich copper ore to justify some smelting operations with the base ores of the Zeranovsk mine.

Ore Treatment.—There seems to be no doubt as to the various mines of the two concessions being capable of yielding a large tonnage of base-metal ores containing gold and silver and, of hornstone gold particularly, while there is evidence for the future profitable working of some of the copper mines. The point of immediate importance for the starting of profitable mining is that of the treatment of the ores, since it is clear that the present idleness of the mines is due to the absence of successful reduction works and not to lack of ore. The problem of treatment requires investigation and the consideration of all local conditions. Mr. Von Gernet, who is at present acting for the Russian Mining Corporation, was employed by the Imperial Cabinet in 1910 to examine the original three concessions, with a view to reporting on the possibility of working the complex ores. Several hundred tons of ore were taken from the dumps of the Riddersk and Zeranovsk mines, and average samples of these were sent to Germany, France, England, and the United States for testing by various processes. The results were such as to satisfy Mr. Von Gernet that modern metallurgical processes would be equal to profitably working the ores

from both mines when properly situated central works were established. His conclusion as to the ore of the Zeranovsk mine was, that a working profit of about \$14 per ton would be obtainable by well-known processes, while a better system would doubtless be elaborated before long to utilize more fully the various metal contents, and so increase the profit per ton. A chlorination plant was at one time put up, but was unsuccessful. The hornstone gold ores should be susceptible of an early solution of the treatment question and should permit of extensive operations.

A cable issued at the end of last week by the Russo-Asiatic Corporation gave the assay of bore-hole C at the Ridder mine, showing an average for the 112 ft. of solid sulphide in the hole of 33.4% zinc, 17.9% lead, 1.3% copper, 12.5 oz. silver, and 9 dwt. gold per long ton, representing a gross value in Russia of nearly £16 per ton. J. P. Hutchins and E. D. McDermott are now at the Altai concessions.

Pumping at the Gold Hill Mines on the Comstock

The equipment at the C. & C. shaft of the United Comstock Pumping Association was described in this journal of August 23, 1913, by A. M. Walsh. At the Gold Hill portion of the lode, the Sturges group of mines, namely, the Crown Point, Belcher, and Yellow Jacket, are working jointly. The following description of the pumps is from the report of George S. Sturges:

The two sinking pumps above referred to are of the direct connected electrically driven type and were made by the Byron Jackson Iron Works. Each pump and motor is mounted on a one-piece cast iron base supported on a 24-in. gage track by two trucks having four wheels each and connected to base by king bolts. The complete pumps proper are made of solid acid resisting bronze and shafts are bronze covered where they come in contact with the water. Pump cases are made in two parts, the upper half can be removed without disturbing the lower part or connections. Main centre bearing between each pump and motor is grease packed and water cooled by circulating jacket. The thrust bearing on pumps, also on motors, is oil lubricated, and metallic packing is employed on upper pump bearing. Hess-Bright bearings are used on motors and are lubricated by circulating oil system. These bearings also have metallic packing. Motors are each 200 hp. and are of the squirrel cage, induction, constant speed type, requiring 440 volts, made by the Westinghouse company, while the Byron Jackson company furnished the 'heads' and bearings.

Each pump has a rated capacity of 1500 gal. under head of 315 ft., allowing for pipe friction, and makes 1200 revolutions per minute. On account of delay in getting part of the equipment, it was impossible to test installation until December 20, when one pump was run a few minutes and it was demonstrated that it could pump water considerably faster than it ran in at that

particular point, and do it while sucking the water 12 ft. along the incline. The length of suction has been doubled. The plant was not fully ready to start until December 30. A severe storm the next day interrupted the electric service to such an extent that an actual start could not be made until the year 1913 had expired.

Two 10-in. wire-wound wooden pipes are used between pumps and 14-in. wooden pipe-line which starts at the 1400-ft. station and makes connection with the old steel pipe in Crown Point drift to Sutro tunnel. Commencing at east end of this steel pipe, which is 1200 ft. long, there is 1000 ft. more of the 14-in. wooden pipe connecting with box in Sutro tunnel. There is approximately 3000 ft. of pipe between 1400-ft. station and joint incline and box in Sutro tunnel. Most of this is run through new drifts and cross-cuts or through those which were reopened and repaired.

Pumps are handled by an electric winch to which an auxiliary power may be attached for use in emergency. A hoist placed in the incline at 1300-ft. level permits handling both waste and ore through this level from the lower levels of the property.

Discovery of Zinc in America

By CHARLES R. KEYES

Notwithstanding the facts that zinc is the last of the common metals to come under the complete control of mankind and that as a chemical element the date of its recognition is scarcely 200 years back, some form or other of it, as an earth of peculiar yet distinctive composition, is known to have been in use in the arts for a period of more than forty centuries. The circumstance that Greek coinage dating 1000 to 1500 years B. C., contains a definite proportion of zinc, so large as 25% in some instances, indicates clearly that it was at this remote time utilized in alloy.

In this country the zinc industry is of so recent origin that its beginnings are still well within the memory of men living. Yet the existence of the metal appears to have been very early known. Mention of the ore for the first time seems to be almost, if not quite, as soon as that of lead. Unlike the case of the last mentioned metal zinc never had that great advantage of being sought for ammunition, the provision of which was so vital a problem to trapper and pioneer in the New World. The earliest record of the ore or metal is usually regarded as that of John Bradbury, an officer, who, investigating the resources of this country in the interests of England, traveled in 1810, through the Louisiana Purchase country, as the region west of the Mississippi river was then called. In the same year zinc was described and analysed from the Franklin furnace.

There appears, however, to be a distinct reference to an American occurrence of zinc very much earlier than any other heretofore specifically noted. In 1655 a French adventurer in the service of England, Pierre Radisson by name, and his brother-in-law, Médard

Grosielliers, visited the Indian tribes dwelling in the neighborhood of what is now Dubuque, Iowa, and spent the season in hunting and exploring mainly on Iowa soil.

Although Radisson's descriptions are very quaint they are at the same time entirely lucid. In the course of his account of the resources of the region he says that "In their country are mines of copper, pewter, and lead. There are mountains covered with a kind of stone that is transparent and tender and like that of Venice." The special mention of pewter without question refers to no other metal than zinc. It will be remembered that this term is the old English title for spelter (German and Dutch *spialter*, Dutch *pialter*, English pewter), and that the name was applied in those days to both the metal and its ore.

That Radisson's reference does not allude to any mineral but zinc is conclusively shown by a number of circumstances. Drybone is a common associate of the galena ores of the district; and it would be easily recognized as the 'pewter ore' of England with which the explorer must have been well acquainted. In Colonial days, also, pewter plate was an important possession of every pretentious household; and the finding of the substance at these mines naturally made a profound impression on an active mind, an excitement second only to that of a gold discovery.

At the time of Radisson's sojourn at the Dubuque locality lead mining had already begun. The mineral had indeed at this time been taken out during a period of more than two decades—ever since the famous visit of Jean Nicollet, in 1634, who in the interests of the fur trade had introduced fire arms among the Indians, and with them created an active demand for ammunition. A main reason for Nicollet's turning back at this point rather than going on in his great quest of the South Sea and a short route to Cathay as he had set out to do, may have been this very discovery of lead deposits affording an unlimited supply for bullets.

Of the three widely separated localities in which lead was mined in this country previous to 1650, the Dubuque field is the only one so far as is now known in which zinc ore occurs. That zinc should be thus early recognized so long before it was actually used on a large scale elsewhere is a fact of some interest.

Tonnages Through Ship Canals

The following table shows the relative business of the principal ship canals of the world in 1912:

	Tons.
Sault Ste. Marie (Soo) 8 months.....	79,718,344
Suez	20,125,120
Kaiser Wilhelm (Kiel).....	7,580,000
Manchester	5,339,884
New York State (Erie) 8 months.....	2,606,116

The two American canals are frozen during four months of the year. Suez is a sea-level canal. The Kaiser Wilhelm locks have a larger capacity than those at Panama.

The Mineral Resources of the Harney Peak Pegmatites—II

By VICTOR ZIEGLER

The general facts as to the distribution and mode of occurrence of the rare minerals of the Black Hills have already been given,* as also special descriptions of the mica and tin deposits. It remains to describe the tungsten, lithia, columbite, and minor miscellaneous minerals.

Tungsten Deposits

The first attempt to utilize tungsten ore was made in 1906, when the Reinbold Metallurgical Co. shipped three carloads of ore (mostly huebnerite) from its mine on Sunday gulch, southwest of Custer. The American Tungsten Co., organized in 1907, erected a small mill on claims about three and a half miles east of Hill City. The Company had practically no chance to produce ore, as it was almost immediately involved in lawsuits, the mill and buildings were attached by laborers' liens, and it went into the hands of a receiver. The mill was never used, and the ore broken down in 1908, much of it of good quality, is still stored in the bins. In 1913 there was organized the Black Hills Tungsten Mining & Milling Co., which erected a small plant on its claims about three miles east of Hill City, and started concentrating ore in September 1913. During the first month of production the Company produced \$3000 worth of tungsten concentrate. The Company has erected shaft-houses, a power-plant, and other improvements, and its activities will be watched with much interest by those interested in the development of Black Hills mineral resources.

All tungsten deposits of any promise occur in well defined quartz veins, similar in character to the tin veins. They are all situated north or east of Hill City, with the exception of the claim of the Reinbold Metallurgical Co. on Sunday gulch, which is situated about five miles southeast of Hill City. The more prominent claims carry wolframite as the chief tungsten mineral. Scheelite, yellow, green, or brown in color, occurs both as a primary and secondary mineral in most veins. Huebnerite is the chief mineral on the Reinbold claim. Ferberite occurs in the Petit claim, $\frac{1}{2}$ mile east of Hill City. Here the deposit is a typical pegmatite.

The Black Metal, Good Luck, Wolfram, and Great Wonder claims are similar in character. They are on quartz veins which are narrow (from 6 to 18 in. thick) and which usually occur in parallel sets. Thus the Wolfram claim shows four distinct veins of about parallel strike and about 10 to 12 inches in average thickness. They exhibit strong pinching and swelling along the strike, often showing swells from 18 to 36 in. through. This is also true of the veins on the other prospects. The quartz, which is the chief mineral, is of a gray pellucid character. It carries notable amounts

of muscovite, both well crystallized and sericitic material; occasional blades of albite; and small tourmaline needles along the contacts with the schists. Graphite occurs in minute flakes and often becomes quite abundant. The veins strike about north parallel to the schistosity of the rocks. In dip they also agree with the schistosity, varying from 50° to vertical. Some veins are quite persistent, and several have been traced 1000 feet.

Wolframite occurs in well crystallized bladed crystals, exhibiting a strong metallic lustre and a blue-black color. The blades are often coarse, $\frac{1}{2}$ to 1 in. thick and 6 to 8 in. wide. They are frequently grouped in aggregates, and some groups 12 to 15 inches in diameter were noted. In some cases the distribution of the wolframite seems to be fairly uniform, in others it is spasmodic and pockety. The value of tungsten ore, however, and its ease of concentration should entitle these deposits to a careful sampling, which will undoubtedly prove that several others are of economic value. Cassiterite occurs in the wolframite veins north of Hill City, but apparently is absent in those east of Hill City. If concentrating tests should prove it to be present, it could readily be eliminated by an electromagnetic separation of the concentrates.

No tungsten ore has been produced in the Southern Hills, with the exception noted, except about 100 tons which was shipped to Germany in 1906. What has been said as to the future of the tin deposits also applies here. A custom mill would undoubtedly be a great stimulus to tungsten mining. Careful sampling would probably show that several of the deposits could support an independent plant of small capacity.

Lithia Deposits

The lithia deposits have been mined somewhat intermittently since 1900, and for the last five or six years have been the chief source of lithia in North America. They have been described lately in some detail,⁴ and no elaborate description will be attempted here. The deposits occur in pegmatites, the more promising occurring in the vicinity of Keystone. The important lithia minerals, with their composition and theoretical lithia content, are as follows:

	Per cent.
Amblygonite, $\text{Li}(\text{AlF})\text{PO}_4$,	10.1
Lithiophyllite-Triphylite, $\text{Li}(\text{FeMn})\text{PO}_4$,	9.5
Spodumene, $\text{LiAl}(\text{SiO}_3)_2$,	8.4
Lepidolite, $(\text{LiKNa})_2[\text{Al}(\text{OH.F})\text{Si}_3\text{O}_{10}]$,	4.2 to 4.4

Spodumene was the first lithia mineral mined, and a total of about 1400 tons was produced. This mineral is present in a great number of pegmatites, and often

*Mining and Scientific Press, April 11, 1914.

⁴Ziegler, Victor, 'The Lithia Deposits of the Black Hills,' Eng. and Min. Jour., Dec. 6, 1913.



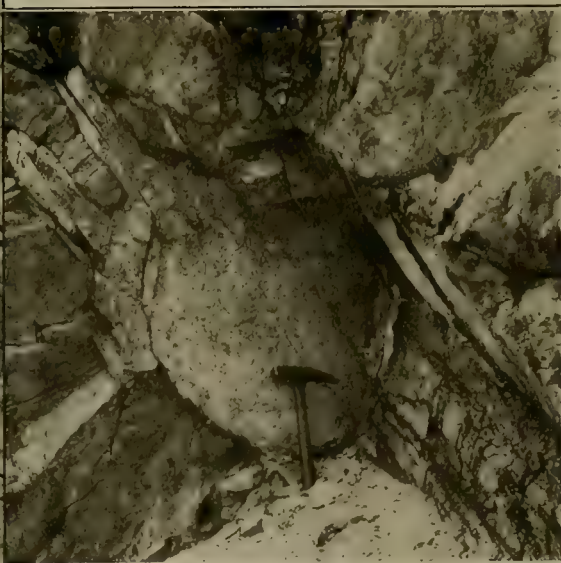
WOLFRAM TUNGSTEN MINE, NEAR HILL CITY, SOUTH DAKOTA.

in abundance. When present it is not sporadic in occurrence, but is usually evenly distributed through the pegmatites, although it favors the central zones. The crystals are often of enormous size. In the Etta mine, where they are best exposed both in the open-cut and in the tunnel, they frequently attain a diameter of three to four feet and a length of 30. The largest 'log' so far found was 42 ft. long and of 5 ft. 4 in. maximum diameter. This one log alone would yield 90 tons of spodumene. The crystals are not definitely oriented, but lie like a huge pile of logs penetrating the pegmatite in all directions. The Hugo, Wood Tin, Dyke Lode, Bull Con, and Swanzy claims, near Keystone, show spodumene in as great abundance and in as large logs on the surface as the Etta. On weathering, the spodumene loses lithia and decomposes into

a silvery or fibrous mass of a dull to silky lustre, which finally disintegrates into a loose mass of minute fibres and needles. No spodumene is mined at present.

The amblygonite occurs in nodules often of great size, but restricted in occurrence to shoots and pockets in the pegmatites. Individual nodules 1000 lb. in weight are common. The masses are white in color, fairly heavy (sp. gr. 3.2), have poor cleavage and a vitreous lustre. The Hugo, Peerless, and Bob Ingersoll mines near Keystone have been the most active producers, while the Beecher (Bond) mine near Custer, the Tin Queen near Oreville, and the Nichols mine, near Hayward, have produced smaller amounts. The Hugo mine is actively worked at present by open-cut methods.

Lithiophylite occurs in disseminated nodules much like amblygonite, but the nodules are of smaller size and are more regular in occurrence and distribution. They are brown to brownish black in color, possess poor cleavage, are fairly hard and heavy. They are frequently coated with a deep purple-red alteration



OPEN CUT, HUGO MINE. EVERYTHING BETWEEN THE WALLS OF THE CUT AND THE TWO CROSSES IS AMBLYGONITE.

CROSS-SECTION OF SPODUMENE LOG, ETTA MINE.

product—purpurite, a phosphate of iron and manganese. A number of pegmatites carry this mineral, in fact it is almost universally present. The Lost Bonanza (now Mica King) and the Dyke Lode have produced about 100 tons at various times. It will probably take the place of amblygonite when these deposits are exhausted.

Lepidolite is quite widely distributed, but important only at the Peerless and Bob Ingersoll mines. It is green, lavender, purple, colorless, or brown in color. A mass of purple lepidolite 5 by 6 by 2½ ft. is exposed in the Bob Ingersoll mine. The lepidolite at the Peerless mine is green in color. Micaceous aggregates two to three feet in diameter are common in both mines. None has been produced as a source of lithia. The total production of lithia minerals up to September 1913 and the approximate value are as follows:

	Tons.	Value.
Spodumene	1400	\$ 30,000
Amblygonite	2800	110,000
Lithiophyllite	100	3,000
Total		\$143,000

Columbite-Tantalite

The tantalate and niobate of iron are only of importance in pegmatite about Keystone. Here they occur in the Etta, Bob Ingersoll, Peerless, Hugo, and in lesser amounts in a number of other claims. These minerals usually occur in irregular shoots or pockets consisting of aggregates of muscovite, lamellar albite, and quartz. The columbite is in small tabular crystals of iron-black color, and a dull metallic lustre, usually enclosed in the albite. The crystals average less than an inch in diameter, but occasional rich streaks are found showing crystals 6 to 8 in. wide. The crystals are usually deeply striated.

Aggregates weighing several hundred pounds have been found at several claims such as the Hugo, Peerless, and Etta, while a mass over 2000 lb. in weight was found at the Bob Ingersoll claim.^a The niobium constant in 25 specimens analyzed, varied from 3.57 to 57.32%, while the tantalum varied from 10.93 to 82.23%.^a These minerals are mined only incidentally as by-products. Probably two tons of picked columbite are at present held by several miners near Keystone.

Miscellaneous

Uranium minerals, such as uraninite, torbernite, and autunite, occur in a number of pegmatites, but apparently nowhere in abundance. Bismuth minerals, as native bismuth, bismuthinite, and tetradyomite, occur. Especially interesting is the occurrence of such minerals in ladder veins in a pegmatite on the Cobalt claim near Bismuth. There is not enough ore to be of importance. Beryl is quite common in large-sized masses

in a number of pegmatites near Keystone, and could be produced quite cheaply should a market arise. That this is likely is shown by the increasing interest in methods for the cheap extraction of beryllium. Feldspar could also be produced at low cost from a great number of pegmatites. So far the markets are in the East and the demand is readily met by producers in Pennsylvania, Maine, and New Hampshire. Apatite, together with other phosphates, might be incidentally recovered and would probably find a ready market for use as a fertilizer. Rose quartz of fine depth of color occurs in several pegmatites. It has been mined to some extent, and found of use as a semi-precious stone. The only important producer has been Scott's claim, near Custer. Appreciable percentages of monazite are reported from placers near Harney Peak.

Ore Treatment at the Champion Reef Mine, India

The following notes are from the annual report of the superintendent, Henry J. Gifford, and cover the general work done during the period ended September 30, 1913:

'Rock' extracted from the mine, tons.....	277,336
Waste sorted out, tons	56,825
Ore milled, tons	220,511
Stamps working, average	140.3
Gold by amalgamation, fine ounces.....	95,756
Recovery by amalgamation, per cent.....	78.8

The pulp leaving the batteries assayed \$2.32 per ton. It has been decided to install a classifying plant and two tube-mills, in order to separate and grind the coarse portion of the pulp. This will increase the work for the filter plant, which is of sufficient capacity to handle the extra quantity.

No. 1 cyanide plant, with the addition of a Butters vacuum-filter, has treated nearly all of the sand and slime produced by the stamp-mill, in addition to 23,843 tons of accumulated slime. The filter-plant has done excellent work, and the average residue from 40,715 tons of slime treated was 16c. per ton. Results at the two plants were as follows:

	Sand.	Slime.
Material treated, tons	197,685	40,715
Before treatment, per ton.....	\$2.40	\$1.52
After treatment, per ton	\$0.88	\$0.16
Recovery, per cent	62.6	88.9
Cyanide consumption, pounds per ton.....	0.661	0.730
Zinc consumption, pounds per ton.....	0.092	0.092

No. 2 cyanide plant treated 101,187 tons of old sand and slime, averaging \$2.76 per ton, with a recovery of 49.4%. The chemical consumption was 0.614 lb. of cyanide and 0.084 lb. of zinc per ton treated. Reserves of old tailing amount to 275,280 tons. Total returns from the mill and cyanide works was worth \$2,528,000.

Copper concentrate produced in December by the Elmore vacuum plant at the Sulitjelma mine, Norway, amounted to 620 tons.

^aBlake, W. P., *Am. Jour. Sci.*, 3d series, XXVIII, pp. 340-341 (1884).

^aHeaden, W. P., *Am. Jour. Sci.*, 3d series, XLI, pp. 89-102 (1891).

Slime Treatment at Broken Hill

*Among Broken Hill's metallurgical achievements of the past year is the successful establishment of the 'Horwood' process for the separation of the constituent metals contained in slime (the invention of E. J. Horwood), and this was accomplished at the works of the Zinc Corporation at Broken Hill, where a plant having a capacity of about 500 tons per week has been in regular operation for about six months, treating current and accumulated dump slimes.

The slime is derived from the material being treated in the main flotation plant, being the finest portion of the floated sulphides—too fine for separation by ordinary concentration. This material was formerly sold for shipment to Europe, but being a mixture of both zinc and lead sulphides, is too rich in lead and poor in zinc to command a satisfactory price from the buyers of zinc concentrate, much of the combined lead and silver being lost in the course of roasting and distilling, and owing to the high zinc content the material is not acceptable to buyers of lead concentrate by reason of the high cost of smelting such refractory material, apart from the question of the sacrifice of the zinc such a sale would involve.

The importance of separating this material into two products, one suitable for zinc distillation, and another for sale to lead smelters—was recognized by the Zinc Corporation; and as the Horwood process had given satisfactory results on a small scale, it was decided to exploit the process on a larger scale, and this was done, first by sending 100 tons of slime to be roasted at Ballarat, and subsequently separating the material in the Corporation's experimental flotation plant at Broken Hill, and secondly, by erecting at the Zinc Corporation works a full-sized unit, including the requisite roaster as an adjunct of the treatment plant.

This plant comprises, first, the requisite receiving tanks for the slime (which is pumped in a 4-in. pipe from the dump or gravitates from the treatment plant), and a 7-ton filter-press in which the slime is dewatered and washed for the removal of soluble salts, which latter operation has a most important bearing on the subsequent treatment, enabling, as it does, the separation to be effected with a much lighter roast, and at the same time causing the silver content to follow the lead. The value of this feature is recognized when it is remembered that under the ordinary lead smelting contract the silver is paid for in full, whereas the silver in the zinc concentrate is subject to heavy deductions.

After the washing, compressed air is turned on for a short time to drive off further water before opening the press, and this permits the cakes to be discharged sufficiently dry to crumble to a large extent on dropping through the grizzly bars set under the

press. Belt conveyors deliver the material to an elevated storage bin, at the bottom of which is a triple-screw automatic feeder regulating the feed to the roaster.

The roaster is of the Edwards duplex type, with 12 panels and 48 rabbles, measuring 102 ft. long by 14 ft. wide. Three small fireboxes on each side furnish the necessary extraneous heat, but as the ore generates heat while being roasted, the fuel consumption is very small, as will be understood when it is stated that the operation does not require the material to even glow, so low can the temperature be kept. The requisite draft is afforded by a small fan which gives absolute control under every possible condition of the atmosphere.

The roasted ore is automatically conveyed to the receiving tank constituting the main storage for the solution used in the subsequent flotation process. This tank is built at such a level that any leakage from the flotation plant will gravitate to the storage tank, where the slime is kept in suspension by slowly revolving arms.

A centrifugal pump takes the pulp from this tank and delivers it to the flotation plant, where the zinc content is floated and recovered as a high-grade zinc concentrate, low in silver and lead, while the lead and most of the silver, having been deadened to flotation by the roasting, remain unfloated and are recovered as a lead smelting product rich in silver.

Typical actual plant results of the process are as follows:

	Zinc, %	Lead, %	Silver, oz.
Feed to roaster	40.4	14.6	21.4
is divided into—			
Zinc concentrate assaying	48.7	5.2	11.6
and—			
Lead residue containing	10.2	44.2	54.6

The grade of the lead is dependent on the amount of gangue present in the original feed.

The separate products gravitate to tanks connected with the filter-presses which promptly remove the solution and enable the products to be despatched to the seaboard without further handling or delay.

The advantage of this process, more especially in regard to material derived wholly or partly from dumps, lies in the fact that the zinc is selectively floated and not the lead. When slime is dumped, the lead content rapidly oxidizes, though the zinc is very slightly affected, and while only a very incomplete selective flotation of the lead can be effected in the case of dump slime, much more of the lead can be floated if this be done simultaneously with the easily floatable zinc: owing to the clots assisting in the flotation of the feebly floatable lead.

A further inherent advantage in preferential floating of the zinc is that the surfaces of the particles of

*Abstract from *Australian Mining Standard*.

zinc sulphide which have been tarnished by oxidation are instantly brightened on immersion in acid solutions, whereas the acid has no effect on the oxidized coating of the leady particles—the importance of this feature as emphasizing the advantages of preferentially floating the zinc will be realized when it is remembered that bright surfaces are essential to a successful flotation.

It follows that higher recoveries of the lead and silver can be obtained from material containing dump slime by first floating both the sulphides, when the maximum possible flotation of semi-oxidized lead and silver can also be obtained, and afterward submitting the mixed concentrate to a preferential zinc flotation process, than is possible if the material be first submitted to a lead selective process. In addition, the grade of the zinc concentrate will be much higher in the former case than in the latter, owing to the fact that after applying the lead selective process to the material a considerable quantity of the feebly floatable leady particles will be floated when the subsequent flotation of the zinc is being effected, the readily floated bright zinc particles mopping up much of the tarnished feebly floatable leady particles, and reducing the grade and consequent value of the zinc concentrate, while sacrificing lead and silver for which very small payments are made when accompanying a zinc.

This process having been successfully tried out and established on a large scale on Broken Hill slime, there is every reason to expect still greater success on such complex pyritic sulphides as occur so abundantly in Tasmania, as both the laboratory tests and the tests made in the experimental plant in Victoria, where the Horwood process was first tried on a working scale, showed the Tasmanian ores to be more easily treated than Broken Hill slimes.

Tests made on Tasmanian ores show that 85 to 90% of the zinc can be recovered as a high-grade zinc concentrate, assaying 57 to 58% zinc, while the same percentage of the lead contents can be recovered in a separate product along with the iron contents of the ore, in a form which makes the material practically self-fluxing.

Production of Explosives in 1912

By ALBERT H. FAY

*The total output in the United States was 489,393,131 lb., equal to 244,696 short tons. The quantity used may be classified as follows:

	Coal mining, pounds.	Railway con- struction, etc., pounds.	Other purposes, pounds.
Black blasting powder	187,090,995	18,533,000	24,669,374
High explosives	20,903,430	89,703,081	123,862,981
Permissible explosives	18,150,618	4,668,399	1,811,253

There was 534,466,580 short tons of coal mined in 1912, consuming 226,142,043 lb. of explosives, or 2.36

*Abstract from Technical Paper 69, Bureau of Mines, Washington.

tons per pound used. The fatalities due to explosives were 133, or 0.59 per 1,000,000 lb. used.

The following table shows the amount of explosives, excluding exports, manufactured and used in the various states in 1912:

	Black blast- ing powder, pounds.	High explosives other than permissible, pounds.	Per- missible explosives, pounds.
Alabama	5,277,375	4,542,192	3,856,130
Alaska	•	•	•
Arizona	•	•	•
Arkansas	2,776,800	1,169,946	•
California	•	•	•
Colorado	2,668,300	7,268,790	656,858
Connecticut	921,325	677,759	5,600
Delaware	•	79,426	•
District of Columbia	•	•	•
Florida	91,950	1,770,182	•
Georgia	694,925	1,238,907	•
Idaho	296,200	3,749,470	•
Illinois	36,674,290	5,879,767	746,094
Indiana	12,503,525	2,634,435	•
Iowa	8,683,375	1,439,367	•
Kansas	11,262,555	2,417,112	63,350
Kentucky	6,435,150	2,629,495	292,933
Louisiana	•	877,813	•
Maine	157,225	666,305	•
Maryland	651,200	1,248,727	14,450
Massachusetts	126,650	1,579,630	•
Michigan	544,225	23,694,970	•
Minnesota	5,549,725	10,647,442	•
Mississippi	13,050	521,245	•
Missouri	4,334,750	17,262,890	•
Montana	3,306,050	•	•
Nebraska	152,475	217,310	•
Nevada	•	•	•
New Hampshire	51,162	266,503	•
New Jersey	•	1,976,054	•
New Mexico	1,178,250	1,798,225	•
New York	926,125	14,474,767	196,375
North Carolina	628,325	1,358,762	•
North Dakota	329,000	197,275	•
Ohio	7,565,700	6,639,698	36,550
Oklahoma	5,192,225	1,687,862	350,200
Oregon	•	4,070,160	•
Pennsylvania	72,199,900	32,059,187	8,108,612
Rhode Island	•	197,350	•
South Carolina	•	340,327	•
South Dakota	104,500	1,756,515	•
Tennessee	4,656,700	3,824,012	198,790
Texas	2,025,775	1,750,382	27,131
Utah	1,551,825	4,385,460	•
Vermont	340,062	270,250	•
Virginia	3,904,725	3,012,704	134,900
Washington	•	7,117,330	•
West Virginia	12,648,150	4,323,135	3,072,095
Wisconsin	250,300	5,303,415	143,150
Wyoming	3,078,275	199,275	95,700
Not segregated	10,541,250	45,247,664	6,631,352
Total	230,293,369	234,469,492	24,630,270

*Represents the product of only one or two manufacturers, and is included in item 'not segregated.'

Forty milligrams of radium bromide was sold in December by the Radium Hill Co., whose laboratory is at Sydney, New South Wales. The mine is in South Australia.

Geology of the Chisana District, Alaska

The bedrock of the district is shale and slate with some intrusives. It has long been known that this region was mineralized (see *Bulletin* 417 of the U. S. Geological Survey), and both copper and gold-bearing lodes have been long known to occur in this general region. The shallow gravels are without doubt of post-Glacial age, but some of the deeper and bench



TRAILS TO CHISANA (AFTER CAIRNES).

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A subsidiary company, called the Nechi Mines (Colombia), Limited, is to be formed by the Oroville Dredging Co. to take over 400 acres of ground recently acquired in Colombia. It is proposed to construct a 9-ft. dredge of 40,000 cu. yd. weekly capacity, at a cost of £36,000. The new Company is to have a capital of £140,000, divided into 140,000 25% preference shares of 10s. each, and 14,000 ordinary shares of 10s. each.

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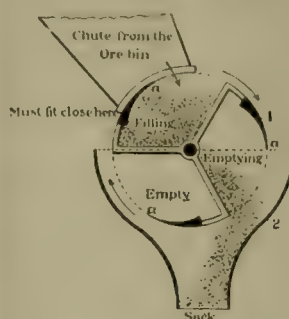
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Filling Ore Sacks

By T. R. ARCHBOLD

Filling ore sacks by hand, when a considerable number have to be done, is a slow process, and expensive in labor, and the machine described and illustrated was designed with a view to reducing the number of men employed and making the work as nearly automatic as possible.

It consists of two parts. A drum (1) divided into six compartments, each compartment holding exactly a sack of ore, revolves in a hopper (2) which is divided in the middle, allowing three compartments to empty out of each side into the sacks. The diagram will make the principle of operation clear. The machine as made will fill two sacks at a time, but, of



course, the drum could be made longer, and three or more filled. The ore passes from the ore-bin through a chute which must fit snugly on the circumference of the drum. Each compartment of the drum is half closed, and the edge of the portion closing it is reinforced with a knife-edge (a) of hard steel. A lever for turning the barrel is fixed on a ratchet. As the lever is depressed, the full compartment empties into the sacks and the next two compartments fill. The bottoms of the sacks rest on a small car, running on a slightly inclined track. The sacks are slipped off the hopper and the car is released by pulling the catch in the middle, when it runs a few feet to where the sacks are being sewn.

The machine has given every satisfaction, and I think that 360 sacks per hour can be filled with three men, a task which used to take 15 men when working with shovels. It is an advantage to know that all sacks contain exactly the same quantity of ore. The only disadvantages I have found are: (1) if the ore has been some time in the bin during wet weather, it packs and delays the work, but this, after all, is the case with all bins; and (2) it will not take large stones, as they jamb between the chute and the drum. The knife-edge obviates this to a great extent, but I found it necessary to put a 'grizzly' above the bin, with bars 1.3 in. apart, and have had no trouble since. In any case, it is not advisable to put large stones in the sacks, because they are almost sure to tear them in transit.

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Discussion

Readers of the MINING AND SCIENTIFIC PRESS are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment. Insertion of any contribution is determined by its probable interest to the readers of this journal.

A Puzzle in Sulphide Enrichment

The Editor:

Sir—By the oxidation of pyrite and chalcopyrite, sulphuric acid and ferric and cupric sulphate are formed. Pyrrhotite, alabandite, and sphalerite when brought in contact with acids generate hydrogen sulphide gas, which has been supposed to precipitate secondary sulphides. Since the acidity of descending solutions decreases with depth, the generation of hydrogen sulphide gas may reasonably be supposed to be confined to the zone of oxidation where sulphuric acid, ferric and cupric sulphate are generally present. It is interesting to note, however, the fact pointed out by F. F. Grout in *Economic Geology* (Vol. 8, p. 415) that in a mixed solution of cupric and ferric sulphates, pyrrhotite and sphalerite cease to be active generators of hydrogen sulphide gas, while alabandite does not.

In an experiment, ferric and cupric sulphate solutions were put in three test-tubes, and in tube A pyrrhotite, in tube B sphalerite, and in tube C alabandite were placed and set aside for a week. No change was observed in tubes A and B. In tube C, in which alabandite was placed, it was noticed that copper sulphide was precipitated and that the pyrite and chalcopyrite were coated with chalcocite and bornite respectively.

Although alabandite has recently been found to be intimately associated with galena, yet it is known to be rather of rare occurrence in sulphide ore deposits, and does not seem to play an important part in the rôle of secondary sulphide enrichment. The experimental fact appears to show that the presence of cupric sulphate inhibits the generation of hydrogen sulphide gas, and it is difficult to see why hydrogen sulphide gas causes precipitation of secondary sulphide in the zone of oxidation, unless alabandite is present.

GEO. S. NISHIHARA,

University of Minnesota, April 8.

Relative Efficiency of Sodium and Potassium Cyanide

The Editor:

Sir—In studying Mr. Butters' valuable figures on relative efficiency of the two cyanides, published in the *Mining and Scientific Press*, March 28, I am not able to reconcile the figures with his conclusions as to relative difference of cost. In order to derive the additional cost due to using sodium cyanide, he evidently intends to get the additional cost of an equal amount used, on the relative costs per pound of 22c. and 17c., respectively, and add to this the cost of half a pound

of sodium cyanide (presumably the excess shown by the figures, though this is really 0.47 lb.). He therefore multiplies 30% by 17 and obtains 5c. Should this not also be multiplied by 2.17, the amount of potassium cyanide being compared, making 11c. instead of 5c., and making the loss per ton of ore, due to using sodium cyanide, equal between 21 and 22c. instead of 16c. as given by him? Perhaps I am mistaken. I hesitate to question figures by such an eminent authority, and if mistaken, should like to have the matter explained for my benefit. It seems to me, however, that my contention is borne out by simply comparing the totals of the amounts used per ton each multiplied by the prices given per pound, namely, 2.64 lb. at 22c. = 58.3c.; 2.17 lb. at 17c. = 37c.; the difference being 21 per ton in favor of potassium cyanide. If this is correct, what is the need of the complex method used of going this comparison? Indeed, in using sodium cyanide always treat it as 130% potassium cyanide for practical purposes, using 0.77 lb. of it in place of 1 lb. of potassium cyanide called for in regular tests, the standardizing being done with pure potassium cyanide and deriving the loss in terms of 100% potassium cyanide. This is the unit on which the price is based, and forms a convenient unit throughout. It is like the relative merits of the gold and silver monetary standard. There must be some standard, but it matters little which is made the standard.

Regarding relative merits of the two, my experience has been that the sodium salt should never be adopted until the ore has been tested in a run with each salt, other conditions being kept the same. I never have seen a case where it gave better results. I have alternated in certain cases from one to the other with no apparent difference in extractions, and in one notable case, where the mistake was made of ordering a carload of the sodium cyanide in starting a new plant, it was impossible to reach, as I remember, within 10% of the extractions indicated in the experimental mill, where potassium cyanide was used, until a supply of the potassium salt was obtained on a rush order. The extractions immediately responded by jumping up to where they belonged. This was at the plant of the Rossland Power Co. at Trail, B. C., working a tailing from concentration of Rossland ore. The physical conditions governing settling had to be observed very closely, owing to the presence of much hydrate slime, settling action prior to agitation having had to be carefully avoided. No lime could be added to them before extraction was obtained, without reducing it by 20% or more. In laboratory tests with the two salts there seemed to be a slightly greater settling with the sodium cyanide, but it was so slight that it hardly warranted us in assuming that as the cause of no extraction. Is it not a fact generally recognized among chemists that the potassium salts are as a rule more active chemically than the sodium? In nearly all chemical works where reference is made to the use of one or the other, in a given case the potassium salt is

I think, generally given the preference. This may account for the greater extraction in most cases when potassium cyanide is used. The evidence is complicated by the fact that much of what we in the United States have used as potassium cyanide is only the sodium salt, diluted, so if the metallurgist switched one to the other in this case, there would be no apparent difference in extraction, as the sodium salt would be used in each case. It may be that cases where a difference between the extractions have been observed are those where a real comparison of the salts obtained through the potassium cyanide being the real thing. It may be that the foisting of diluted sodium cyanide on the operators in America has been the cause of a considerable financial and national loss through imperfect extractions. This in part is to be blamed on the tinkered up tariff schedule that charged a higher duty on the sodium salt, making it an object to perpetrate fraud, not only on the Government, but on the public.

It is not likely to be continued now that the duty has been removed from both, but it behooves operators everywhere to look carefully into this question, beginning the investigation with a determination of the metal content of their salt if supposedly potassium cyanide is used, and if the sodium salt is used to try out the other salt in comparison. I believe that in a majority of cases the conclusions will agree with Mr. Butters' Divisadero results: that the potassium salt will give greater extraction at a less cost. In his case, taking the last four years, two with one and two with the other, the sodium cyanide shows 1.85 lb. against 2.05 lb. of potassium cyanide, which, at the prices given, shows a financial advantage of 6c. per ton in direct saving, and over 3% better saving in gold.

C. M. EYE.

Los Angeles, April 2.

What Is the Matter With Prospecting?

The Editor:

Sir—I have followed prospecting for a great many years; finding prospects and earning grubstakes to develop them. The fact that "there is plenty of money" to develop prospects is undoubtedly true, but those prospects must be sufficiently developed to show an amount of ore in excess of the price offered, and then the prospector must wait from one to two years for the cash. The old custom of people with money 'taking a chance' to develop a good iron-cap or other promising lode is past; we prospectors must show the 'goods' or there is no trade. The time when we could sell a reasonably fair prospect for a few hundred dollars, and then move on to find another, is gone. Now we have to find the prospect, then go and earn our own grubstake by wages, and develop our claim. Hence it takes years, where before it took months. The money available seems to be in the hands of the big mining companies, and they buy on a 'sure thing' margin. This condition of 'sure thing' buying is

caused by the mining engineers employed by the companies. Their jobs depend on their ability to pick paying properties, and they therefore turn down many otherwise good claims. There is plenty of interest, but it seems to be centred around the big concerns.

Personally I would not care to be placed on the government payroll. I would rather sell a claim once in a while. The Government might extend the service of the Geological Survey by producing reports sooner and by examining and reporting on mineral claims for prospectors, should they so desire. As a rule, prospectors are too poor to hire mining engineers, and a report from the Geological Survey would aid greatly in selling, or perhaps satisfy the prospector that the claim is no good and that therefore he need waste no more time on it. The apex law as it now stands looks good to me, though I think it well to enlarge the claims to 1500 ft. square, which would do away with a great many cross-claims, from which much litigation arises, and also provide more timber for mining. Government aid in building trails and roads would be greatly appreciated, also assay offices where assays could be procured at cost, if not free.

Of course, the 'wild-catter' is largely responsible for the falling off in prospecting, and, too, I have been told that "there are more failures in mining from mismanagement than from lack of mineral," which has a large bearing on selling prospects—perhaps larger than any other cause.

J. C. STUTZ.

Danville, Washington, February 18.

The Editor:

Sir—One of the writers on this subject says: "The nomadic prospector, with his shovel, pick, pan, and a sack of grub, on a burro, is largely of the past," and it is not worth while trying to revive him; yet an item in a Portland paper of January 21 says: "The usual winter influx of argonauts, prospectors of the good old golden days of placer mining, is scattered along the Rogue river with pick and pan, striving for a grubstake, and still looking forward to striking it rich." There are still Klondikes, Iditarods, and Chisanas to be discovered; other Tonopahs and Goldfields will be opened up; as also more High Grades and Buffalo Humps will put temporary dampers on the enthusiasm of nomadic prospectors. In the United States, notwithstanding statements to the contrary, there are still vast areas of virgin ground, immense territories practically unscratched; northern California, Oregon, southern Idaho, northern Nevada, and much of the southeastern states is still open to the search. Northern Canada, the Labrador country, and northern British Columbia are practically unknown; Siberia, China, and Tibet have never been prospected, and millions of square miles of Africa have scarcely been entered. Who is to be the pioneer in the great task of opening up these districts to exploitation and improvement but the man who takes his life in his hands,

zinc sulphide which have been tarnished by oxidation are instantly brightened on immersion in acid solutions, whereas the acid has no effect on the oxidized coating of the leady particles—the importance of this feature as emphasizing the advantages of preferentially floating the zinc will be realized when it is remembered that bright surfaces are essential to a successful flotation.

It follows that higher recoveries of the lead and silver can be obtained from material containing dump slime by first floating both the sulphides, when the maximum possible flotation of semi-oxidized lead and silver can also be obtained, and afterward submitting the mixed concentrate to a preferential zinc flotation process, than is possible if the material be first submitted to a lead selective process. In addition, the grade of the zinc concentrate will be much higher in the former case than in the latter, owing to the fact that after applying the lead selective process to the material a considerable quantity of the feebly floatable leady particles will be floated when the subsequent flotation of the zinc is being effected, the readily floated bright zinc particles mopping up much of the tarnished feebly floatable leady particles, and reducing the grade and consequent value of the zinc concentrate, while sacrificing lead and silver for which very small payments are made when accompanying a zinc.

This process having been successfully tried out and established on a large scale on Broken Hill slime, there is every reason to expect still greater success on such complex pyritic sulphides as occur so abundantly in Tasmania, as both the laboratory tests and the tests made in the experimental plant in Victoria, where the Horwood process was first tried on a working scale, showed the Tasmanian ores to be more easily treated than Broken Hill slimes.

Tests made on Tasmanian ores show that 85 to 90% of the zinc can be recovered as a high-grade zinc concentrate, assaying 57 to 58% zinc, while the same percentage of the lead contents can be recovered in a separate product along with the iron contents of the ore, in a form which makes the material practically self-fluxing.

Production of Explosives in 1912

By ALBERT H. FAY

*The total output in the United States was 489,393, 131 lb., equal to 244,696 short tons. The quantity used may be classified as follows:

	Coal mining, pounds.	Railway con- struction, etc., pounds.	Other purposes, pounds.
Black blasting powder	187,090,995	18,533,000	24,669,374
High explosives	20,903,430	89,703,081	123,862,981
Permissible explosives	18,150,618	4,668,399	1,811,253

There was 534,466,580 short tons of coal mined in 1912, consuming 226,142,043 lb. of explosives, or 2.36

*Abstract from Technical Paper 69, Bureau of Mines, Washington.

tons per pound used. The fatalities due to explosives were 133, or 0.59 per 1,000,000 lb. used.

The following table shows the amount of explosives, excluding exports, manufactured and used in the various states in 1912:

	Black blast- ing powder, pounds.	High explosives other than permissible, pounds.	Per- missible explosives, pounds.
Alabama	5,277,375	4,542,192	3,856,130
Alaska	*	*	*
Arizona	*	*	*
Arkansas	2,776,800	1,169,946	*
California	*	*	*
Colorado	2,668,300	7,268,790	656,858
Connecticut	921,325	677,759	5,600
Delaware	*	79,426	.....
District of Columbia	.....	*	.....
Florida	91,950	1,770,182	*
Georgia	694,925	1,238,907	*
Idaho	296,200	3,749,470	*
Illinois	36,674,290	5,879,767	746,094
Indiana	12,503,525	2,634,435	*
Iowa	8,683,375	1,439,367	*
Kansas	11,262,555	2,417,112	63,350
Kentucky	6,435,150	2,629,495	292,933
Louisiana	*	877,813	*
Maine	157,225	666,305	.....
Maryland	651,200	1,248,727	14,450
Massachusetts	126,650	1,579,630	*
Michigan	544,225	23,694,970	*
Minnesota	5,549,725	10,647,442	*
Mississippi	13,050	521,245	.....
Missouri	4,334,750	17,262,890	*
Montana	3,306,050	*	*
Nebraska	152,475	217,310	.....
Nevada	*	*	*
New Hampshire	51,162	266,503	.....
New Jersey	*	1,976,054	*
New Mexico	1,178,250	1,798,225	*
New York	926,125	14,474,767	196,375
North Carolina	628,325	1,358,762	*
North Dakota	329,000	197,275	*
Ohio	7,565,700	6,639,698	36,550
Oklahoma	5,192,225	1,687,862	350,200
Oregon	*	4,070,160	.....
Pennsylvania	72,199,900	32,059,187	8,108,612
Rhode Island	*	197,350	*
South Carolina	*	340,327	.....
South Dakota	104,500	1,756,515	.....
Tennessee	4,656,700	3,824,012	198,790
Texas	2,025,775	1,750,382	27,131
Utah	1,551,825	4,385,460	*
Vermont	340,062	270,250	.....
Virginia	3,904,725	3,012,704	134,900
Washington	*	7,117,330	*
West Virginia	12,648,150	4,323,135	3,072,095
Wisconsin	250,300	5,303,415	143,150
Wyoming	3,078,275	199,275	95,700
Not segregated	10,541,250	45,247,664	6,631,352
Total	230,293,369	234,469,492	24,630,270

*Represents the product of only one or two manufacturers, and is included in item 'not segregated.'

Forty milligrams of radium bromide was sold in December by the Radium Hill Co., whose laboratory is at Sydney, New South Wales. The mine is in South Australia.

Geology of the Chisana District, Alaska

The bedrock of the district is shale and slate with some intrusives. It has long been known that this region was mineralized (see *Bulletin 417* of the U. S. Geological Survey), and both copper and gold-bearing lodes have been long known to occur in this general region. The shallow gravels are without doubt of post-Glacial age, but some of the deeper and bench

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What Is the Matter With Prospecting?

The Editor:

Sir—I have followed prospecting for a great many years; finding prospects and earning grubstakes to develop them. The fact that "there is plenty of money" to develop prospects is undoubtedly true, but those prospects must be sufficiently developed to show an amount of ore in excess of the price offered, and then the prospector must wait from one to two years for the cash. The old custom of people with money 'taking a chance' to develop a good iron-cap or other promising lode is past; we prospectors must show the 'goods' or there is no trade. The time when we could sell a reasonably fair prospect for a few hundred dollars, and then move on to find another, is gone. Now we have to find the prospect, then go and earn our own grubstake by wages, and develop our claim. Hence it takes years, where before it took months. The money available seems to be in the hands of the big mining companies, and they buy on a 'sure thing' margin. This condition of 'sure thing' buying is

caused by the mining engineers employed by the companies. Their jobs depend on their ability to pick paying properties, and they therefore turn down many otherwise good claims. There is plenty of interest, but it seems to be centred around the big concerns.

Personally I would not care to be placed on the government payroll. I would rather sell a claim once in a while. The Government might extend the service of the Geological Survey by producing reports sooner and by examining and reporting on mineral claims for prospectors, should they so desire. As a rule, prospectors are too poor to hire mining engineers, and a report from the Geological Survey would aid greatly in selling, or perhaps satisfy the prospector that the claim is no good and that therefore he need waste no more time on it. The apex law as it now stands looks good to me, though I think it well to enlarge the claims to 1500 ft. square, which would do away with a great many cross-claims, from which much litigation arises, and also provide more timber for mining. Government aid in building trails and roads would be greatly appreciated, also assay offices where assays could be procured at cost, if not free.

Of course, the 'wild-catter' is largely responsible for the falling off in prospecting, and, too, I have been told that "there are more failures in mining from mismanagement than from lack of mineral," which has a large bearing on selling prospects—perhaps larger than any other cause.

J. C. STUTZ.

Danville, Washington, February 18.

The Editor:

Sir—One of the writers on this subject says: "The nomadic prospector, with his shovel, pick, pan, and a sack of grub, on a burro, is largely of the past," and it is not worth while trying to revive him; yet an item in a Portland paper of January 21 says: "The usual winter influx of argonauts, prospectors of the good old golden days of placer mining, is scattered along the Rogue river with pick and pan, striving for a grubstake, and still looking forward to striking it rich." There are still Klondikes, Iditarods, and Chisanas to be discovered; other Tonopahs and Goldfields will be opened up; as also more High Grades and Buffalo Humps will put temporary dampers on the enthusiasm of nomadic prospectors. In the United States, notwithstanding statements to the contrary, there are still vast areas of virgin ground, immense territories practically unscratched; northern California, Oregon, southern Idaho, northern Nevada, and much of the southeastern states is still open to the search. Northern Canada, the Labrador country, and northern British Columbia are practically unknown; Siberia, China, and Tibet have never been prospected, and millions of square miles of Africa have scarcely been entered. Who is to be the pioneer in the great task of opening up these districts to exploitation and improvement but the man who takes his life in his hands,

eats as he tramps, and sleeps wherever night overtakes him as he forges deeper and deeper into the wilds?

W. S. KEITH.

Portland, Oregon, February 20.

The Editor:

Sir—I have waited patiently in this discussion to read what I consider the most potent factor in the decline of prospecting and small-scale mining, but none has hit the mark. It is not because all available area has been gone over, for many veins are to be discovered in areas already prospected; it is not because of government regulations, although no doubt these have discouraged the prospector; it is not because capital is scarce; but it is because automobiles in the minds of the mass of people are more interesting than mining stock. The man with \$100, \$200, \$500, or \$1000 who formerly would take a nip at stock, now has his all in an automobile and his savings go to keep it running. Figure the amount of money put into machines by the near wealthy or near poor, and one can readily see what an important factor this industry has become in the distribution of savings. Just as the moving-picture theatre has taken coin from the saloons, so have automobiles taken money away from mining investments. We need go no further for our answer: a man who has his house mortgaged for a machine is not going to 'take a flyer' on a mining venture—the upkeep of the machine is more important.

ALGERNON DEL MAR.

South Pasadena, California, March 10.

The Editor:

Sir—As to the prospector, he is mortal and dies. With the inevitable discovery of some new bonanza gold camp a legion of young prospectors will arise as from the earth. As to the asserted exhaustion of virgin territory containing potential bonanzas, I do not agree. In northeastern California, northwestern Nevada, and southeastern Oregon there remain 25,000 square miles of territory spotted with porphyry districts wherein may be seen today ocular proof of mineral in veins of gold, silver, lead, and copper ores; not forgetting the coal formation in Modoc county. This entire domain is truly a howling wilderness awaiting the battalions of prospectors not yet organized and drilled, but in existence and ready to enlist in the noblest occupation of earth—mining. The mining industry is at a low ebb and is constantly being discredited not only by the jackals who hang on the flanks of the business, but is continually afflicted with a fire from the rear from newspapers and magazines that tout every commercial scheme, no matter how unscrupulous. And until the public domain is fully restored to the prospector, the obstacles which constantly multiply to dishearten the remnants of the old time prospectors who have accomplished so much will operate to prevent the enlisting of younger men in the ranks of those who have sub-

dued the deserts and the mountains. I am bound to write the foregoing for the reason that they are facts not sufficiently emphasized, since the prospector as a class has no journal for his spokesman.

N. E. GUYOT.

High Grade, California, February 5.

The Editor:

Sir—I have been much interested in the discussion in the *Mining and Scientific Press* on the subject of how to encourage prospectors. I note that one of the questions which you have asked representative mining men, relates to government aid. It occurs to me that something might be done along this line in the way of broadening the reports which come out of the Geological Survey. My experience has been that one reason why prospectors, and particularly why the owners of partly developed mining properties, find it difficult to interest capital is, that they are seldom able to make a proper presentation of the facts with reference to the properties for whose development they ask money. If the Government would extend the work done through the Geological Survey to the examination of prospects and partly developed properties, including a sampling thereof, and make the results of these examinations public, mining people would have something dependable to go by, and prospectors, or the owners of partly developed mining properties, would be substantially served. I submit this suggestion as a practical one with relation to the kind of aid that might be extended by the national Government to western miners.

DONALD C. CATLIN.

New York, January 21.

The Editor:

Sir—From my own observations, I would say that the tendency is for the one-time prospector to seek work with the operating companies, rather than to go into the hills; that the large development and operating companies are more exacting in their requirements, at least as regards accuracy in the reports that are submitted to them. Lacking the earmarks of accuracy, the reports of many properties that might otherwise have commanded some attention are consigned to the waste-basket.

It appears to me that there is a greater success attendant upon sending an engineer into a field that has been somewhat exploited for the purpose of gathering all available data on the mines that have been and are being operated, and then if results are encouraging to secure option or bond on properties in that district, rather than in going into new fields where results are exceedingly problematical. This, however, eliminates the prospector to a large extent, and it may be to a certain extent the reason why old-time methods of prospecting are less in vogue.

S. F. SHAW.

Frisco, Utah, March 9.

Concentrates

Most of these are in reply to questions received by mail. Our readers are invited to ask questions and give information dealing with the practice of mining, milling, and smelting.

Asbestos production of Quebec in 1913 was 136,195 tons, worth \$28.10 per ton.

Water used by 11 mines at Kalgoorlie amounted to 33,414,000 tons in December last.

Black blasting powder used in coal mines is usually made of 73 parts of Chile saltpeter (sodium nitrate), 16 parts of charcoal, and 11 parts of sulphur.

Miners sometimes open metal powder kegs with the point of a pick, causing a spark and resulting in an explosion. Partly on this account, kegs are often made of cardboard.

Leaching sand at the Oroya-Black Range mill, Western Australia, takes 134 hours for an 85-ton charge, which is percolated by 125 tons of various solution washes. The gold recovery is 85.34% at a cost of 47c. per ton, according to W. B. Chomley in the *Monthly Journal of the Chamber of Mines*.

Davison's formula, $s = \frac{200}{d}$, where s equals the r.p.m. and d the diameter of the tube in inches, still holds good for the rate of revolution of tube-mills. The same authority gave the charge of flints as $0.44n$, where n equals the internal capacity, but subsequent practice has demonstrated the advisability of filling tube-mills more than half full.

Mill capacity in the Flat River lead district, Missouri, is as follows: Federal Lead Co., 4500; St. Joseph Lead Co., and Doe Run Lead Co., now consolidated, 6200; St. Louis Smelting & Refining Co., 2500; and Desloge Consolidated Lead Co., 1800 tons per 24 hours. In 1912, according to H. A. Guess, 4,064,366 tons of crude ore was milled, yielding 218,803 tons of concentrate, containing 146,913 tons of lead, worth \$13,222.170.

Moisture and acid are foes of electric insulation and are especially active when combined in mines. According to H. H. Clark and L. C. Ilsey, of the Bureau of Mines, the average amount of free sulphuric acid in 16 different mine waters was 23.68 grains per gallon. Samples of wire, covered with different insulating compounds were treated with these waters for certain periods, and showed marked decreases in the insulation resistances. The rubber insulation stood better than other preparations.

A simple method of raising the boom on a revolving steam-shovel is as follows, according to the *Excavating Engineer*: Set the dipper firmly against a block on the ground diagonally forward from under

the shipper shaft. Lock thrusting gears with a bar or wedge. Propel forward slowly, thus raising the boom. This is much safer and much more accurate than using the boom engines. The boom may be lowered in the same manner.

Standard silver or gold is not of uniform composition, but its base metal content is controlled by local regulation. The American standard for both gold and silver admits of an addition of 10% of other metals. Standard gold carries 1% silver and 9% copper, and standard silver 10% copper. British standard gold contains 22 parts of gold per 24, which is locally designated 22 carat. With standard silver the carat proportions are also used in calculating base content, although the term 'carat' is not used in designating the silver fineness. Standard silver contains 22.2 parts of silver and 1.8 parts of base. Bullion is often sold in England and the colonies at so much per ounce standard gold, the price including the proportion of silver found in standard gold. Any additional silver content is paid for at the ruling market price of the metal.

A useful type of apparatus for cleaning-up mill accumulations and for amalgamating the gold in cyanide slag is the berden pan. The standard size is 5 ft. in diameter. The pan consists of a revolving circular trough, in one casting, driven by a shaft set at an angle of about 45°, which is fixed through the centre of the trough and terminates in a footstep bearing. The pan runs at a speed of from 12 to 15 r.p.m. by bevel gearing, the pinion being loose on the driving shaft so that the pan can be stopped in disengaging the gears by means of a suitable strike. The grinding is done by means of a cast iron ball, which revolves in a pool of mercury in the concavity of the trough, and which weighs about 120 lb. The material to be amalgamated is thus brought in close contact with the 'quick.' A continuous stream of water may be added to the pan so that the fine material can escape as soon as ground, to be subsequently caught in a settler; or the pan may be run with intermittent charges. The former method is preferred by some millmen, as it allows for the thorough cleansing of the mercury by stopping all feed to the pan for a few hours previous to cleaning-up, while others are certain that a better recovery is made by the intermittent system. The ball used for grinding is particularly well adapted for the purpose, and its use results in a minimum of wear. When anything in the nature of a drag or shoe is used the iron invariably found in mill accumulations is held by it. This results in scouring and severe wear of the pan body. Liners are unsuitable for this type of pan on account of the amalgam working through and lodging between the liner and the pan, although they have been used without much bother from this source. The pan body is in the form of one simple casting and even with continuous use will last for a number of years if a ball is used for grinding.

Special Correspondence

PLATTEVILLE, WISCONSIN

CONDITIONS AND PRICES IN MARCH.—DISTRICT PRODUCTION.—

MINES CONTRIBUTING TO THE OUTPUT.—ORE BUYERS.—

PRICES FOR CERTAIN GRADES.

Producers of zinc ore in this region had a distressing and discouraging time in March; yet in spite of all the drawbacks, it proved the best month so far of this year. Inclement weather prevailed most of the month, wagon roads were for the most part impassable and outlying mines were almost entirely isolated and market conditions were at a dead standstill, metal ruling for the month at \$5.15 per cwt., East St. Louis quotations, with scarcely any deviation from this figure at any time. Zinc ore showed a wide latitude between high and low-grade ores, ranging from \$36 to \$40 per ton, for standard grades. Low-grade ore was in good demand, and some competition led to prices being paid of from \$1 to \$2 per ton above average base, on low and medium grade zinc ore production.

While soft ground militated against the free movement of drilling machines and material to new mining sites, some removed by a considerable distance from established roads, there was nevertheless a good increase of action along these lines during the period. Scores of Keystone drills were in operation, while machinery and building material was provided for a number of new power, mining, and concentrating equipments. Ore production showed strong gains, and shipments were above the reports issued for February. The following figures include deliveries made on March 28. Lead ore shipments were almost too insignificant to deserve mention, the demand and prices offered furnishing no incentive for producers to 'let go.' Production of iron pyrite held up well, but deliveries were lighter, due to bad roads. At the close of the month, fully 5000 tons of zinc ore carried over.

Districts.	Zinc lb.	Lead lb.	Pyrite lb.
Benton	4,310,000	.....	2,658,000
Galena	4,292,000	79,600	.....
Cuba	3,094,000	.....	991,840
Platteville	2,396,000	.....	.....
Livingston	2,280,000	.....	.....
Hazel Green	1,970,000	50,000	.....
Linden	1,736,000	119,560	492,500
Shullsburg	1,704,000	.....	.....
Harker	1,372,000	.....	.....
Montfort	226,000	64,000	.....
Highland	60,000	.....	.....
Mineral Point	20,000	.....	.....
New Jersey Zinc Co.	2,806,600	.....	.....
Total	26,342,600	313,160	4,142,340

The mines responsible for this production are given by districts, namely: Benton—Frontier, Fox, Fields, Indian Mound, Wilkinson, and Martin; Galena—Black-Jack, Vinegar Hill, Northwestern, Federal and Great Western Lead Mfg. Co. (new); Cuba—Masbruch mine and National Sep. Co.; Platteville—East End mine and Empire roasters; Livingston—Coker, Ellsworth, and Rundell; Hazel Green—Kennett and Cleveland; Linden—Ross Bros., Glanville, Saxe-Pollard, Optimos No. 1 and 2, and Linden Sep. Co.; Shullsburg—Winskill mine only; Harker—Peacock, B. M. & B. Mining Co., Lucky Six; Montfort—O. O. David, Dodgeville, Lucky Five, Mineral Point local, and Section Four out of Highland.

Among buying concerns the tonnage was distributed as follows: Mineral Point Zinc Co., 4712 tons; National Separating

Co., Cuba, 2265 tons; Grasselli Chemical Co., Cleveland, 1279 tons; Empire roasters, 819 tons; Linden Zinc Separating Co., 652 tons; M. & H. Zinc Co., LaSalle, Illinois, 667 tons; Illinois Zinc Co., Peru, Illinois, 643 tons, and American Zinc Co., 352 tons.

The gross production of concentrates aggregated 20,000,000 lb., and net refined ores from separating plants and concentrates direct to smelter, 13,000,000 lb. More attention is being given to ore separation and the shipments of high-grade separator finished product is gradually increasing all over the field, and no doubt will eventually be confined to shipments of high-grade ore out of the field to smelter direct altogether.

Prices paid for the different grades submitted by one of the most prominent buyers in the field show the following figures: for 30% zinc content, the average low-grade ore of this field, \$14.50; 35%, \$17; 40%, \$20; 45%, \$23 to \$24; 50%, \$28 to \$30; 55%, \$32 to \$34; and 60%, \$37 to \$40 per ton. The Linden Ore Separating Co. produced 62% ore and carried off field honors with the top price of \$42 per ton.

KALGOORLIE, WESTERN AUSTRALIA

WAGE DEMANDS.—ASSOCIATED NORTHERN BLOCKS' AFFAIRS.—

DEVELOPMENT IN THE CHAFFERS.—BULLFINCH RETURNS.—

GREAT BOULDER COMPANY'S OPTION IN VICTORIA.

The miners' unions of Bullfinch, Golden Ridge, and Leonora have all applied for a higher schedule of rates on the expiring of the current agreement, which is about to fall due. With regard to Bullfinch, the Chamber of Mines offered an increase of 12c. per shift for hand labor in raises, and 12c. per shift extra for all surface work. The miners turned down this offer, and all three cases will now go to the Arbitration Court. The Golden Ridge case appears foolish, as there is only one mine concerned, and it is nearly worked out, and will be closed down and abandoned in the course of the current year. For over a year the Company has been looking



ASSOCIATED NORTHERN MILL, KALGOORLIE, WHICH HAS FINISHED A 10 YEARS' RUN, AND IS NOW BEING DISMANTLED.

for a new mine, and at present has an option on the Idaho, east of the Hannan's Star, Kalgoorlie; but this option is shortly to be abandoned, as the lode is too patchy for profitable operation by this Company.

The Associated Northern Blocks has closed down both the Iron Duke mill at Boulder, and the Victorious mill at Ora Banda, and will earn no revenue until the sulphide plant on the latter is installed. The Iron Duke mill has closed down permanently, and the public has been notified that no more ore will be treated for prospectors in future. In the meantime development is being pushed on in the Victorious at No. 6 and the shaft is well on its way to No. 7 level. The bricks

for the foundations of the furnaces are being made on the mine, and it is probable that the Merton furnaces and Krupp ball-mills from the Kalgoorlie property will be removed to Ora Banda. The ore-shoot on the No. 6 level of the Victorious appears to have split into three parts, and shows 40 ft. of ore assaying \$11.76 per ton, then 77 ft. of waste, followed by 30 ft. assaying \$19.20 per ton. Another blank of 43 ft. is followed by 20 ft. of ore assaying \$10.56, and 50 ft. assaying \$5.94 per ton. The drift is 6 ft. wide in the hanging wall of the lode, and there may be better gold content in the foot-wall, as at 70 to 100 ft., where it is barren in the drift, the foot-wall side assays \$10.08 per ton. The mine may therefore eventually develop satisfactorily.

The management of the Chafers is still continuing development at No. 15 and 17 levels. At the former, the main west cross-cut cut No. 1 lode at 66 ft., where it was 6 ft. wide, assaying \$6.18 per ton. At 117 ft. No. 2 lode was met with, 6 ft. wide, assaying \$4.46 per ton; at 367 ft. No. 3 lode, 10 ft. wide, assaying \$6.12 per ton, and at 503 ft. No. 4 lode, 6 ft. wide, assaying \$6.72 per ton. At No. 17 level the west cross-cut cut No. 1 lode at 176 ft., where it is 10 ft. wide, assaying \$9.48 per ton, and No. 2 lode at 207 ft., where it is 5 ft. wide, assaying \$6.72 per ton. No development has been done on these lodes so far. The new treatment plant, consisting of rock-crushers, furnaces, agitation vats, filter-presses, etc., have been ordered from the West Australian Machinery Co., together with a 400-hp. National gas-engine and generator, and four No. 8 Krupp ball-mills have been ordered from Germany. The plant is not expected to be ready for six to eight months, but in the meantime the lodes at No. 15 and 17 levels will be opened, and both levels connected with No. 16. A large fan is used for ventilation purposes, otherwise it would be impossible to drive the levels so far from the shaft with no natural ventilation.

The return of the Bullfinch for January fell to \$8.30, and the profit to \$4.12 per ton against \$13.14 and \$8.62 per ton for the previous ten months since the mill started. As the rich ore is practically exhausted, returns in future will be normal and profits probably will not exceed \$24,000 per month. The creep in the mine is not likely to affect returns at present, but should rain fall, a further subsidence may be looked for. The shaft is quite safe, as the northern lode series is 450 ft. on one side, and the southern 300 ft. on the other side. A. L. Hay, the manager, is confident of the future of the mine.

Richard Hamilton, of the Great Boulder Proprietary, in an interview regarding the Company's acquisition of the Magdala-Moonlight group of mines at Stawell, in Victoria, stated that he had taken an option of 6 to 12 months, and intended testing the lode by diamond-drilling. If satisfactory, he would install a sulphide plant similar to the Great Boulder plant, and capable of treating 15,000 tons per month and of giving employment to 600 men. The probable reserve of sulphide ore in the mine was 100,000 tons, worth \$7 to \$8 per ton.

Gold returns from Western Australia in January 1914 were \$2,379,200, and from the principal mines as follows:

Name.	Tonnage.	Value.	Profit.	Dividend.
Great Boulder	17,017	\$236,650	\$130,000	.....
Ivanhoe	20,238	165,600	50,000	\$175,000
Kalgoorlie	10,845	107,000	46,200	120,000
Bullfinch	6,316	57,900	26,800	.....
Fenian	3,040	47,500	24,400	22,500
Lake View & Star	18,118	107,200	17,500	.....
Edna May	1,235	25,200	15,900	20,600
Queen of the Hills	4,344	32,200	13,200	.....
Yuanmi	10,400	79,600	13,100	.....
Menzies Consols	2,538	33,000	12,800	.....
Sand Queen	1,650	30,000	12,500	11,250
Oroya Links	12,400	63,500	8,500	.....
Kyarra	890	19,500	8,400	.....

Sons of Gwalia	13,589	105,300	7,200	.....
Martins	2,570	24,000	6,600	.....
Inchiston Consols	1,950	20,000	5,500	.....
Mountain Queen	4,055	18,800	4,900	.....
Associated	10,802	62,700	3,500	.....
Inchiston Extended	450	8,000	3,500	.....
Ida H.	1,470	21,700	3,400	.....
Black Range	3,017	30,700	3,400	.....
Boulder No. 1	2,111	6,500	3,100	.....
Golden Ridge	2,639	19,000	2,700	.....
South Kalgoorlie Consols	9,861	50,000	1,500	.....
Lake View Consols	8,526	6,500	800	.....
Commodore	860	6,600	200	.....
				Loss.
Great Fingall Consols	2,390	35,000	13,000	.....
Golden Horse-Shoe	25,500	142,300	12,500	.....
Perseverance	20,463	90,460	5,700	.....
Burbank's Main Lode	1,256	12,600	5,600	.....
Victorious	5,507	31,300	5,300	.....
Marvel Loch	442	4,500	300	.....
Associated Northern	618	13,400	.....	.....
Marmont	289	6,400	.....	.....

LONDON

INSTITUTION OF MINING AND METALLURGY AFFAIRS.—ROYAL SCHOOL OF MINES.—RUSSIAN MINING CORPORATION CONCESSIONS.

The annual general meeting of the Institution of Mining and Metallurgy held recently was a great success in many ways. The council's report for the year 1913 was presented, and it contained much matter for congratulation. I have already referred to the acquisition by the Institution of a house for itself. The financial position has been greatly improved by gifts of £10,000 from the Wernher estate, and by subscriptions of £3879 from 544 members toward the twenty-first anniversary fund. An appeal is now being made for a further £3000 toward this fund, in order that all indebtedness in connection with the new home may be discharged. The petition for a Royal Charter is now before the Privy Council. The Institution has a serious source of anxiety, owing to the proposals of the British Government authorities on education to amalgamate the Imperial College of Science and Technology, of which the Royal School of Mines forms a part, with the proposed glorified University of London. The Institution shares the feelings of those interested in special advanced technical training against any affiliation with a general educational university. The idea of an independent technical college, untrammelled with connections with classes on Hebrew, music, and surgery, is apparently too revolutionary for the powers that be, who go by precedent and custom more than by unbiased judgment on each case on its merits. Sir Thomas Holland, lately of the Indian Geological Survey, and now professor of geology at Manchester, has pointed out that the constitution of the older universities is not due to the ingenious design of intellectually capable men, but merely the legacy of a gouty past. Everybody connected with science intends to strenuously, but courteously, resist any proposal of the Government to place the Imperial College under the domination of unsympathetic educationalists. Let us hope that the Government will not propose to use the army for enforcing the proposed amendment of the law and constitution. On leaving the presidential chair, Bedford McNeill received unusually kind treatment at the hands of his friends and colleagues. By his continuous attention to the business of the Institution, his invariable suavity and kindness, his erudition, and his ability as a speaker and presiding officer, Mr. McNeill made himself a tremendous success, greatly to the benefit of the Institution. On his retiring, F. H. Hatch took the presidential chair. His inaugural address touched on the advantages accruing from the association of geologists

with mining operations, and also on the history of the development of the theory of ore deposits.

A few weeks ago I gave some particulars of the Russo-Asiatic Corporation, which has acquired a huge ore deposit, the Ridder, in the Altai district of western Siberia. This property formed part of the Thurn and Taxis concessions; but was acquired direct from the Russian Government, on the prince abandoning this part of the concession. The Russian Mining Corporation, controlled by F. W. Baker and Lord Harris, and responsible for the flotation of the Lena Gold-fields, has more recently acquired the remaining part of the concession from the prince himself. The property contains many thousands of square miles and is divided into two parts by the Ridder. The northern part is the Zminogorsk and the southern the Zeranovsk. During the winter, communication is maintained with the Trans-Siberian railway at Novo-Nikolaevsk by means of sleighs, and the journey from Zminogorsk takes seven days. During the summer, steamers ply on the Irtysh river, from Omsk to all the concessions. A new line, called the Altai railway, is in course of construction from Novo-Nikolaevsk and Barnaul to Semipalatinsk. It will pass within 75 miles from the Zminogorsk concession. The Kalchugina coal mines are on this route, and the railway will greatly facilitate the delivery of coal and coke to the mines. Water-power suitable for the generation of electric current is available at several places. One installation of 1500 hp. has already been erected in the Zeranovsk concession, but has been allowed to get into poor condition. Details of the concessions will be found on page 651 of this issue.

NEW YORK

COPPER SITUATION.—ANACONDA AND AMALGAMATED COPPER COMPANIES.—UNITED STATES SMELTING, REFINING & MINING CO.—UTAH CONSOLIDATED.—MIAMI.—BUTTE MINES.—STEWART'S TROUBLES.

Following its usual contradictory tendency, the market in coppers slumped immediately upon the appearance of a favorable monthly report of the Copper Producers' Association as given in this journal last week. Undoubtedly the weakness which developed was due to the fact that production for the month broke all previous records, the previous high mark for production having been made in August 1912, when total output was 145,628,521 lb. Since the first of the year, domestic deliveries have been abnormally light, in fact, including December last, the average for four months is only about 41,500,000 lb., hardly more than 50% of normal domestic consumption. This fact, taken in connection with the record shipments abroad and the somewhat discouraging business outlook at home, has not made for confidence in the stability of metal prices. The exports of copper metal have come in for the usual amount of criticism, and, despite assertions that European buyers are clamoring for early deliveries, users of metal on this side are outspoken in their belief that large amounts of copper are being held speculatively on the other side. Apparently the feeling is growing that there is more manipulation in copper than is healthy. This feeling is, in all probability, due more to the fact that the power to manipulate exists, rather than to any actual flagrant examples that can be pointed out. Another element that has never received as much consideration as it deserves from the consumer, though the producers seem to have grasped it to better advantage, is the growing appetite which the world has for copper. Production must be larger if it is to keep up with the demand, and in tracing the ascending line across the chart, temporary slumps can be disregarded. Economically speaking, it is a good thing that there is a concentrated strength behind the copper situation that can prevent temporary demoralization, and an unnecessary waste of a great natural resource.

Considerable interest attaches to the forthcoming reports

of the Anaconda and Amalgamated companies. The former had some extraordinary expenses during the past year, and production was about 20,000,000 lb. less than in 1912. Costs have increased unavoidably, in higher wages and in necessary new construction; while, on the other hand, it will probably be shown that the average price of copper sold was slightly below that received in the preceding year. It will not be a matter of surprise, therefore, if the annual report of the Anaconda should show a deficit. Amalgamated's dividend disbursements approximate the amount which it receives from Anaconda; but as both companies have substantial surplus accounts, and as Amalgamated has some other sources of income, no great importance will be attached to the showing beyond its indication as to future copper costs. It is to be recognized that Amalgamated's costs can be kept down only by increased expenditure, which is a Hibernian way of putting it, but electric haulage and the many other items of new construction and reconstruction that are chargeable to capital account are, in final analysis, additions to copper costs. It is estimated that a showing of 10¢ for Anaconda will be creditable for the past year.

The United States Smelting, Refining & Mining Co. makes an exceedingly good showing in its report for 1913, when it is considered that the Company now derives almost half of its revenue from its silver properties, and only about 20% from its copper mines, especially as its silver production comes from the Real del Monte and neighboring properties at Pachuca. One of the most interesting features of the report is that which refers to its efforts to acquire new properties. During 1913 there were 614 properties submitted, out of which three were purchased and three taken under option, of which options one had been allowed to lapse at the close of the year covered by the report. Commenting upon the small percentage of properties that could stand the test of examination, the *Boston News Bureau* says editorially: "It is, of course, true that mining engineers have been proved not infallible. Some of the largest contributors, present and assured, to the copper outputs of the Southwest and South America were first rejected on expert advice and long hawked about. But most of these instances, it is also to be observed, were of the low-grade 'manufacturing' type, involving not only fine calculation, but a great deal of pioneering courage and also of subsequent ingenuity in devising and adjusting. This sort of industrial mining is a very recently developed art." It is to be added to the comment of the *News Bureau* that in many of the instances mentioned the low-grade properties alluded to were obliged to wait until the present processes were developed and perfected to that point which made possible the profitable extraction of ores, which theretofore could have been handled only at great loss. In these cases the engineers who have turned down camps, which afterward developed into great profit earners, have been absolutely right all the time. Perhaps there would not be so many various things 'the matter with prospecting' if the present-day prospector could feel it incumbent upon him to prove something more than the mere existence of metals in ores, and could realize that minerals could exist and yet at the end of a year's operation would show in the balance-sheet rather as a liability than an asset.

The report of the Utah Consolidated shows earnings equivalent to \$2.12 per share, a greater profit than has been earned at any time during the past five years.

Miami failed to earn its dividend in 1913, so that in order to make the distribution to shareholders, the existing surplus was drawn upon to the extent of \$186,592. Miami's copper costs were 10.68¢c. per pound, which must be cut down somewhat if the property is to keep place among the porphyries. Production was 33,134,334 lb., which was sold for an average price of 15.24¢c. per pound.

The Davis-Daly company is to levy an assessment and become one of the deep-level properties of Butte. The smaller Butte mines seem to have a hard time to get to a satisfac-

tory producing basis. Tuolumne, Pilot Butte, Butte-Ballaklava, and Davis City have each been struggling for some years without bringing much but anxiety to the outside shareholder. Butte, on the whole, has evidently come back as a mining camp, and outside operations are more numerous than for some years past. It would be a great source of gratification in the East if there could be made some genuine spectacular successes, such as North Butte or some of the earlier mines of the camp, to bring back the attention of the public to mining possibilities. The present mining market of the East, except for some investment buying in the porphyries, and the regular grind of trading in Amalgamated, is not worth mentioning.

The troubles of the Stewart Mining Co. seem inclined to multiply. The payment of a dividend declared to be paid April 25 has been enjoined. Apparently it is a Heinze fight, and, as usual, shrouded in much entanglement arising from certain loans made by the Company to Heinze, upon which action was to be taken by the present board. The election of the present directors, who are insisting upon the payment of a dividend, is attacked as illegal, the conclusion being that the real question at issue is the disposition of the Company's earnings, by way of loans or by way of dividends.

DULUTH, MINNESOTA

WORK BEING DONE BY THE STEEL CORPORATION IN THE DISTRICT.

- REVOLVING SHOVELS FOR CLEANING-UP ORE AT THE MINES.
- THE CUYUNA RANGE.

The twelfth annual report of the United States Steel Corporation for 1913 has recently been issued and shows that its iron ore production from the Mesabi range was 21,634,206 tons, compared with 20,001,953 tons in 1912. Capital expenditure was made at the iron ore properties of the range for an additional pumping engine at the Trout Lake concentrating plant at Coleraine; a concrete-mixing plant at Hibbing; a revolving shovel at the Genoa mine; a change-house, capacity for 150 men, at the Spruce mine; a general superintendent's residence for the Virginia district; and equipment for underground operations in the following mines: Judd, Duncan, Philbin, Graham shafts No. 1 and 2, and Sullivan. During the year a new steel ore-dock was under construction at Duluth with 384 pockets, and a drying plant was installed at the Whiteside mine. At the Hull-Rust mine, pumping and lighting equipment was installed; and at the Fayal mine the engine and boiler house was enlarged and other equipment installed. Construction work on the new steel plant at Duluth, and the connecting railroad to serve the same, proceeded during the year, \$5,912,027 being spent. It is expected that this plant will be completed for operation in the spring of 1915. The plant will comprise two blast-furnaces, 10 open-hearth furnaces, one 40-in. blooming mill, one combination 28-in. and 18-in. rail and shape mill, one combination 16, 12, and 8-in. merchant mill, and a by-product coke plant of 90 ovens, together with the necessary complement of auxiliary departments, such as power-plants, pumping stations, machine and other shops. There has been laid out, adjacent to the plant, a subdivision, on which work has been commenced in building the first allotment of 170 houses for use by employees. The total expenditure to the end of 1913, for acquirement of the land, site of the steel plant and subdivision, construction of plant, development of the subdivision, and building of the railroad, is \$13,445,648. Work was commenced during the year on a cement plant situated adjacent to the new steel plant. This plant is being constructed by the Universal Cement Co., a subsidiary Company, and will have a capacity of 1,400,000 bbl. per year. It will utilize blast-furnace slag in the manufacture of the cement, and will probably be completed for operation in 1915.

An interesting feature of the work being done in the pit at the Genoa mine is the use of a Marion revolving steam-

shovel for loading ore, which is hauled to the pocket at the shaft in standard cars by locomotives, dumped, and hoisted to the surface by skips, and dumped on the stockpile. The work is carried on at a depth in the pit which will not permit of its being hauled out by locomotives. The revolving shovel is useful in this connection, as it works ahead in the corners, swings around, and deposits the ore in the car behind. The locomotive also hauls ore from the 'scrums,' which are places worked by underground methods around the edge of the pit. These places are the thin parts of the orebody which were not uncovered by the stripping operations, and the ore is mined very cheaply by this method, contracts for this sort of work having been let at different mines on the range for as low as 20c. per ton delivered on cars in the pit. The tendency, some years ago, was to use the heaviest shovels obtainable for all classes of work; but at present lighter shovels are being used for cleaning-up work; that is, removing the last cut from the surface of the ore. The success attending the use of this revolving shovel will probably result in their more general adoption, especially for the class of work in which it is now engaged, and probably also for cleaning-up, where a shallow cut necessitates much delay. The idle time of the large shovels is expensive, and their unwieldiness makes them particularly unsuited for the work. The heavy shovels are at a disadvantage on a deposit whose surface has pot-holes. The revolving shovels should be able to clean-up completely as they go along and eliminate entirely the use of teams and scrapers in final cleaning.

The Oliver Iron Mining Co. has changed its plan of attack for the orebody under Carson lake, near Hibbing, and will not pump the lake out as first proposed. Stripping from one of the adjoining mines is being dumped in the lake, and the water displaced is forced out into the drainage ditch. In this way they are killing two birds with one stone, as the problem of securing suitable dumping ground is a serious one in many instances. The underground operations, of course, will require more pumping by this method.

The Madrid mine is to be operated by the Eureka Ore Co., recently incorporated, and the balance of the ore removed as soon as possible. This mine is under the city of Virginia. The caves made by the mining operations are to be filled with stripping from an adjoining property as soon as possible so as to restore the surface to its original condition.

Developments are promising on the Cuyuna range. Many drills are at work and results are said to be showing up new orebodies in widely separated localities. The Pennington mine at Iron-ton and the Thompson mine at Crosby have shovels at work, and will ship ore from their pits this year. The Thompson mine was worked last year as an underground proposition. A steam-shovel is working at the Rowe pit mine at Riverton, and preparations are being made for resuming work with the hydraulic plant as soon as weather conditions permit. The Adams mine, at Orelan, has about 1500 tons of ore stocked and is pumping about 250 gal. of water per minute. The Barrowa mine of the M. A. Hanna Co., at Barrows, is hoisting about 200 tons per day and has a stockpile of about 20,000 tons. The Wilcox mine near Brainerd is to operate its pumps and compressors by electric power. The hoist and some of the pumps are to be steam driven. The new 1200-gal. pump for the Rogers Brown Ore Co.'s Armour No. 2 mine will also be electrically driven. Both the Armour No. 2 and the Kennedy mines of this Company now use electric power for surface and underground haulage.

Several of the larger independent companies operating on the Mesabi Range are now acquiring interests on the Cuyuna Range and are taking steps toward developing their interests.

Steps have been taken by the engineers of Virginia and vicinity to organize an engineer's society which will probably extend an invitation to the engineers of the range to join.

General Mining News

ARIZONA

GILA COUNTY

(Special Correspondence).—During March, 10,330 ft. of development at the Inspiration again surpassed all previous records, but, unlike most other records in underground operation, this one was accomplished without noticeably increasing the underground payroll. Since the greater proportion of the work in this mine consists of driving the sub-level drifts and the incline raises connecting these drifts, it is possible to work a large number of faces, and, the method employed being such as practically to eliminate any handling whatever of the broken ground, the conditions are very favorable for making excellent advances. The haulage drift on the 600-ft. level is now within 200 ft. of connection, and is expected to be holed through about April 20.

At the test mill the 12-compartment flotation machine is now nearly ready for operation, and the 6 by 20-ft. tube-mill will be installed as soon as it is received. An interesting test is to be made between this mill and the Hardinge mill, as both are to be run on identical feeds and under similar conditions, to obtain a result that will be an impartial test of the two types of mills as fine grinders. This test will be exhaustive and of interest to the metallurgical world.

Machinery for the hoist and compressor plant will begin to arrive on about April 20. Among the shipments recently made were 18 cars (328 tons) of Nordberg hoisting equipment and auxiliaries, and 6 cars of compressor machinery of Ingersoll-Rand manufacture.

Several men have been engaged for the past week making the necessary excavations for installation of a 150-ton set of Fairbanks railroad track scales. These scales will be placed near the rock-crushing plant. The scales are built in four parts, having a total length of 50 ft., and are equipped with an automatic registering beam. Foundations for the reverberatory furnaces are soon to be started at the smelter site. These furnaces, which will be 120 ft. long and 20 ft. wide, are to rest on slag bases. The slag will be obtained at the Old Dominion smelter at Globe, whence it will be brought in slag pots, and while still molten will be poured into the foundation pits so that upon solidifying it will adapt itself to all the minor irregularities and form a massive block of material universally regarded by smelters as the most desirable for this class of work. The American Bridge Co. has sub-let its contract for the smelter plant to the Oscar Daniels Co. of New York City. Axel Peterson will be in charge of the erection work for this firm. The Miami underground work covered 3656 ft. in March, and the ore milled was 111,098 tons. The Miami company has started to remodel the mill so that it will have a daily capacity of 4000 tons, with higher extraction than at present.

Miami, April 9.

MARICOPA COUNTY

(Special Correspondence).—The Copper Belt Mining Co. owns 300 acres of property near the Monte Cristo silver mines, near Wickenburg. A 15-hp. gasoline engine and hoist have been installed, while a head-frame and machine-drills are to be added. A shipment of ore to the El Paso smelter averaged \$21 per ton in copper, gold, and silver. A reverberatory furnace will probably be erected.

Phoenix, April 2.

MOHAVE COUNTY

(Special Correspondence).—The main shaft of the Southwestern Mining Co. is to be sunk another 200 ft., and a large tonnage of copper ore is expected to be found. Mining is being done in sulphide ore at present.

Copprville, April 2.

During March the Tom Reed mine yielded gold worth \$105,000. The winze from the 900 to the 1100-ft. level is nearly through, and is in high-grade ore. The Gold Road mill is treating 300 tons of ore per day, yielding about \$24,000 per week. A good orebody is being opened at 1000 ft. in the Tennessee mine at Chloride. A 40-hp. engine has been installed at the Gold Reed mine for the air-compressor. The Midnight mine has been examined by officials of the American Smelting & Refining Co. At the Telluride property, the shaft is down 200 ft., and good ore is being developed. A 6-drill compressor is to be installed. The mine adjoins the Tom Reed on the south, and is managed by J. E. Rose.

CALIFORNIA

AMADOR COUNTY

There is said to be a good deal of activity in the Plymouth district, apart from that at the Plymouth Consolidated. The old Rhetta claims have been acquired by Thomas Lane and associates, and work is to be started. The Myers ranch has been optioned to these people also. Good ore has been opened in the Alpine.

CALAVERAS COUNTY

Miners in this county are prospecting for gravel channels. At the Emerson mine, on Stockton hill, a good deal of driving has been done to connect with an old shaft. The old Magee and Megaw adit is in 2000 ft., and small quantities of 'pay' gravel have been opened. The Stockton Ridge Consolidated gravel claim is being actively worked under Stephen Hughes. Dredging people are sampling ground in Chili gulch.

ELDORADO COUNTY

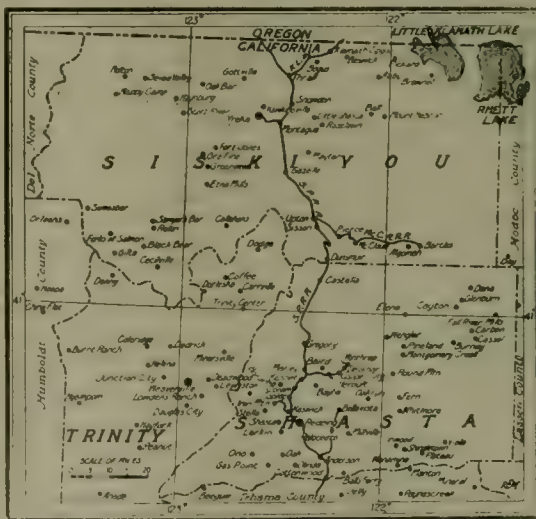
In the *Mountain Democrat* of April 11 and 18, the Mother Lode in this county is described in an interesting manner by Harold Macdonald.

NEVADA COUNTY

Very rich ore is being extracted from the Pennsylvania mine at Grass Valley.

SHASTA COUNTY

(Special Correspondence).—Ore will be sent to the Mammoth smelter early in May from the Shasta Belmont mine.



PART OF SHASTA COUNTY.

which is developing satisfactorily. Considerable prospecting is going on in the vicinity of Heroult and Copper City, and several encouraging discoveries have been reported recently. The ore contains a good deal of zinc in addition to copper, also silver and gold. Good progress is being made with the

erection of buildings at the camp of the Mountain Copper Co. near Minnesota station, a short distance from Keswick. The site for the concentrating plant is being graded, and it is expected to have the 250-ton plant in commission before the end of summer. It is estimated that shipments of high-grade ore from the Iron Mountain mine to the smelter at Bay Point averages about 12,000 tons per month.

Redding, April 6.

SIERRA COUNTY

Work has been resumed at the Little Bear Creek mine above Alleghany, and the Balsam Flat mines, on Lafayette ridge. At the former the 3-stamp mill may be replaced by 10 stamps. J. W. Evans is superintendent. At the latter mine, development is to include driving under a gravel deposit.

COLORADO

It is expected that by May 1 there will be 29 mining counties of the state, with a total membership of 5000, that will have joined the Colorado Metal Mining Association, while by the end of the year there will be 12,000 members. The aims of the society are to benefit the mining industry generally.

CLEAB CREEK COUNTY

(Special Correspondence.)—The ore production of the district for March 1914 was 27% above that of 1913, \$32,000 having been paid out at the local sampler. Four to five feet of \$30 gold-silver-lead ore has been opened by the adit on the Avalanche vein at Freeland. Ore returning a settlement of 250 oz. silver and 40% lead was opened in the Young America mine. Three cars of \$35 to \$55 gold-silver ore are being shipped weekly from the New Era at Freeland.

Idaho Springs, April 6.

GILPIN COUNTY

At the Carr mine, lessees are meeting with good results, and shipments down to 800 ft. have yielded good returns in gold, silver, and copper. The shaft has been repaired to below 1100 ft. The Bates Leasing Co., of Chase gulch, Black Hawk, is making fair shipments. Ten tons from the 400-ft. level returned 1.69 oz. gold, 17.2 oz. silver, and 2.2% copper. Three lots from the Pittsburg yielded the following: 3.22, 4.45, 11.5 oz. gold; 4.8, 5.75, 10.5 oz silver; and 6.75, 6.75, 19.3% copper respectively.

MONTROSE COUNTY

There is considerable activity in the carnotite mining district in spite of bad weather. There are reported to be 40 cars of ore between Placerville in San Miguel county and Paradox in Montrose county.

PARK COUNTY

A number of claims have been located in the new district containing rich uranium ores, near Hartsell, about 45 miles from Cripple Creek.

SAN MIGUEL COUNTY

The Tomboy mill treated 12,515 tons of ore in March, yielding bullion and concentrate worth \$81,500, with a profit of \$26,000.

TELLER COUNTY (CRIPPLE CREEK)

The cross-cut at 1750 ft. in the Portland has been driven 40 ft., and has opened 6 ft. of good ore. Eleven feet of rich ore is being opened at 350 ft. in the El Oro, and a car of ore per day is being shipped. Lessees at 600 ft. in the Gold Dollar are driving on 4 ft. of good ore.

IDAHO

The proposal to abolish the federal assay offices in the Western states is meeting with vigorous opposition from the mining interests, and the Boise chapter of the Idaho Mining Association is endeavoring to get Congress to block the move to close the Boise office. Net earnings of this office during the past nine months were over \$31,000.

SHOSHONE COUNTY

Shipments of ore and concentrate from 15 mines in the

Coeur d'Alene district in March totaled approximately 40,880 tons, containing lead, silver, zinc, and copper. A large tonnage of zinc ore has been developed in the Interstate-Callahan mine on East Nine Mile. An ore-shoot has been opened for 1100 ft. Seventy men are employed in the mine. Developments in the Hypotheek, down to 700 ft. are highly encouraging. The Snowstorm Mining Co., which recently purchased the Missoula copper mine for \$600,000, has 15 men employed at present. A writer in *The Wallace Miner* reports that the Butte Creek district at Murray contains promising mines. The new mill for the National copper mine at Mullan is working.

MICHIGAN

HOUGHTON COUNTY

Reports covering operations of several of the copper companies during 1913 are as follows:

On March 9, 1914, the Allouez Mining Co. had 339 men employed against 308 in July 1913, when the strike started. Early last year No. 2 mill started with four Hardinge mills, which are doing good work. 'Rock' stamped was 236,663 tons, compared with 333,618 tons in 1912. The copper output was 4,091,129 lb., of which 3,819,324 lb. was sold for \$598,558. The profit was \$155,728, and balance of assets are \$249,292. The total cost per pound was 12.09 cents.

On March 9, 1914, the Centennial Copper Co. was employing 164 men compared with 118 at the time of the strike in July 1913. During the past year the stamps crushed 85,443 tons of 'rock.' No. 2 mill with four Hardinge mills were started early in the year. The output of copper was 1,612,262 lb., of which 1,355,496 lb. was sold for \$208,174. The net profit was \$31,397, and surplus is \$27,847. The cost of production was 13.38c. per pound of refined copper.

Results of the Isle Royale Copper Co. were as follows: There was 314,679 tons of 'rock' stamped, yielding 4,158,548 lb. of copper, of which 3,870,974 lb. was sold at 15.29c. per pound. Receipts were \$591,933, and the year's work left a deficit of \$128,313. The previous surplus was \$557,743, but this was reduced to \$175,441. The cost per pound of copper was 18.81c. Development during the first six months of the year, and prior to the strike, covered 11,972 feet.

The Quincy Mining Co. is one of the most important Michigan copper companies, and during 1913 suffered a large reduction in its output and profit. Copper production was 12,184,128 lb. against 20,634,800 lb. in 1912; receipts were \$1,921,198 against \$3,381,587; profit, \$257,840 against \$1,089,674; balance for dividends, \$76,160 against \$960,779; dividends, \$412,500 against \$550,000; and a surplus of \$896,938 compared with \$1,393,278.

The annual report of the Superior Copper Co. shows the following: 'Rock' stamped, 130,826 tons; copper output, 2,992,765 lb.; copper sold, 2,538,057 lb.; revenue, \$458,449; profit, \$93,912; balance of assets, \$193,697; cost per pound of refined copper, 12.86c. Good ore was opened on No. 17, 18, 19, and 20 levels south of the shaft on the West lode.

There was nothing special to note regarding the Tamarack Mining Co.'s work in 1913. Over half the 'rock' mined came from the Osceola amygdaloid lode. Water pumped from No. 1 and bailed from No. 5 shaft averaged 12,800,000 and 2,760,000 gal. per month, respectively. Plans are under way for a crushing mill to treat 1500 tons per day of sand from Torch lake. A leaching process being tried at the Calumet & Hecla mills may suit a portion of the product from the proposed plant. Results in 1913 were as follows:

'Rock' stamped, tons	227,563
Refined copper, pounds	4,168,743
Cost per pound, cents	16.60
Price received for 3,852,040 lb., cents.....	15.45
Total income, all sources	\$643,566
Loss on operation	48,373
Balance of assets	1,070,938

MONTANA

BLAINE COUNTY

The Ruby Gulch Mining Co., at Whitcomb, will add to its electric plant equipment a 250-kva. alternating-current generator with 9½-kw. exciter, and has purchased the apparatus from the General Electric Company.

SILVERBOW COUNTY

The report of the East Butte Copper Mining Co. for 1913 contains the following data: The Company, since April 8, 1909, has operated the Pittsmtont property as well as its own. The main shaft was sunk 310 ft. in heavy ground, from 1275 to 1585 ft. Mine development consisted of driving a total of 2400 ft. on No. 6, 8, 10, and 12 levels; cutting out a station, and skip-loading pockets, and driving 1250 ft. on No. 15 level. A large tonnage of high-grade ore was opened on the 600-ft. level. Work in the upper levels was very satisfactory. At No. 15, sufficient work has not been done to reach any of the ore-shoots from No. 12 level. On account of a number of causes, mining was \$4.75 per ton, much higher than usual. It was intended to enlarge the furnace plant and equip it with mechanical chargers; but this will be done about the middle of 1914. Results were as follows:

Ore treated, Company and custom, tons.....	186,815
Copper, pounds.....	14,401,108
Silver, ounces.....	506,897
Gold, ounces.....	8,803
Gross income.....	\$2,471,551
Total expenses.....	1,881,112
Net income.....	764,455
Surplus after paying interest, development, equipment, etc.	531,772

The Anaconda Copper Mining Co. has ordered a 150-hp. and two 100-hp. induction motors, with compensators and switchboard, from the General Electric Company.

The orebody recently cut at No. 14 level of the Butte & Superior is said to be 35 ft. wide, assaying 20% zinc and 7 to 8 oz. silver per ton.

During March the Butte & Superior mill treated 33,170 tons of ore yielding 10,561 tons of concentrate, averaging 51.5% zinc, with 90.05% recovery. Figures for March of last year were 20,140 tons, 7073 tons, 45.88% and 76.79% respectively.

NEVADA

NYE COUNTY

A restraining order has been issued by the court stopping the West End company from mining ore in the disputed territory claimed by the Jim Butler company. Full details of the dispute are given in *The Tonopah Miner* of April 11.

STOREY COUNTY

The United Comstock Pumping Association has decided to install two Lakenan type hydraulic pumps for the 2500-ft. station in the C. & C. shaft. Each will have a capacity of 2200 gal. per minute to the Sutro tunnel, and will take the place of the Riedler and centrifugal pumps now at work.

From the 2350 and 2400-ft. levels of the Ophir mine, 127 tons of \$11.03 ore was mined last week. The Mexican mill treated 365 tons of Mexican ore worth \$6.29 and 281 tons of Monte Cristo ore worth \$7.57 per ton. The Pumping Association has completed its work at the 2500-ft. north drift.

WHITE PINE COUNTY

According to the *March Safety First* of the Nevada Consolidated Copper Co., there is a continued improvement in the casualty record at the mine, concentrator, and smelter. At Copper Flat there was only one serious injury; none at the Veteran mine; three minor accidents at the mill out of 23,000 shifts (750 men) worked; while at the smelter there were nine disabling accidents of no great importance. The Company's officials were instructed in first-aid, etc., during the month by the hospital doctors.

NEW MEXICO

SOCORRO COUNTY

(Special Correspondence.)—In The Oaks mine, at a depth of 15 ft. below adit 'B', the vein is 4½ ft. wide, worth from \$15 to \$20 per ton. The Alberta Development Co. is to start shipping ore extracted during development. The Pacific mine is producing from 20 to 30 tons of ore per day. The Deadwood mill treated 350 tons of ore during the first week in April, yielding 4200 oz. gold and silver bullion, and 1½ tons of concentrate.

Mogollon, April 6.

OREGON

BENTON COUNTY

(Special Correspondence.)—The Oregon Bureau of Mines and Geology, under the direction of H. M. Parks, is now preparing to place its field men at work. An attempt will be made to cover practically the entire state during the months of good weather. The wide area and many mineral industries of the state make this a large task, but the Bureau is now well organized and will be able to follow its work along more systematic lines than last year. Special attention will



MAP OF OREGON.

be given to gold-dredging in eastern and southern Oregon, to coal deposits in southwestern Oregon, and to building stone in northern Oregon. The deep mineral deposits of Baker and Josephine counties, carrying gold and copper, will also be investigated. From 6 to 20 men will be kept in the field during the summer and fall, and the reports will be prepared monthly.

Corvallis, April 3.

JACKSON COUNTY

(Special Correspondence.)—The old Braden mine, near Gold Hill, is one of the first properties in Oregon to take up the 'sliding-scale lease system' in its operation, by which a number of its operatives and employees derive a share of the returns. There are about 40 on the payroll, and some receive as high as \$200 to \$350 per month. This property is well equipped. O. A. Jackson, of Fort Worth, Texas, has purchased the old Opp mine, near Jacksonville, for \$200,000. It will be further developed and ore treatment changed considerably. A 20-stamp mill is on the property.

Gold Hill, April 8.

TENNESSEE

POLK COUNTY

The annual report of the Tennessee Copper Co. for 1913 includes the following information: The physical condition of the Tennessee mine is said to be good. Ore reserves were

increased during the year and stood at 5,534,983 tons on December 31 as against 5,071,000 at the close of the preceding year. Certain changes are now being brought about, which, when completed, will place the Company in position to mine and handle an additional 1000 tons of ore per day. It has been demonstrated that it is more profitable for the Company to smelt its own ores than to do a custom-smelting business, and the additional equipment installed, it will be possible for Tennessee to maintain its maximum production of copper without ores from other properties.

	1913.	1912.
Ore mined, tons	483,926	443,038
Copper from Tennessee ore, pounds.....	13,493,140	13,252,634
Copper from custom ore, pounds.....	4,257,822	4,427,583
Cost per ton of Tennessee ore.....	\$2.93	\$2.87
Cost per pound of copper.....	0.1134	0.11
Acid manufactured, tons.....	197,713	.....

UTAH

JUAR COUNTY

The May Day Mining & Milling Co. reports as follows for the year ended April 1, 1914: On account of the low price of spelter, shipments of zinc ore were stopped about the middle of the year. Parts of the mine to the 1000-ft. level were leased, and this plan has proved to be a good way of developing the property, and at the upper adit and 700-ft. levels orebodies were opened in new ground, according to C. C. Griggs, the superintendent, in his report to the manager, J. C. Dick. The ore from the adit averages 50% lead and 20 to 30 oz. silver per ton. The mine generally looks promising. Ore shipments were: lead, 1881 tons returning \$30,673, and zinc, 1474 tons returning \$12,815. With cash on hand of \$13,370, and other receipts, the revenue was \$58,117. Mine labor cost \$15,777, and payments to lessees \$13,430, while the cash on hand is \$14,777.

On the 200-ft. level of the Yankee Consolidated, 80 ft. of ore, supposed to be the Beck ore-shoot, has been opened. Development at 1700 ft. has cut a vein of good ore. In March the Gemini mine, operated by lessees, produced 2600 tons of ore averaging \$26.82 per ton. About 150 men are employed. John H. McChrystal is superintendent. The Iron Blossom company is paying 10c. per share, or \$100,000, on April 25.

SALT LAKE COUNTY

The Utah Consolidated Mining Co.'s report for 1913 shows the following: Copper ore reserves are estimated at 287,038 tons averaging 1.9% copper, 0.05 oz. gold, and 0.70 oz. silver; and lead ore reserves total 51,409 tons averaging 15.3% lead, 0.054 oz. gold, 3.27 oz. silver, and 0.98% copper. During the year 20,510 ft. of development and 2814 ft. of diamond-drilling was done. The metal output was 7,710,668 lb. copper, 19,208,063 lb. lead, 378,960 oz. silver, and 14,172 oz. gold from 181,077 tons of copper and 70,889 tons of lead ores, treated at the International Smelting & Refining Co.'s smelter. The total revenue was \$2,424,576; dividends, \$450,000; and surplus at end of 1913, \$772,096.

WASHINGTON

STEVENS COUNTY

The United Copper company will erect 12 five-room cottages and a hall for its married employees at Chewelah. The single men will also receive attention. The raise from the 1000-ft. level, to connect with a winze being sunk from the 600-ft. level in the ore recently cut, is up 30 ft. in ore.

CANADA

BRITISH COLUMBIA

During the week ended April 7 the Granby smelter treated 23,048 tons of ore and shipped 370,000 lb. of blister copper.

ONTARIO

At 550 ft. in the Hollinger mine, the vein has been cut, showing 10 ft. of ore. Foundations are finished for the new

power plant on Gillies lake. The building is to be of concrete, 55 by 140 ft in area. It will contain 4500 cu. ft. compressors and other equipment. In connection with this, a shaft is being sunk 230 ft below the level of the lake, and pipes will be run down the shaft from the compressors to connect with an air-chamber, where the air will be stored and regulated by the pressure of 200 ft. of water from the lake. This plant will supply air for 110 drills for the Hollinger, Acme, and Miller-Middleton properties. The present Hollinger plant can supply 50 machines, although only 37 are in use, and 12 at the Acme or Dixon claims. The Canadian Mining & Finance Co., which controls these properties, is erecting the plant. Development in the Acme mine is producing good results. The Little Pet claim, near the Dome mine, has been sold for \$100,000 to Buffalo people, headed by C. L. Suerill. At 90 ft. in the Tough-Oakes there is 12 in. of ore averaging \$500 per ton. During March the Nipissing high and low-grade mills treated 184 and 6802 tons respectively, and the refinery shipped 696,737 oz. silver. A small rich vein was opened on No. 4 level.

COSTA RICA

The Abangarez Gold Fields company treated 6635 tons of ore in January, yielding \$36,561 at a cost of \$54,632.

KOREA

The Seoul Mining Co., operating the Suan Concession, in Whang Hai province, reports the following results for March 1914:

Stamps working	40
Time, days	28.75
Ore crushed, tons	6,340
Total recovery	\$47,832
Operating expenses	22,500
Net earnings	25,332

The Oriental Consolidated Mining Co. reports that in January the Kuk San Dong 40-stamp mill worked only 15 days, and the Tabowie 80-stamp mill 25 days, on account of ore and water shortage, respectively. The 240 stamps worked 24.7 days, crushing 24,705 tons, yielding \$143,757. The net profit was \$47,292. In February the tonnage of 21,954 yielded \$149,084. There was a further shortage of water. Lessees are working at the Kuk San Dong mine. It is intended to lease the Candlestick mine, and large numbers of Koreans came to the property to be on hand to get a portion. The Taracol cyanide plant treated 1797 tons of concentrate, yielding \$45,576, with 83% recovery. The results are gratifying.

MEXICO

GUANAJUATO

At the El Durazno y Anexas property, in the Santa Rosa district, owned by Fernando Rubio Rocha, considerable work is under way. The San Nicolas del Monte vein is being developed. This orebody is also in La Asuncion ground. A 2.5 by 2.5-metre adit has been driven 425 metres into the former property. Small shipments have returned 17 kg. silver and 900 gm. gold per ton.

JALISCO

The Mutual Mining & Milling Co., of Mexico City, owning the Zapote group of copper mines in the Ameca district, probably will have its 25-ton concentrating plant ready for operation during the coming month. Some high-grade ore will be sent to the Aguascalientes smelter. The Magistral-Ameca Copper Co., owning the Magistral copper mines in the Ameca district, has started to take down the concentrating plant which was erected at the mines several years ago, and this will be rebuilt along new lines. The plant was originally designed for the treatment of ores by a flotation process. Shipments of high-grade ore to the Aguascalientes smelter will shortly be increased to 10 carloads per month.

Personal

B. H. DUNSHÉE is in Oakland for the month.

CHARLES A. CHASE was in San Francisco recently.

W. H. BLACKBURN has been in Los Angeles recently.

C. W. METCALFE was in San Francisco last Saturday.

J. PARKE CHANNING was expected at Payson, Arizona, last week.

D. W. BRUNTON was examining property in Mariposa county last week.

WILBUR H. GRANT has opened an office in the Holbrook building, San Francisco.

H. FOSTER BAIN is visiting the Searles Lake deposits of the American Trona Company.

H. V. WINCHELL and WALTER H. WILEY are at Tonopah in connection with the West End v. Jim Butler litigation.

A. D. BROKAW has been appointed assistant professor of mineralogy and economic geology in the University of Chicago.

GEORGE M. TAYLOR, general manager of the milling department of the Portland Gold Mining Co., was in San Francisco this week.

C. R. FORD, formerly with the National Mines Co., of National, Nevada, is now with the Alkalai Mines Co., of Eureka, Nevada, under the same management.

GEORGE H. GABREY, formerly chief geologist for the American Smelting & Refining Co., has opened an office as consulting mining geologist at 115 Broadway, New York City.

THE AMERICAN ELECTROCHEMICAL SOCIETY'S twenty-fifth general meeting is to be held in New York City on April 16, 17, and 18, at the Chemists' Club. Among the excursions are visits to plants of the American Smelting & Refining Co. and the United Lead Co. The papers to be presented number over 30, and those of interest to mining men are as follows: 'Progress in Leaching and Electrolytic Treatment of Copper Ores in South America,' by E. A. Smith (this is really a lecture); 'Hydro-electrometallurgy of Copper,' by Robert R. Goodrich; 'Leaching of Copper Tailings,' by Rudolph Gahl; 'Metal Inventory in an Electrolytic Copper Refinery,' by Ralph W. Deacon; 'Electrolytic Zinc,' by Joseph W. Richards; and 'Sane Economics in the Use of Energy in Electric Furnaces,' by F. A. J. Fitzgerald.

THE INSTITUTE OF METALS held its annual general meeting in London during the third week in March. The president, vice-admiral Sir Henry Oram, gave an address on modern warship machinery. Regarding condenser tubes, he said that the worst trouble was caused by their splitting while at work, in fact, they became a menace to the efficiency of the fleet. In 1908, out of 2,500,000 tubes there were 90 failures; but in 1912 and 1913 there were only 131 failures out of 3,800,000 tubes at work.

THE ILLINOIS MINERS' AND MECHANICS' INSTITUTES, under the direction of R. Y. Williams, have authority to promote the technical efficiency of persons working in and about mines of the state, and to assist them to better overcome the increasing difficulties of mining. There are 79,411 men employed at the coal mines. *Bulletin* No. 2 outlines the methods to be used in this work, and the subjects of instruction.

BULLION received at the San Francisco Mint in March was as follows: gold, 163,068.981 fine oz.; and silver, 15,432.84 fine oz., with total value of \$3,379,577.48. The coinage executed was \$2,154,000, and ₱43,000 for the Philippines.

Society Meetings

APRIL

Name.	Date.
American Electro-Chemical Society	16-18
Institution of Mining and Metallurgy.....London....	16

MAY

American Iron and Steel Institute	22
Geological Society of America (Cordilleran Section), Seattle	21-23
Institution of Mining and Metallurgy.....London....	21
Mining and Metallurgical Society...San Francisco....	4
National Fire Protection Association	5-7

JUNE

American Institute of Electrical Engineers	22 or 26
American Society for Testing Materials	23-27
American Society of Mechanical Engineers.....end of June	
Colorado Scientific Society, Denver.....	6
Franklin Institute	Philadelphia.....end of June
Society for the Promotion of Engineering Educa- tion	29 to July 2

AUGUST

American Inst. Mining Engineers..Salt Lake City....	10-14
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SEPTEMBER

American Chemical Society	9-12
American Institute of Electrical Engineers.....not fixed	
Colorado Scientific Society, Denver.....	3

OCTOBER

American Institute of Electrical Engineers.....	9
American Iron and Steel Institute	23-24
Colorado Scientific Society, Denver.....	3

NOVEMBER

American Institute of Electrical Engineers	13
Colorado Scientific Society, Denver.....	7

DECEMBER

American Institute of Electrical Engineers	11
American Society of Mechanical Engineers	7-8
American Museum of Safety	11-20
Colorado Scientific Society, Denver.....	5 and 19
Geological Society of America, Philadelphia.....	29-31
Society of Gas Lighting (annual meeting).....	10
Society of Naval Architects	11-12

SEPTEMBER 1915

American Institute of Mining Engineers, San Francisco	27-30
Engineering Congress, San Francisco.....	20-25

Schools and Societies

THE Chicago section of the Illuminating Engineering Society met on April 10, when papers on railway signals were discussed.

EFFICIENCY SYSTEMS and their effect on industrial relations were considered by the United States Commission on Industrial Relations at public hearings held in Washington, D. C., on April 13, 14, and 15.

LEHIGH UNIVERSITY students, on March 28, visited the Cornwall Ore Banks Co.'s mine at Cornwall, Pennsylvania, and on April 4 inspected the mine of the Empire Steel & Iron Co. at Mt. Hope, New Jersey.

THE FOREST PRODUCTS EXPOSITION, to be held at Chicago in the Coliseum, April 30 to May 9, and at New York in the Grand Central Palace, May 21 to 30, inclusive, gives every assurance of being one of the most representative and comprehensive industrial expositions of this kind which has been held in the history of the industry.

The Metal Markets

LOCAL METAL PRICES

San Francisco, April 16

Antimony	9 — 9 3/4 c
Electrolytic copper	15 1/2 — 15 3/4 c
Pig lead	4 05 — 5 00
Quicksilver (flask)	\$39.00
Tin	40 1/2 — 42 c
Spelter	6 1/2 — 6 3/4 c
Zinc dust, 100 kg zinc-lined cases, 7 1/2 to 8 c per pound.	

EASTERN METAL MARKET

(By wire from New York.)

NEW YORK, April 16.—There is not much to note about the market, copper being practically stationary, with little business being done; lead is quiet, and spelter is weak. Bar silver is 58 1/4 c per ounce. Tin is weak at 35.85 to 36.15c. Antimony is dull, Cookson's being quoted at 7.25c. Trading on the Stock Exchange is improving, but uneasiness prevails in financial circles. In London, lead is f18, spelter, f21 10s; copper, f64 15s, and tin, f164 15s, per ton, respectively; and bar silver steady at 26 8 1/2 d. per ounce.

SILVER

Below are given the average New York quotations in cents per ounce, of fine silver.

Date	Average week ending
Apr. 9	58.50
" 10 Good Friday	58.25
" 11	58.25
" 12 Sunday	58.06
" 13	58.25
" 14	58.25
" 15	58.25

Monthly averages.

	1913.	1914.		1913.	1914.
Jan.	63.01	57.58	July	58.70	.....
Feb.	61.25	57.53	Aug.	59.32	.....
Mch.	57.87	58.01	Sept.	60.53	.....
Apr.	59.26	.....	Oct.	60.88	.....
May	60.21	.....	Nov.	58.76	.....
June	59.03	.....	Dec.	57.73	.....

In spite of the small movements in prices during the week ended March 26, business has been more brisk, according to Pixley and Abell, of London. Most of the buying has come from the Indian bazaars, some of it for shipment by this week's steamer, which takes approximately £200,000, and some in anticipation of their requirements later on. The Continent also has bought moderately. Trade in China is very quiet, and, although a few selling orders have been in evidence, the amounts were insufficient to depress rates. Owing to some liquidation of the bull account, the cash position has for the time being become easier, and cash and forward have been quoted at the same level since April 20, but as most of this silver was bought for consumption, and supplies will be restricted for some months, future cash demand will not be easily met, especially as the bull account is now a negligible quantity. It is possible, however, that, as the bazaars have bought freely just lately, there may be a period of quietness and therefore the effect of small stocks may take a little time to influence rates. The decline in the production of Mexico during 1913 is important, and it is probable that since January 1 of this year the rate of production has been still further decreased.

COPPER

Quotations on copper as published in this column represent average wholesale transactions on the New York market and refer to electrolytic copper. Lake copper commands normally 1-5 to 1-4c. per lb. more. Prices are in cents per pound.

Date	Average week ending
Apr. 9	14.35
" 10	14.30
" 11	14.25
" 12 Sunday	14.18
" 13	14.25
" 14	14.25
" 15	14.25

Monthly averages.

Monthly Averages.					
	1913.	1914.		1913.	1914.
Jan.	16.54	14.21	July	14.21	....
Feb.	14.93	14.46	Aug.	15.42	....
Mch.	14.72	14.11	Sept.	16.23	....
Apr.	15.22	....	Oct.	16.31	....
May	15.42	....	Nov.	15.08	....
June	14.71	....	Dec.	14.25	....

Figures showing the production of metallic copper last year in Russia are now published and show that between 1913 and

1912 little progress was made. This is due to a considerable reduction in the quantity of copper produced in the Urals mining district. In the other copper-producing areas good progress has been made. The quantity produced last year made 2,095,000 pounds (1 pound weighs 16 lb.), against 2,047,000 in 1912 and 1,564,000 in 1911. The tendency of Russian copper production is not toward a decline, but on the contrary it is still making for greater progress than ever. Several of the large Urals smelters are being transformed and have therefore been laid idle for this particular purpose. Obviously, therefore, while the period of transformation necessitated a setback in the production, it indicates a more intensive production than ever in the near future.

German copper consumption during January and February was 34,433 tons, against 30,875 tons in 1913. Of the 1914 consumption, 30,902 tons was imported from the United States, according to L. Vogelstein & Company.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date	Average week ending
Apr. 9	3.80
" 10	3.80
" 11	3.80
" 12 Sunday	3.80
" 13	3.80
" 14	3.80
" 15	3.80

Monthly averages.

	1913.	1914.		1913.	1914.
Jan.	4.28	4.11	July	4.35	.....
Feb.	4.33	4.02	Aug.	4.60	.....
Mch.	4.32	3.94	Sept.	4.70	.....
Apr.	4.36	.....	Oct.	4.37	.....
May	4.34	.....	Nov.	4.16	.....
June	4.33	.....	Dec.	4.02	.....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending	Apr. 2
Mch. 19	39.50
" 26	39.00

Monthly averages.

1913.		1914.	1913.		1914.
Jan.	39.37	39.25	July	41.00	.....
Feb.	41.00	39.00	Aug.	40.50	.....
Mch.	40.20	39.00	Sept.	39.70	.....
Apr.	41.00	.....	Oct.	39.37	.....
May	40.25	.....	Nov.	39.40	.....
June	41.00	.....	Dec.	40.00	.....

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date	Average week ending
Apr. 9	5.00
" 10	5.00
" 11	5.00
" 12 Sunday	5.00
" 13	5.00
" 14	5.00
" 15	5.00

Monthly averages.

	1913.	1914.		1913.	1914.
Jan.	6.88	5.14	July	5.11	....
Feb.	6.13	5.22	Aug.	5.51	....
Mch.	5.94	5.12	Sept.	5.55	....
Apr.	5.52	....	Oct.	5.22	....
May	5.23	....	Nov.	5.09	....
June	5.00	....	Dec.	5.07	....

TIN

New York prices control in the American market for tin, since the metal is almost entirely imported. San Francisco quotations average about 5c. per lb. higher. Below are given average monthly New York quotations, in cents per pound:

Monthly averages.

	1913.	1914.		1913.	1914
Jan.	50.45	37.85	July	40.70	....
Feb.	49.07	39.76	Aug.	41.75	....
Mch.	46.95	38.10	Sept.	42.45	....
Apr.	49.00	....	Oct.	40.61	....
May	49.10	....	Nov.	39.77	....
June	45.10	....	Dec.	37.57	....

The Stock Markets

SAN FRANCISCO STOCKS AND BONDS

(San Francisco Stock and Bond Exchange.)

April 15.

BONDS

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Associated Oil 6s	98		Natomas Consol. 6s	—	26
Unlisted.			Pac. Port. Cement 6s	—	—
Ass. Oil 6s	—	—	Santa Cruz Cement 6s	43	—
General Petroleum 6s	39	41	Union Oil	—	—

STOCKS

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Amalgamated Oil	76	—	General Petroleum	2	—
Associated Oil	38	39	Noble Electric Steel	85c	—
Giant	83	86	Natomas Consol.	14	—
Pac. Cat Borax, com	—	57	Pac. Port. Cement	90	94
Pacific Crude Oil	—	30c	Riverside Cement	—	63
Sterling O. & D.	—	1.25	Santa Cruz Cement	43	—
			Stand. Port. Cement	19	—

NEVADA STOCKS

(By courtesy of Nevada Stock Exchange.)

April 16.

Atlanta	\$.57	Montana-Tonopah	\$.89
Belcher .....	.40	Nevada Hills .....	.29
Belmont	7.90	North Star .....	.32
Con. Virginia .....	.21	Ophir .....	.37
Florence .....	.55	Pittsburg Silver Peak .....	.32
Goldfield Con.	1.42	Round Mountain .....	.26
Goldfield Oro .....	.11	Sierra Nevada .....	.14
Halifax .....	.80	Tonopah Extension	1.95
Jim Butler .....	.95	Tonopah Merger .....	.59
Jumbo Extension .....	.27	Tonopah of Nevada	6.70
MacNamara .....	.07	Union .....	.10
Mexican	1.10	Victor .....	.33
Midway .....	.36	West End .....	.53
Mispah Extension .....	.44	Yellow Jacket .....	.29

CALIFORNIA STOCKS

(Latest Quotations.)

	Bid.	Ask.		Bid.	Ask.
Argonaut	\$2.75	...	Central Eureka ..	\$0.55	...
Brunswick Con.	\$1.05	...	Mountain King ...	0.30	...
Bunker Hill	1.90	...	South Eureka	1.50	...

COPPER SHARES—BOSTON

(By courtesy of J. C. Wilson, Mills Building.)

April 16.

	Bid	Ask		Bid	Ask
Allouez	\$ 10	41	Mohawk	\$ 43	44
Ariz. Commercial	4	41	Nevada Con.	14	15
Butte & Superior	35	35	North Butte	26	26
Calumet & Arizona	68	68	Old Dominion	49	50
Calumet & Hecla	416	420	Osceola	77	79
Copper Range	37	37	Quincy	58	59
Daly West	2	21	Shannon	54	54
East Butte	10	11	Superior & Boston	2	2
Franklin	54	54	Tamarack	42	43
Granby	81	82	U. S. Smelting, com	37	37
Greene Cananea	34	35	Utah Con.	10	11
Ile-Royale	18	19	Winona	3	3
Mass Copper	3	4	Wolverine	43	45

NEW YORK CURB QUOTATIONS

(By courtesy of E. F. Hutton & Co., Kohl Building.)

April 16.

	Bid.	Ask.		Bid.	Ask.
Braden Copper	8	8 1/8	La Rose	1 1/2	1 5/8
Braden 6s	160	165	Mason Valley	3	3 3/8
B. C. Copper	1 1/4	1 7/8	McKinley-Dar.	73c	75c
Con. Cop. Mines	2 1/8	2 3/8	Mines Co. Am.	2 3/8	2 5/8
Davis-Daly	1 1/2	5/8	Nipissing	6 3/8	6 5/8
Ely Con.	4	6	Ohio Copper	1/4	3/8
First National	1 1/2	1 5/8	Stand. Oil of Cal.	306	308
Giroux	3 1/4	1	Tri Bullion	1/4	1/2
Hollinger	16 3/4	17 1/2	Tuolumne	1/2	3/4
Iron Blossom	1.25	1.30	United Cop. com.	1/4	3/4
Kerr Lake	4 3/8	4 1/2	Yukon Gold	2 3/4	2 7/8

NEW YORK STOCK EXCHANGE

(By courtesy of J. C. Wilson, Mills Building.)

April 16.

	Bid	Ask		Bid	Ask
Amalgamated	\$ 73 1/2	74	Miami	\$ 23 1/2	23 3/4
Anacosta	34	34 1/2	Nevada Con.	14 1/2	15
A. S. & R., com	66 1/2	66 1/2	Quicksilver, com	1 1/2	2 1/4
Calif. Pet., com	23 1/2	23 1/2	Ray Con.	21	21 1/4
Chino	40 1/2	40 1/2	Tenn. Copper	33 1/2	34
Guggenheim Ex.	53	53 1/2	U. S. Steel, pf'd.	109	109 1/2
Inspiration	17 1/2	17 1/2	U. S. Steel, com	58 1/2	58 3/4
Mexican Pet., com	64 1/2	65	Utah Copper	56	56 1/2

LONDON QUOTATIONS

(By cable, through the courtesy of Catlin & Powell Co., New York.)

April 16.

	£	s.	d.		£	s.	d.
Alaska Mexican	1	7	6	Mexican Eagle, com	1	17	6
Alaska Treadwell	8	5	0	Mexico Mines	5	0	0
Alaska United	3	2	6	Messina	1	8	9
Arizona	1	18	9	Oroville	0	12	6
Camp Bird	0	12	6	Pacific Oilfields	0	2	6
Cobalt Townsite	2	3	9	Rio Tinto	71	15	0
El Oro	0	13	9	Santa Gertrudis	0	15	0
Esperanza	0	15	0	Tanganyika	2	5	0
Granville	0	10	0	Tomboy	1	1	3
Kern River Oilfields	0	8	9				

AUSTRALASIAN

April 16.

	£	s.	d.		£	s.	d.
British Broken Hill	2	1	3	Mount Elliott	3	15	0
Broken Hill Prop.	1	17	6	Mount Lyell	1	7	6
Golden Horse-Shoe	2	12	6	Mount Morgan	3	2	6
Great Boulder Prop.	0	15	0	Waihi	2	5	0
Ivanhoe	2	16	9	Waihi Grand Junc.	1	6	3
Kalgurli	1	17	6	Zinc Corporation, Ord.	1	1	3
Mount Boppy	0	12	6				

Copper and Spelter Production

The following table shows the production of these metals, in metric tons, during the past 10 years, and how one has kept pace with the other:

	Copper:		Spelter:	
	Produc- tion.	Consump- tion.	Produc- tion.	Consump- tion.
1913 (estimated) ...	1,000,716	1,020,000	1,001,100	1,046,000
1912	1,019,800	1,040,200	977,900	987,500
1911	893,400	953,700	902,100	903,200
1910	887,900	913,700	816,600	827,000
1909	849,200	787,500	783,200	798,900
1908	757,800	706,500	722,100	730,500
1907	712,000	663,600	738,400	743,200
1906	720,600	722,600	702,000	705,200
1905	693,900	727,400	658,700	663,800
1904	647,900	662,500	625,400	629,300

The value of the 1913 output is approximately \$330,000,000 and \$113,000,000, respectively. The United States produces 56% of the world's output of copper and 32% of the spelter.

Portland Cement Production

Final figures for the portland cement industry in 1913, as obtained by the U. S. Geological Survey on March 16, show a production of 92,097,131 bbl., shipments of 88,689,377 bbl., and stocks on hand 11,220,328 bbl. It is somewhat interesting to compare these figures with the estimates made by the Survey on January 15. These estimates were as follows: production, 92,406,000 bbl.; shipments, 88,853,000 bbl.; and stocks on hand, 11,375,000 bbl., the percentage of error ranging from only 0.003 in production to about 0.01 in stocks on hand.

IRON ORE at Lake Erie docks on April 1 amounted to 6,925,678 tons, against 6,728,035 on the same date of last year. Shipments from docks to furnaces were 820,741 tons, the lightest for three years.

Company Reports

DREDGING COMPANIES IN VICTORIA, AUSTRALIA

During the three months ended February 28, 30 dredges in the Bright district produced 8138 oz. of gold, valued at \$154,000. During the term the following companies paid dividends: Reliance, \$11,520; Confidence, \$5280; Owens Valley, \$3510; Wandiligong, \$10,080; Porepunkah, \$2400; Buckland Star, \$1920; Buckland River, \$1680; Phoenix Syndicate, \$1680; Excelsior, \$1440; Maori Queen, \$2010; Kia Ora, \$1100; and Harriettville Star, \$1200; a total of \$43,850.

TEWKSBURY AMALGAMATED GOLD DREDGING CO., VICTORIA

During the half-year ended December 31, 1913, only three dredges out of five were in commission. They handled 447,792 cu. yd. of gravel, yielding 6.3c. per yard. The average cost was 5.57c. per yard. Only two boats worked at a profit, while the profit was only \$3400. The managing director, P. W. Tewksbury, does not hold out much encouragement for further work.

WANDILIGONG GOLD DREDGING CO., VICTORIA

During the half-year ended on January 31, 1914, this Company, with two boats at work, treated 265,393 cu. yd., yielding 1536 oz., valued at \$30,250. The total output to date is 19,007 oz., worth \$370,000. The paid-up capital of the Company is only \$25,920, but it has paid \$103,250 in dividends, or \$17.20 on each \$5 share. The Company's claims are approaching exhaustion, particularly that area allotted to No. 2 dredge, which has only a few months' work left, while No. 1 plant has about 12 months' work before it. The Company has \$6480 on fixed deposit and a cash balance of \$9120.

TOLIMA MINING COMPANY, LIMITED

This Company owns the Frias silver mines, a property of 3000 acres in Tolima, Colombia. The report for the year ended June 30, 1913, gives the total amount of mineral exported during the year as 896 tons, with an average assay value of 467.9 oz. silver per ton. The price of silver for the year gave an average of 29 $\frac{3}{4}$ d. per oz., and the profit on revenue account was \$25,000. During the year 17,134 tons of ore was raised to the surface, which gave 9720 tons of ore for cobbing and treatment in the mill producing 884.69 tons of mineral for export, having an average assay value of 469.92 oz. silver per ton, giving a total production of 415,740 oz. of fine silver. The lead content gave an average for the year of 15.7%; the value of the lead contained was \$11,500. Reserves were estimated at 1448 tons averaging 400 oz. per ton. The prospects of the mine are good. A dividend of 12c. per share was paid.

OLD DOMINION COPPER MINING & SMELTING CO. UNITED GLOBE MINES COMPANY

This Company operates at Globe, Arizona, and the report covers the year 1913. A total of 169,961 tons of three grades of ore was mined, averaging 5.88% copper, at a cost of \$4.78 per ton. On account of various improvements in the mine, it was not until December that operations underground were normal. The new crushing and sampling plant has a capacity of 100 tons per hour. A geological department was organized toward the end of the year, and better results from prospecting and development are expected. The new 500-ton concentrating plant will hardly be running before next August. Results were as follows:

Copper, pounds	31,061,645
Silver, ounces	193,845
Gold, ounces	4,254

Of this, 12,116,492 lb. copper, 142,528 oz. silver, and 3835 oz. gold was obtained from custom ores.

Revenue from all sources	\$3,957,107
Profit	1,943,793
Dividends	810,000
Surplus at end of 1913	1,193,247

The United Globe Mines Co. is controlled by the old Dominion company. Its report for last year shows that the most important development was on the No. 16 level, where from 16 to 30 ft. of 3.5 to 7% copper ore was opened. The flow of water on this level is about 650,000 gal. per day. A 100,000-cu. ft. fan was installed at the Kingdom shaft and has improved the ventilation. An electric hoist and new change house are to be erected at the Grey shaft. A total of 167,917 tons of oxidized, sulphide, concentrating, and silica fluing ores was mined, including 5084 tons of old slag. The revenue was \$1,221,052; expenses, \$739,606; and profit, 481,445. With the previous surplus the sum available was \$1,062,739, of which \$690,000 was paid in dividends, leaving the present surplus of \$372,739.

UNITED STATES SMELTING, REFINING & MINING COMPANY

Operations conducted by this well known Company at its mines and smelters in the United States, and mines in Mexico, resulted as follows in 1913:

	1913.	1912.
Metal output		
Copper, pounds	20,239,973	21,152,620
Lead, pounds	58,116,504	56,385,769
Silver, ounces	13,089,708	12,059,829
Gold, ounces	148,372	140,183

The average price received for the metals was copper, 15.433c.; and lead, 4.396c. per lb.; and silver, 60.503c. per ounce.

Income account for the past two years shows the following:

	1913.	1912.
Earnings of all companies, less production cost, etc.	\$4,555,122	\$5,497,965
Depreciation, improvements, etc.	969,536	1,265,000
Profit	3,585,586	4,232,965
Preferred dividends	1,702,144	1,702,120
Common dividends	1,053,322	877,762
Surplus	830,120	1,418,083
Previous surplus	3,648,722	2,230,639
Total surplus	4,478,842	3,648,722

The assets include ores and matte, \$1,011,112; supplies of fuel and timber, \$1,392,273; metal in ore and on hand, \$3,148,897, and cash, \$3,455,647.

The coal properties in Utah, controlled by a subsidiary company produced 869,522 tons of coal, 40% over that of 1912, and the profits were equivalent to 4.35% on the investment, after providing for certain changes. The Bingham mines produced 78,165 tons of lead and 123,757 tons of copper ores. Work was started on the Niagara mine. From the Centennial-Eureka 100,442 tons of lead-copper-silver ore was mined. Developments were fairly satisfactory. The Midvale smelter worked throughout the year. Further improvements are to be made. The concentrating mill and Huff electrostatic separating plant did good work. The lime company produced 109,224 tons of limestone. The Mammoth copper mine in California is opening well. The lead refinery at Grasselli, Indiana, and the copper refinery at Chrome, New Jersey, were improved, and worked steadily, as also did the smelter at Chrome. In Arizona the Gold Road mine yielded 103,628 tons of ore. The mine is looking fair but the average ore developed was rather low. The Needles mill worked continuously, but the smelter only a short time. The Real Del Monte y Pachuca mines in Mexico worked without interruption. The monthly tonnage has been increased from 36,000 to 50,000 tons, while additions to the mills will further increase the output. Ore reserves in the eight mines being operated are larger than before. Additional ground has been secured. The Last Chance claims, at Bingham, Utah, were acquired and developments appear promising.

Monthly Copper Production

AHMEEK COPPER MINING CO., Kearsarge, Michigan. \$1.-250,000 in \$25 shares; 24,796 shares owned by Calumet & Hecla; 1800-ton mill at Hubbell; concentrate smelted by Calumet & Hecla smelter. Total in 1913, 9,100,000 pounds.

ALLOUEZ MINING CO., Allouez, Michigan. \$2,500,000 in \$25 shares; controlled by the Calumet & Hecla, which owns 43,000 shares and \$250,000 in notes of the Company; ore is milled by the Lake Milling, Smelting & Refining Co., in which the Allouez owns half. Total in 1913, 4,091,129 pounds.

ANACONDA COPPER MINING CO., Butte, Montana. \$108,312.-500 in \$25 shares; controlled through Amalgamated Copper Co. by Thos. F. Cole, J. D. Ryan, and Standard Oil interests; 10,000-ton concentrator and smelter at Anaconda; 5000-ton concentrator and smelter at Great Falls, Mont.; also 70-ton electrolytic refining plant at Great Falls. Production figures include copper from all companies which ship custom ore to Anaconda smelters.

Month.	Pounds.	Month.	Pounds.
January 1914.....	24,400,000	March	23,800,000
February	21,300,000		

ARIZONA COPPER CO., LTD., Morenci, Arizona. £703,894, of which £379,974 is in 5s. ordinary shares, £500,000 in 5% debentures; controlled by Edinburgh Investors; mill at Morenci is being enlarged to 3000-ton capacity and a new 1200-ton smelter near Clifton has just been started.

Month.	Pounds.	Month.	Pounds.
January 1914.....	3,474,000	February	3,063,000

BRADEN COPPER CO., La Junta, Chile. \$2,332,030 in \$10 shares and \$4,000,000 in 6% convertible bonds; entire stock held by Braden Copper Mines Co.; \$12,000,000 in \$5 shares; \$5,000,000 in convertible bonds; controlled by Guggenheim interests; two mills at La Junta; 3000-ton capacity smelter at Racagua.

Month.	Pounds.	Month.	Pounds.
January 1914.....	2,426,000	March	1,801,000
February	2,862,000		

BRITISH COLUMBIA COPPER CO., LTD., Greenwood, B. C. \$2,958,545 in \$5 shares; controlled by Newman Erb; 600-ton sampling plant and 2500-ton smelter.

Month.	Pounds.	Month.	Pounds.
July	618,379	October	688,000
August	700,000	November	682,383
September	626,761	December (est.)	800,000

CALUMET & ARIZONA MINING CO., Warren, Arizona. \$6,285,710 in \$10 shares; has absorbed the Superior & Pittsburg Copper Co. by stock exchange; controlled by Hoatson and other Lake Superior interests; 3000-ton smelter at Douglas. Total in 1913, 52,987,383 lb., 880,915 oz. silver, 18,989 oz. gold.

Month.	Pounds.	Month.	Pounds.
January 1914	5,798,464	March	5,870,000
February	5,948,900		

CALUMET & HECLA MINING CO., Calumet, Michigan. \$2,500,000 in \$25 shares; controls the Ahmeek, Allouez, Centennial, Isle Royale, La Salle, Osceola, Tamarack, and Superior copper mining companies, as well as a number that are non-productive; controlled by Agassiz and Shaw interests; 2 mills on Lake Linden, capacity 15,000 tons; smelter Hubbell, Mich.; electrolytic refinery and smelter at Buffalo, N. Y.; figures include output of subsidiaries. Total in 1913, 53,420,000 pounds.

CANANEA CONSOLIDATED COPPER CO. S. A., Cananea, Sonora, Mexico. Capital \$20,000 in shares of \$100; entire stock owned by Greene Consolidated Copper Co.; \$10,000,000 in \$10 shares; 945,320 shares are held by Greene Cananea Copper Co.; \$50,000,000 in \$100 shares, which is controlled by Thos. F. Cole and J. D. Ryan; 2 mills and smelter at Cananea, 3000-ton capacity. Total in 1913, 37,050,574 pounds. Output does not include copper from custom ores, which amounts to about 600,000 lb. per month, exclusive of Miami.

Month.	Pounds.	Month.	Pounds.
February	2,282,000	March	3,510,000

CENTENNIAL COPPER MINING CO., Calumet, Michigan. \$2,250,000 in \$25 shares; 44,350 shares are held by Calumet & Hecla Mining Co.; ore milled by Lake Milling, Smelting & Refining Co. Total in 1913, 1,400,000 pounds.

CERRO DE PASCO MINING CO., Cerro de Pasco, Peru. \$10,000,000; entire stock held by Cerro de Pasco Copper Co.; \$60,000,000 in \$1 shares which is owned by Cerro de Pasco Investment Co., which is controlled by J. B. Haggin, and Morgan

estate; 3000-ton smelter at La Fundicion; monthly production figures not given out; output in 1912 was 45,000,000 lb. copper.

CHINO COPPER CO., Santa Rita, New Mexico. \$3,500,000 in \$5 shares; 121,200 shares are held by Guggenheim Exploration Co.; controlled by Sherwood Aldrich and C. M. MacNeill; 5000-ton mill at Hurley, N. M.; concentrate smelted at El Paso.

Month.	Pounds.	Month.	Pounds.
January 1914.....	6,138,140	February	5,769,948

CONSOLIDATED COPPER MINES CO., Ely, Nev. \$3,000,000 in \$5 shares; \$3,000,000 in convertible bonds; is a recent merger of the Giroux, Butte & Ely, Chalmers, and Coppermines companies, controlled by Thos. F. Cole, Wm. B. Thompson, Charles F. Rand, and Jas. Phillips, Jr.; reduction plant not yet built; production so far derived solely from Giroux; ore treated at Nevada Con. smelter.

Month.	Pounds.	Month.	Pounds.
August	541,189	November	136,539
September	204,307	December	197,649
October	160,911	January 1914	148,411

COPPER QUEEN CONSOLIDATED MINING CO., Bisbee, Arizona. \$2,000,000 in \$10 shares; owns 100,000 shares of Greene Cananea; almost all its stock is held by Phelps, Dodge & Co., Inc.; \$44,995,000 in \$100 shares; 4000-ton smelting plant at Douglas, Ariz. Total in 1913, 85,389,630 pounds.

Month.	Pounds.	Month.	Pounds.
January 1914.....	8,099,847	March	7,122,739
February	6,448,770		

COPPER RANGE CONSOLIDATED MINING CO., Painedale, Michigan. \$39,369,200, in \$100 shares; owns 99,659 shares of Baltic M. Co., 99,699 shares Copper Range M. Co., 99,345 shares of Tri-mountain M. Co., half interest in Champion Copper Co., 16,392 shares of Copper Range R. R. Co., and \$870,000 in Copper Range R. R. bonds; controlled by Wm. A. Paine; production is derived from the Baltic, Champion, and Tri-mountain companies, each of which mills its ore; concentrate is smelted by Michigan Smelting Co., Houghton, which is owned by mining companies. Total in 1913, 24,996,000 pounds.

Month.	Pounds.	Month.	Pounds.
January 1914	3,276,000	March	3,834,000
February	3,518,000		

DETROIT COPPER MINING CO., Morenci, Ariz. \$1,000,000 in \$25 shares; owned by Phelps, Dodge & Co.; 1300-ton mill and 350-ton smelter. Total in 1913, 22,352,299 pounds.

Month.	Pounds.	Month.	Pounds.
January 1914.....	1,590,681	March	1,973,725
February	1,814,214		

EAST BUTTE COPPER MINING CO., Butte, Mont. \$3,000,000 in \$10 shares; owns 83% of the stock and all bonds of the Pittsmtont Copper Co., which holds 90% of the stock and all bonds of Pittsburgh & Montana Copper Co.; controlled by Wm. A. Paine; 350-ton mill and 1000-ton custom smelter. Total in 1913, 14,401,108 pounds.

Month.	Pounds.	Month.	Pounds.
January 1914	1,088,862	March	1,530,717
February	1,182,063		

FRANKLIN MINING CO., Demmon, Mich. \$4,166,650 in \$25 shares; controlled by R. M. Edwards and the U. S. S. R. & M. Co.; 1000-ton mill. Total in 1913, 1,040,000 pounds.

GRANBY CONSOLIDATED MINING, SMELTING & POWER CO., LTD., Phoenix and Hidden Creek, British Columbia. \$14.-849,565 in \$100 shares; controlled by General Chemical Co. interests; 4400-ton smelter at Grand Forks and 2000-ton smelter at Anyox. Total in 1913, 21,511,747 pounds.

Month.	Pounds.	Month.	Pounds.
January 1914	1,793,840	February	1,661,212

GREAT COBAR, LIMITED., Cobar, New South Wales. £1,000.-000 in 200,000 shares of £5 each; also 6% first-mortgage debentures. Operates gold, copper, and coal mines, coke works, flotation concentration plant, blast-furnaces, and a refining plant. During past fiscal year treated 361,566 tons for 13,016,640 lb. copper, 27,136 oz. gold, and 127,542 oz. silver.

Month.	Pounds.	Month.	Pounds.
January	1,137,920	February	898,240

HAMPDEN CLONCURRY COPPER MINES, LIMITED., Cloncurry, Queensland. £400,000 in shares of £1 each; 350,000 issued. During past fiscal year treated 24,744 tons for 5,815,040 lb. copper, 818 oz. gold, and 24,457 oz. silver.

Month.	Pounds.	Month.	Pounds.
January	929,600	February	1,321,600

MASON VALLEY MINES CO., Yarnston, Nev. \$750,000 in \$5 shares; \$1,000,000 in 6% convertible bonds; controlled by W. B. Thompson, 1000-ton smelter at Thompson, Nev.; also smelter ore of Nevada-Douglas Copper Co. and custom ore; smelter production. Total in 1913, 14,641,000 pounds.

Month.	Pounds.	Month.	Pounds.
January 1914	944,000	March	992,000
February	1,254,000		

MIAMI COPPER CO., Miami, Ariz. 146,200 \$5 shares issued; \$2,200,000 in 6% bonds convertible at \$11 outstanding; controlled by General Development Co. (Lewisohn interests); 3000-ton mill at Miami; concentrate smelted at Chacabana. Total in 1913, 33,944,795 pounds.

Month.	Pounds.	Month.	Pounds.
January 1914	3,258,950	March	3,361,100
February	3,193,300		

MOCTEZUMA COPPER CO., Nacozari, Sonora, Mexico. \$2,000,000; entire stock owned by Phelps, Dodge & Co.; 2000-ton mill; concentrate smelted by Copper Queen, Co.; Total in 1913, 36,691,013 pounds.

Month.	Pounds.	Month.	Pounds.
January 1914	3,024,556	March	2,882,884
February	2,642,543		

MOHAWK MINING CO., Mohawk, Mich. \$2,500,000 in \$25 shares; controlled by Stanton interests; 3000-ton mill, Traverse bay; concentrate smelted by Michigan Smelting Co. Total in 1913, 8,016,000 pounds.

Month.	Pounds.	Month.	Pounds.
January 1914	3,024,556	March	2,882,884
February	2,642,543		

MOUNT ELLIOTT, LIMITED., Cloncurry, Queensland. £750,000 in 150,000 shares of 5 each. During past fiscal year treated 41,623 tons for 10,373,440 lb. copper, 8757 oz. gold, and 7285 oz. silver.

Month.	Pounds.	Month.	Pounds.
January	891,520	February	875,840

MOUNT LYELL MINING & RAILWAY CO., LTD., Queenstown, Tasmania. 1,300,000 shares of £1 each. Operates an extensive copper property, two railways, blast-furnaces, converters, and three superphosphate works in Australia. During past fiscal half-year treated 142,615 tons for 5,470,080 lb. copper, 187,097 oz. silver, and 4050 oz. gold.

Month.	Pounds.	Month.	Pounds.
Dec. 25 to Jan. 21	911,680	Jan. 22 to Feb. 18	1,189,440

MOUNT MORGAN GOLD MINING CO., LIMITED. Operates a large gold and copper mine near Rockhampton, Queensland, a pyrite mine, iron and limestone quarries, a coal mine, concentrating plant being built, blast-furnace plant, and controls an electrolytic refinery at Port Kembla, New South Wales. During past half-year treated 152,016 tons for 9,741,960 lb. copper and 51,982 oz. gold.

Month.	Pounds.	Month.	Pounds.
Jan. 11 to Feb. 8	1,283,520	Feb. 8 to Mar. 8	1,106,560

NEVADA CONSOLIDATED COPPER CO., Ely, Nevada. \$10,000,000 in \$5 shares; has absorbed the Cumberland-Ely Copper Co.; controlled by American Smelters Securities Co. through the Utah Copper Co., which owns half of the Nevada Con. stock; the Nevada company owns the Steptoe Valley Mining & Smelting Co., \$10,000,000; 16,000-ton mill and 1500-ton smelter at McGill, Nevada. Total in 1913, 64,972,829 pounds.

Month.	Pounds.	Month.	Pounds.
January 1914	5,791,122	February	4,588,243

NEVADA DOUGLAS COPPER CO., Mason, Nev. \$4,054,800 in \$5 shares; \$276,900 in 6% convertible bonds; also \$158,200 6% refunding bonds; controlled by A. J. Orem; ore smelted at Mason Valley smelter.

Month.	Pounds.	Month.	Pounds.
January 1914	409,733	February	387,287

OHIO COPPER CO., Bingham, Utah. \$12,292,700 in \$10 shares; \$1,326,000 in 6% convertible bonds; 3500-ton mill at Lark, Utah; concentrate smelted at Garfield.

Month.	Pounds.	Month.	Pounds.
January 1914	722,400	March	616,129
February	599,391		

OLD DOMINION COPPER MINING & SMELTING CO., Globe, Ariz. \$4,050,000 in \$25 shares; 155,245 shares are owned by the Old Dominion Co., which is owned by Phelps, Dodge & Co.; 300-ton mill, 2400-ton smelter. Production figures include custom ore smelted. Total in 1913, 31,061,645 pounds.

Month.	Pounds.	Month.	Pounds.
January 1914	2,797,000	March	2,997,000
February	3,066,000		

OSCEOLA CONSOLIDATED MINING CO., Osceola, Mich. \$2,403,750 in \$25 shares; owned by Calumet & Hecla; 2 mills, 4000-ton capacity, at Torch Lake. Total in 1913, 11,325,010 pounds.

PHILIPS, DODGE & CO., Inc. \$11,295,000 in \$100 shares; controlled by C. H. Dodge, James Douglas, and others; owns the Copper Queen, Montezuma, Detroit, and Huron Mountain copper companies, Stag Canon Fuel Co. indirectly controls Old Dominion United Globe and Commercial Copper Mining Co.; members of the firm control the El Paso & Southwestern railway, and have large interests in the Rock Island and Great Northern railways. Production figures include all properties under its control and copper derived from custom ore, the latter ranging from 750,000 to 1,000,000 lb. per month. Total in 1913, 151,151,144 pounds.

Month.	Pounds.	Month.	Pounds.
January 1914	13,411,695	March	12,493,651
February	11,441,123		

QUINCY MINING CO., Hancock, Mich. \$2,750,000 in \$25 shares; controlled by W. R. Todd; 4500-ton mill at Mason, 340-ton smelter at Ripley.

Month.	Pounds.	Month.	Pounds.
January 1914	1,434,000	February	1,632,000

RAY CONSOLIDATED COPPER CO., Ray, Ariz. \$11,975,740 in \$10 shares; controlled by Sherwood Aldrich and C. M. MacNeill; 8000-ton mill at Hayden, Ariz.; concentrate smelted in A. S. & R. Co. smelter adjoining. Total in 1913, 53,745,934 pounds.

Month.	Pounds.	Month.	Pounds.
January 1914	5,705,000	February	5,600,000

SHANNON COPPER CO., Metcalf, Ariz. \$3,000,000 in \$10 shares; controlled by N. L. Amater; 500-ton mill and 1000-ton smelter at Clifton. Total in 1913, 13,640,000 pounds.

Month.	Pounds.	Month.	Pounds.
January 1914	938,000	March	1,082,000
February	904,000		

SHATTUCK ARIZONA COPPER CO., Bisbee, Ariz. \$2,500,000 in \$10 shares; controlled by Duluth investors, ore smelted at Calumet & Arizona smelter. Total in 1913, 13,219,756 pounds.

Month.	Pounds.	Month.	Pounds.
December	1,050,781	February	1,134,430
January 1914	1,276,636		

SOUTH UTAH MINES & SMELTERS., Newhouse, Utah. \$4,300,000 in \$5 shares; \$1,300,000 in 6% convertible bonds; controlled by Samuel Newhouse; 1000-ton mill; concentrate smelted at Tooele, Utah. Total in 1913, 1,883,129 pounds.

Month.	Pounds.	Month.	Pounds.
January 1914	284,092	March	106,381
February	344,200		

TAMARACK MINING CO., Calumet, Mich. \$1,500,000 in \$25 shares; owned by Calumet & Hecla; 2 mills, 3500-ton capacity, at Torch Lake. Total in 1913, 4,142,000 pounds.

TENNESSEE COPPER CO., Copperhill, Tenn. \$5,000,000 in \$25 shares; \$1,500,000 in 6% convertible bonds; controlled by Jas. Phillips, Jr., and Lewisohn interests. Total in 1913, 13,493,140 pounds.

Month.	Pounds.	Month.	Pounds.
January 1914	1,474,890	March	1,262,181
February	1,232,812		

UNITED STATES SMELTING, REFINING & MINING CO. \$44,871,150 in \$50 shares; copper production chiefly derived from its subsidiary, the Mammoth Copper Mining Co., Kennett, California.

Month.	Pounds.	Month.	Pounds.
January 1914	1,572,817	February	1,629,902

UNITED VERDE COPPER CO., Jerome, Ariz. \$3,000,000 in \$10 shares; owned by W. A. Clark; 1000 to 1200-ton smelter at Clarkdale; monthly figures not given out, estimated at about 3,000,000 lb. Total in 1913, 37,750,000 pounds.

Month.	Pounds.	Month.	Pounds.
January 1914	2,900,000	February	2,600,000

UTAH CONSOLIDATED MINES CO., Bingham, Utah. \$1,500,000 in \$5 shares; owns the Highland Boy Gold Mining Co. and 5000 shares of International Smelting & Refining Co. stock; ore smelted at Tooele. Total in 1913, 7,710,668 pounds.

UTAH COPPER CO., Bingham, Utah. \$15,625,990 in \$10 shares; owns half of Nevada Consolidated; controlled by A. S. & R. Co., Sherwood Aldrich, C. M. MacNeill, and W. B. Thompson; 2 mills, 20,000-ton capacity, at Garfield; concentrate smelted at Garfield plant of A. S. & R. Co. Total in 1913, 119,939,809 pounds.

Month.	Pounds.	Month.	Pounds.
January 1914	10,649,000	March (est.)	11,000,000
February	9,492,898		

WOLVERINE COPPER MINING CO., Kearsarge, Mich. \$1,500,000 in \$25 shares; owns \$80,000 interest in Michigan Smelting Co.; controlled by J. R. Stanton; mill on Traverse bay treated 388,500 tons during last fiscal year. Total in 1913, 5,700,000 pounds.

Month.	Pounds.
March	628,000

Book Reviews

ELECTRO-THERMAL METHODS OF IRON AND STEEL PRODUCTION. By John B. C. Kershaw. P. 233, Ill., index. D. Van Nostrand, New York, 1914. For sale by *Mining and Scientific Press*. Price \$3.

In this book Mr. Kershaw has amplified and brought up to date the information given by him in 1907 in his well known 'The Electric Furnace in Iron and Steel Production'. The first two chapters include a general sketch of the principles involved in electric heating and the broad lines of designing furnaces for iron and steel making. The succeeding chapters are mainly taken up with consideration of various furnaces in actual use. As Mr. Kershaw is not connected in a business way with any of the companies or patentees concerned in selling these furnaces, his review is especially valuable. The book is an excellent guide to knowledge of just what is now being done in this important field.

THE PETROLOGY OF THE IGNEOUS ROCKS. By F. H. Hatch. P. 454, Ill., index. George Allen & Co., Ltd., London, 1914. For sale by *Mining and Scientific Press*. Price \$4.25.

This is volume 1, 'The Igneous Rocks,' of the well known 'Text Book of Petrology,' of which the first edition appeared in 1892. A companion volume on the 'Petrology of the Sedimentary Rocks' forms the second volume of the series. In this the seventh edition there has been considerable change. New chapters on 'Pyroclastic Rocks' and 'Metamorphic Derivation of the Igneous Rocks' have been added, and numerous additional illustrations have been used. The book is a brief, general, but excellent summary of essential facts regarding the physical characters, constituent minerals, and classification, of igneous rocks in general with three chapters on the distribution of igneous rocks in Great Britain.

OIL PRODUCTION METHODS. By Paul M. Paine and B. K. Stroud. With a chapter on 'Accounting System,' by W. F. and W. B. Sampson. P. 239, Ill., index. Western Engineering Pub. Co., San Francisco, 1913. For sale by *Mining and Scientific Press*. Price \$3.

There have been few books on the technology of oil production and those that have been published have been general and in the main based upon European practice. Redwood's three volume work includes a number of chapters upon drilling methods, but even so large a book does not find room for much that is modern and significant. Many years ago the Pennsylvania Geological Survey issued an excellent description of practice in that state, but the book is long since out of date and methods have greatly changed. Mr. Paine and Mr. Stroud describe the methods in actual daily use in California, and they write from first hand knowledge. Their book accordingly is up to date, authoritative, and extremely useful to those interested in the oil industry.

THE ENGINEERING INDEX, ANNUAL FOR 1913. Compiled from the 'Engineering Index,' published monthly in *The Engineering Magazine* during 1913. P. 508. The Engineering Magazine Co., New York, 1914. For sale by the *Mining and Scientific Press*. Price \$2.

This is the thirtieth year that the index has been made and this is the twelfth of the annual volume reprints. The work is too well known to require extensive review. It covers all branches of engineering from Civil to Industrial Economy, and while some papers escape the vigilant eye of the compiler, it can be relied upon to cover most of the important ones. It is well printed and well arranged and will be especially helpful to mining engineers and metallurgists who wish to keep in touch with engineering in its broader aspects.

Industrial Progress

An American Locomobile

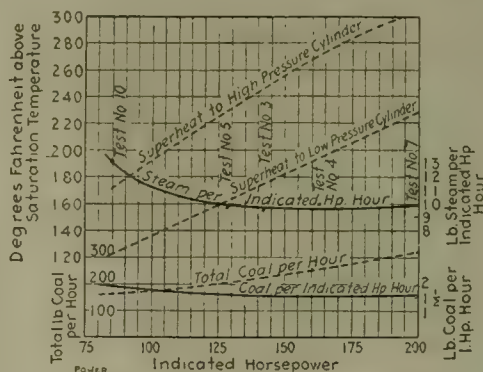
The locomobile is a self-contained engine-boiler unit, designed to use superheated steam and increase over-all efficiency by decreasing radiation losses. The name is best known in the United States from the fact that an engine of this type was used on one of the pioneer automobiles.



A BUCKEYEMOBILE POWER-PLANT.

Essentially a locomobile consists of a high-class compound engine mounted upon its boiler, with the cylinders in the smoke box, the steam passing from the superheater directly to the high-pressure cylinder, and from this through a reheater directly to the low-pressure without outside piping. The condenser and feed pumps are run from the engine itself. Above is presented a view of such an engine, built by the Buckeye Engine Co., and marketed under the name Buckeyemobile. A number of these are giving excellent results.

The analysis of a test of one such engine, as reported by F. R. Low in *Power*, is printed below:



TEST RESULTS OF BUCKEYEMOBILE.

The engine developed an indicated horse-power on less than 9.75 lb. steam per hour, and the coal curve is, as will be noted, particularly flat. This unit delivers a kilowatt for about 2½ lb. of coal per hour, an indicated horse-power hour for less than 1½ lb. when condensing, and a little more than 2 lb. non-condensing. As these engines run at very high temperature, special oils are necessary for lubrication, but that difficulty has been successfully met. A wide range of fuels can be used.

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EDITORIAL

A GOLD discovery is reported from Sundance, Wyoming, assays as high as \$1960 per ton being quoted, with the richest of the samples yet untested. According to the *Centennial Post*, "a number of nuggets have been found near Devil's Tower, and the theory has been advanced that the tower is the core of the crater of an ancient volcano and may be filled with gold." It is to be regretted that this said volcano is extinct, but no doubt the author of the theory that it "may be filled with gold" can devise some method to rejuvenate the volcano and put it in the producing class again.

THE fiftieth anniversary of the founding of the School of Mines of Columbia University will be fittingly celebrated on May 28 and 29 by a reunion of the School of Mines graduates, which will be in the nature of a congress at which will be discussed some of the problems of modern mining engineering practice. Honorary degrees will be given to some of the distinguished alumni and the first lecture on the 'Chandler Foundation' will be included in the program. As the alumni roll of the School of Mines includes many of those whom the industry has recognized as leaders in the profession, and who will be present at this meeting, a most interesting session is assured and a large attendance is anticipated.

IN a recent address before the Chemical Society of the Massachusetts Institute of Technology, Mr. Arthur D. Little pointed out to the undergraduates of that institution the importance of clearness and simplicity in engineering reports. The difference in perspective of the technologist and layman is a subject which is often forgotten by the engineer when writing his report. As a result, the subject matter is so obscured in technical phraseology, which is meaningless to the non-technical reader, that it is valueless to a large number of those for whom it was prepared. It should, therefore, be the purpose of the engineer to present the results of his investigation in a manner which is intelligible to the non-technical mind. The success of an engineer is influenced in no small degree by his ability to impart to others his technical knowledge in terms which are understood, and therefore the cultivation of correct English should be an essential part of his training.

STEAM-SHOVEL work is in high favor at the copper mines and is proving to be adapted to many situations in which underground mining methods have heretofore been supreme. At the Utah Copper Company all underground work has finally been abandoned. At the Chino it is possible that all ore will eventually be mined by steam-shovels and at Ely it is said that plans for converting the Ruth mine into an open pit have been worked out and are now under most careful consideration. Experimental work with flotation has proved that Ely ores are well adapted to the process, and it is said that announcement that a flotation plant is to be built may be expected.

QUESTIONS of nomenclature have been at the bottom of many a stubborn controversy among scientific men. Indeed, rather more than others, they attach deep significance to priority and exactness in definitions. This is excellent in itself, but on more than one occasion insistence on minor matters has served to retard rather than advance scientific knowledge. At Kalgoorlie, due mainly to the independent investigations of Mr. Malcolm Maclaren and Mr. C. O. G. Larcombe, two sets of names have been applied to the same rocks. The result has been confusion which might readily have become worse except for the sensible action of the two geologists mainly concerned. We called attention to the situation last year at the time that we printed Mr. Maclaren's series of informing articles on the geology of the district, and we print this week a letter from Mr. Larcombe in which he proposes a modified system of nomenclature designed to smooth away the difficulties in the way of further discussion. Mr. Maclaren, having read the paper and consulted with Mr. Larcombe, asks us to say that he agrees to the changes proposed, and there can, therefore, be no necessity for further confusion. We are glad to have had a part in bringing this about, and we commend to others the spirit of mutual accommodation exhibited by Messrs. Maclaren and Larcombe. Possibly because they are mining geologists and so more concerned with results than theories, they have been entirely willing to sacrifice personal claims as authors to prevent possible confusion. We may differ, tolerantly let us hope, in our interpretations, but let us agree, as far as may be, in using the same name for the same thing. This will make for progress in the industry.

MINING in Australia is exceedingly dull at present. This country, which has produced minerals to the value of approximately \$3,985,000,000 to date, needs another Ballarat, Bendigo, Broken Hill, Charters Towers, or Kalgoorlie to give it a new lease on life. The most promising district at present is Broken Hill, where improved metallurgical methods have put new life into the industry. Kalgoorlie is busy with geological problems, and the other once-important districts are steadily declining. Chillagoe, Great Fitzroy,

and Mount Perry, three of Queensland's big copper mines, have suspended operations recently and several gold mines in Victoria have also been closed. The dredging industry of this state is being hampered by legislation, and what the outcome will be is not known. Great Cobar has been having trouble and the Junction mine at Broken Hill, which has been on the decline for a number of years, is now for sale. Tasmania is practically holding its own in mineral production, although the Tasmania gold mine is to be shut down. In Western Australia, the Victorious, Burbank's Main Lode, and Associated Northern mines are not operating at present, and reduced returns are coming from the Bullfinch. The Ivanhoe recently had a fire and is laboring under a handicap. While there is nothing new in South Australia, it is hoped that trans-Australian railways will develop new mineral districts, and that the investigations in the Northern Territory will result in a new field being opened. With the ever-increasing wages and present prices, metal mines of Australia are reported as generally depressed, and the optimists of the industry are in the decided minority.

SEIZURE of Vera Cruz by the American marines marks the culmination of a long series of insults to the American flag and American people by the *de facto* government of Mexico. The Mexican policy of President Wilson has been for peace, with the hope that the time was not far off when Mexico would settle her internal troubles and set up a government worthy of recognition. This policy, which has only obtained through the will of the President, has been the subject of repeated abuse by the Huerta government; over 150 American lives have been sacrificed through lack of protection, American industries in Mexico have in great part either dwindled to nothing or suspended operations completely, the American nation has been singled out for insult, and the American government has been antagonized by the officials of the Huerta administration to beyond endurance. The unhappy affair at Tampico placed the President and administration in the position of either being held up to ridicule by the American people and nations of the earth for permitting of this further insult, or insisting upon a formal acknowledgment of the many grievances which the American people bore against the Huerta administration. The latter alternative was chosen, and rightly so. It is to be hoped that this step toward the ultimate fall of the *de facto* government in Mexico, will not mean war and the invasion of Mexican territory by American troops, but that the seizing of the Mexican ports and the cutting off of military supplies and revenue will hasten the downfall of Huerta and bring the Mexican people to realize that a legally constituted government and the blessings of peace can only be obtained by active coöperation among themselves. The present civil war is leading to nothing. The Mexicans must put country above party if they expect others to respect their country.

Spelter and Lead in 1913

The world's production of zinc for the year 1913, according to statistics published by the United States Geological Survey and various consular reports amounted to 1,103,359 short tons, which is an increase of 33,314 tons over the production of the previous year. Of this output of spelter, the United States was the largest producer, with a production of 346,676 tons; Germany was second, with 311,914 tons; and Belgium third, with 217,941 tons. The imports of zinc into the United States during the year 1913 were valued at \$722,962, as compared with \$1,363,884 for the previous year. The exports from the United States for 1913 amounted to \$1,735,099, while that of the preceding year was \$1,846,301.

In Australia almost the entire spelter production was practically confined to the Broken Hill district of New South Wales, where the zincblende production was of minor importance until the advent of flotation methods when the old tailing dumps, together with the zinc-bearing tailing from the lead concentrators, had been made to yield a good profit. The development of a treatment for these ores forms one of the most interesting chapters in the zinc metallurgy, beginning with the Potter acid flotation experiments in 1901 and subsequent developments in acid and oil flotation, until in 1909 the problem passed from the experimental stage, although several years previous to this large tonnages of zinc ores were being successfully treated by flotation methods. The advance which has taken place in zinc mining and metallurgy in the treatment of Australian ores is evidenced by the production of zinc concentrates, which has advanced from 97 tons, valued at \$4808 in 1889, to 516,378 tons valued at \$6,885,999 in 1911. Practically all of this concentrate is smelted in the European smelters of Belgium and Germany, though some is treated locally at the Port Pirie smelter of the Broken Hill Proprietary Mines Company.

The zinc concentrate production of Austria for 1912 amounted to about 34,674 tons, valued at \$577,451; of this amount about one-half was devoted to government uses, according to a consular report. The Hungarian production is not significant, amounting in 1912 to only 857 tons valued at \$13,961. The Hungarian government is reported to be endeavoring to stimulate an interest in zinc mining and smelting and a natural gas smelter is proposed for Transylvania. During 1912 the zinc imports into Hungary were valued at \$981,919. The German production for the year 1913 was 311,914 tons of spelter, a material increase over the production of the previous year, which was 298,794 tons. The imports and exports of both zinc oxide and lithopone showed an increase during 1912, the exports of oxide amounting to 28,731 long tons, as compared with 20,994 tons for the previous year. The exports of lithopone increased from 13,742 tons in 1911 to 15,117 tons in 1912. The Italian mines during 1913 produced about 100,000 tons of zinc concentrate, which

was shipped to the smelters of France and Belgium.

While zinc ores are found in association with silver and lead ores in various parts of the Caucasus mountains, the principal production at the present time is from near Sadon in the Vladikavkaz district of the Tersky province. The total production of silver, lead, and zinc ores in the Caucasus in 1912 is reported by the mining department of the Caucasus to have been 28,495 tons, as compared with 26,060 tons for the preceding year. In the Olkusz district there was a production of 48,427 tons of zinc carbonate and 18,768 tons of zinc carbonate carrying some lead. The latest available statistics from Spain are for the year 1911, during which period 162,140 long tons of zinc ore valued at \$1,213,649 was mined. Most of the production came from the provinces of Murcia, Santander, and Cordoba. The exports of blende and calamine for 1911 amounted to 127,632 long tons valued at \$1,188,83. Zinc as bars and sheets totaling 2336 long tons and valued at \$294,370 was exported, the finished product going to France, Great Britain, Argentina, and the Netherlands.

Statistics of the world's lead production for 1913 are not yet available, but final figures for the production of the United States, as compiled by Mr. C. E. Siebenthal of the United States Geological Survey, have recently been printed. According to his figures, the total production of refined lead made from ore amounted to 462,460 tons of 2000 pounds. This agrees closely with the preliminary estimate of 466,843 tons that we printed, through the courtesy of the Geological Survey, on January 3. In 1912, the primary lead production was 480,894 tons, and there was accordingly a decrease of 18,434 tons, equivalent to 3.8 per cent. The secondary lead, obtained from skimmings, drosses, old metals, etc., amounted to 67,168 tons in 1912, and is estimated at 72,834 tons for 1913, though this is subject to slight revision. Part of this secondary lead, 39,730 tons, was recovered in the form of alloys. As we have previously noted, there are no figures of lead consumption in the United States. Mr. Siebenthal estimates the primary lead "available for consumption" in 1913, at 419,485 tons, basing this estimate on the following figures: stock in bonded warehouses January 1, 10,492; imports for consumption, 11,980; imports for warehouse, 45,165; production from domestic ores, 411,878; total supply, 479,515. The amounts withdrawn were as follows: exports of foreign lead from warehouse, 44,544; in manufactures with drawbacks, 9757; decrease by liquidation, 419; stocks in bonded warehouse, December 31, 5310; total withdrawn, 60,030 tons.

Of the total lead production, 301,160 tons is classified as desilverized, and 131,867 as soft lead. The latter showed a decrease of about 10,000 tons. There were also 29,433 tons of desilverized soft lead, and 14,667 tons of antimonial lead. A curious feature is that a small amount of soft lead from Wisconsin and of desilverized from Idaho found its way to Canadian smelters.

While it is impossible to apportion the product ex-

actly according to the source of the ore, since the statistics are based upon returns from smelters and refiners who do not, in all cases, know the exact source, the following fairly accurate distribution of the production is made:

Domestic ore:	1912.	1913.
Alaska	45	6
Arizona	3,891	4,901
California	811	3,294
Colorado	37,039	42,840
Idaho	127,780	137,802
Illinois	513	619
Kansas	1,937	1,504
Kentucky	91	16
Missouri	162,610	152,430
Montana	2,517	3,256
Nevada	5,699	6,142
New Mexico	2,511	1,821
North Carolina	34	10
Oklahoma	2,500	3,214
Oregon	21	37
South Dakota	12	7
Texas	30	108
Utah	60,664	71,069
Virginia	85	878
Washington	53	9
Wisconsin	3,301	2,639
Undistributed	120	63
Zinc residue	3,131	3,765
Total from domestic ore.....	415,395	436,430
Foreign ore:		
Africa	1,774	5,976
Canada	29	16
Mexico	7,407	4,512
South America	2,332	2,617
Other foreign	30	102
Foreign base bullion:		
Mexico	76,805	37,359
Total from foreign ore and base bullion	88,377	50,582
Grand total, derived from all sources.....	503,772	487,012

In the figures of consumption, lead in ore, base bullion, pigs, bars, and old metal are included. Decrease by liquidation covers losses in smelting and refining in bond and other corrections. Warehouse stocks cover only lead of foreign origin, as it has been found impossible to obtain complete figures of domestic stocks. Of the imports the bulk, amounting to 95,000,000 out of 114,000,000 pounds, came from Mexico as usual. The total imports, however, have decreased steadily since 1908. There has been a growth of imports from South America, from 469,770 pounds in 1908 to 8,766,327 pounds, and an even greater increase in imports from other countries, but the decline in Mexican imports more than offsets this. Mr. Siebenthal's figures afford the one measurably complete and accurate insight into the lead industry of the country that it is possible to obtain each year, and it is a pleasure to note that they are showing increasing detail. We see no reason why the lead producers should not coöperate in collection of monthly statistics as the copper pro-

ducers do, but so far, trade jealousy and the fact that the American Smelting & Refining Company controls 65 per cent of the production has prevented. We trust that this may soon be a matter of the past, as complete, accurate, and prompt statistics are the best of bases for sane trading and the furthering of industrial development.

End of Copper Miners' Strike

Workers in the copper mines of the Lake Superior district have officially declared the strike to be over, and the Western Federation of Miners remains unrecognized by the mining companies of that district. While the mines of the district have been working at about normal capacity for the past two months, this official acknowledgment on the part of the men of a willingness to return to work marks the climax of a labor struggle which was doomed to failure at the outset. It would seem after a strike lasting from July 23 of last year until the present, at a cost to the Western Federation of over \$1,000,000 in addition to the loss in wages and hardships endured, that the men who have borne the brunt of the battle would realize that strike methods which involve riot and bloodshed are not the means whereby any good for labor may be attained. It may be contended that labor in the district under the new régime is enjoying better working conditions and wages; but these concessions were granted several months ago and cannot be attributed to the warlike methods which have since prevailed. There is little evidence of anything for the good of organized labor having been accomplished under Mr. Charles H. Moyer's leadership and the Western Federation of Miners' activities.

The effect upon some of the operating companies of the district is shown by the following table of the total receipts for the past two years of a number of the companies, which furnishes a true barometer of the state of industry.

	Total receipts 1913.	Total receipts 1912.
Mass Consolidated	189,557	349,374
Quincy	1,921,198	3,381,587
Ahmeek	1,433,695	2,757,576
La Salle	15,535	10,244
Superior	478,977	673,032
Centennial	247,120	285,075
Isle Royale	649,946	1,395,636
Allouez	650,205	918,435
Winona	419,235	541,128
Tamarack	643,566	1,300,238
Osceola Consolidated	1,774,810	3,071,818

It will be seen what a marked decline has taken place in bulk of the business of the copper companies and to this must be added the greatly increased cost in production, which at the Ahmeek property was almost 100%, the total cost of refined copper in 1913 was 13.30c. per pound, while in 1912 it was 7.85c. While this figure is exceptional, a general increase in production costs is to be noted and deficits are by no means uncommon.



FRAMEWORK, COMPLETED MILL, AND LABORERS AT THE LA GRANDE PROPERTY.

Mill Building in the Andes

By ALFRED A. WATSON

The Collahuasi mining district is situated in the province of Tarapaca, Republic of Chile, S. A., a few miles from the boundary line of Bolivia. The ores of the district are principally copper, carrying a small amount of gold; some silver veins have also been discovered, but are not at present being exploited. The copper deposits cover a large area, extending over the top and sides of the Collahuasi mountain and the neighboring hills. They are principally owned and worked by two foreign companies, the Poderosa Mining Co., Ltd., owned by English interests, and the Collahuasi-La Grande owned by the Société Française des Mines de Cuivre, Collahuasi La Grande, a French company having its office at 43 Boulevard Haussmann, Paris, France. Up to now only the highest grade ore has been exploited and it is shipped abroad for treatment. Communications with the port of Antofogasta, Chile, distant 535 kilometres, is by means of the Ferrocarril de Antofogasta a Bolivia (Antofogasta-Bolivia R. R.) A branch line of 96 kilometres in length joins Collahuasi La Grande with the main line of this railway at Ollagué, which is the end of the Chile division, the road from there being entirely in Bolivian territory.

Collahuasi La Grande lies in 21° south latitude and $68^{\circ}40'$ west longitude and at Punto Alto, where all

the machinery was delivered, the rails are 4820 metres (15,814 feet) above sea level. A reference to the Ferrocarril de Antofogasta a Bolivia may be interesting as it is the only main artery of communication at present in operation from the Republic of Bolivia to the Pacific coast. The Arica-La Paz railroad, belonging to the Chilean government, for some reason has not been fully opened for traffic. The Bolivian railway does an immense business on a 2 ft. 6 in. gage. The passenger cars are roomy and comfortable, the sleeping and dining cars are excellent, while the freight cars are of 20,000 kg. (20 long tons) capacity each. The road at kilometres 116 to 170 inclusive runs through the rich nitrate fields of Antofogasta province and reaps a rich harvest from the transportation of nitrates to the coast and from machinery, timber, crude oil, and other supplies for the return journey.

At Calama, kilometre 239 and 2265 metres above sea level, the river Soa is crossed for the first time. The waters of this river are used for irrigation purposes, consequently an oasis is created, which is the only green spot encountered during the whole journey. Calama is the only important town on the Chilean division. At San Salvador, kilometre 254, a branch line 8 kilometres long connects with Chuquicamata, 2696 metres (8840 ft.) above sea. A large copper de-



YARETA, METHOD OF HAULING LUMBER, AND A GROUP OF LLAMAS.

posit is there being developed by the Chile Copper Company, a Guggenheim concern, which is erecting immense works for the treatment of the ore at the mines. The river Soa is again crossed by means of a steel viaduct at kilometre 298, near Girochi. The rails are 102.4 metres (336 ft.) above the surface of the river; the bridge is of six spans of 80 ft. each and supported by steel towers. A branch line 20 kilometres runs from Conchi to Conchi Jezo, another important copper district.

San Pedro, at 312 kilometre and 3223 metres (10,700 ft.) altitude, is on a tributary of the river Soa. There, at the foot of the volcano San Pedro is the main reservoir for the storage of potable water which supplies all the requirements of the railroad, the nitrate plants, and also the city of Antofogasta, 193 miles distant. It is a good piece of engineering. The highest point on the main line of the railway is Ascotan, 360 kilometres (223 miles) from Antofogasta, the height above sea level being 3955 metres (12,859 ft.). From here the line runs on a slightly lower level right through into Bolivia, the height at Cebollan, 387 kilometres, being 12,200 feet.

Borax Lake

The run from Ascotan to Cebollar discloses a scene of matchless interest. The railroad skirts the shores of the celebrated borax lake of Cebollar, 24 miles long and several miles wide. The surface of the lake in certain seasons is pure white, like freshly fallen snow, varied by turquoise colored water in places. The old volcanoes on the border of the lake display the most wonderful colors, one especially showing vivid scarlet, reds, yellow, grey, and brown; a truly marvelous sight. The lake is the property of the Borax Consolidated, Limited and is said to be one of the largest natural deposits of borax known. At kilometre 435 and 3696 metres above sea level and two miles from the Bolivian boundary is situated Ollagüé, which is the end of the Chilean division of the railway. It lies at the base of the isolated and imposing volcano of Allagüé, 5872 metres (19,266 ft.) high. It is quite a feature of the landscape and emits constantly a plume of steam from near the summit. The Collahuasi branch line starts from Ollagüé, and at kilometre 89 reaches Montt, which is on the Poderosa company's property. Six kilometres further is Punto Alto, which is one kilometre from Collahuasi La Grande, the terminus of the line.

Owing to the distance from the coast such heavy expense was incurred in shipping ores that it was possible to ship the highest grade of ore only; according to reports, ore containing less than 18% copper did not repay the cost of mining and freight. The La Grande company, however, determined to make an effort to avail itself of the enormous quantity of so-called low-grade ore which remained in the mines and on the dumps. With this object in view a 100-ton unit of a concentration plant was ordered after careful consideration as to location of the plant and the choosing of a convenient spot where sufficient water was to be

obtained, and where the ores from the various mines could be delivered at a reasonable cost by means of an overhead tramway of moderate length. Such a site was found at Capella, 14,650 ft. above sea level and near one of the Company workings, being some 6 kilometres distant from Punto Alto, where all machinery and material was delivered by the railroad company and transported from there to the mill site by mule carts and trollies. Accordingly timber and all other materials required were ordered from Antofogasta and rushed to the spot with all speed so that no delay should be caused by the winter snows. Grading was started on mill site and buildings for administration, *bodega*, *pulperia*, and dwellings for the workmen and their families were erected.

The country rock upon which the foundations were built was very friable in places and filled with fractures, necessitating heavy concrete retaining walls for the buildings. All machinery foundations, floors, and storage-tank were of concrete, the materials for which were carefully selected, the sand washed, and the aggregate graded. The best portland cement was used, and the most careful attention given to variations in temperature, so as to prevent the concrete from freezing, a very necessary precaution at that altitude. In all, some 720 cubic metres of concrete was used.

The concentration plant consisted of the following machinery, the ore being delivered at the receiving station by sub-aerial ropeway. One 6 by 10 ft. grizzly; one 60 ft. by 14 in. Robins conveyor; one 60 ft. by 36 in. Robins picking-belt conveyor; one 7 by 10 in. Blake crusher; one shaking tray feeder; two 24 ft. by 12 in. wet or dry crushing rolls; one 35 ft. by 8 in. Buckley elevator; one 84 by 48 in. revolving screen; one set of four 66 by 36 in. revolving trommels; one 24 by 12 in. crushing roll for re-crushing; one 40 ft. by 6 in. backed elevator; six 3-compartment 34 by 20 in. Hartz jigs, one 4-ft. Callow screen, one set of 3 hydrometric sizers, three No. 5 Wilfley tables, one 9-ft. pulp dewatering cone, and three 6-ft. vanners. The motive power was furnished by one 125-hp. Babcock & Wilcox water-tube boiler (another is being added) with water heater, boiler feed, pumps, etc. One 16 by 36 in. Corliss engine, one Bellis and Morecombe vertical duplex engine for driving, 50-hp. electrical generator, a general outfit for electric lighting, electric pumps, and motors for cableway, etc. The machinery was furnished by Fraser & Chalmers, Limited, London.

Mountain Sickness

A serious obstacle to carrying on work at such altitudes is the sickness and danger incurred by mountain sickness, called locally *puna* (poona) in Chile and *soroche* in Peru. It commences by difficulty in breathing, severe pains in the head, and vomiting, and the heart's action is terrific in intensity. Persons desiring to live there must be provided with sound lungs and a stout heart (in more ways than one) and good circulation of the blood. At first it is exhausting to make the slightest exertion and it requires from a few days to

a month or more to become acclimated. Frequently people have to be returned to a lower altitude without delay and some cases have a fatal termination. It is not to be wondered at that the natives from near the coast have the greatest dread of Collahuasi, the climate of which is probably aggravated by the fumes coming from some volcanoes that are situated at no great distance.

Climatic Conditions

The temperature is extremely variable. In winter the thermometer falls to 10° F. each night. During the daytime it occasionally rises to 45°, but usually only to 30° F. In any case immediately the sun gets low it drops below freezing. A sudden gust of wind will cause a drop of 15° at once. Snow lying on the ground makes the cold intense. Under such conditions it is difficult to secure the necessary intelligent workmen. The seasons in the southern latitudes are of course the reverse of the northern ones, midwinter down there being mid-summer north of the equator. In the Andes in summer it rains, the natives say, but what falls is hail and very severe storms they are, usually accompanied by terrific thunder and lightening. During the summer these cause little inconvenience but in the winter months heavy winds prevail, blowing sometimes with hurricane force, the snowstorms being of the regular western type, and the snow fine and dry. The cold is intense, the wind drifts the snow, all work has to be suspended, and all communication from outside is cut off for days. A curious thing about the snow in that region is that it gradually disappears without showing any signs of water around the edges. It simply seems to become less and less until it finally disappears. Another curiosity is that running water always freezes up in winter but the ground, which is loose and spongy, does not freeze below 3 or 4 inches.

Under these conditions the milling plant was erected. Ordinary labor is performed by Bolivian Indians, of which the women are the most conscientious workers. The Bolivians are tractable people, but the Chilenos are more intelligent, although harder to handle. All of the workmen are addicted to drink, which has to be guarded against, principally during their national *fiestas*. A better class of labor was obtainable at wages from 50 to 75% above the usual ones prevalent nearer the coast. In fact that was the only inducement for men to remain on the work for a limited time. The wages paid were, boss carpenter 25 pesos,* concrete boss 20 pesos, boss machinist 20 pesos, boss electrician 16 pesos, boss blacksmith 16 pesos, carpenters 14 to 17 pesos. Ordinary mechanics and blacksmiths 14 pesos, concrete mixers 11 pesos, common labor from 6 to 10 pesos per day. The timber, from Puget Sound, and costing delivered at Punto Alto 135 pesos per M., was rough sawed and framed on the spot by native carpenters, not one of whom had had any previous experience in mill construction. When the frames of the building

were raised the workmen refused to go aloft. In fact, at times the cold was so intense and the wind so strong that it was impossible to go aloft and finally when the galvanized iron covering had to be put on it was necessary to put on the sides first and the roof afterwards, otherwise it would have certainly been carried away by the wind. Fortunately the entire buildings were successfully covered in previous to the beginning of the winter snows. The buildings were built on terraces on a side hill in the usual manner, which exposed them to the terrific winds which came up the valley. For this reason, combined with necessity of providing against damage from earthquake, a thorough system of bracing had to be executed, providing against such emergencies. The erection of machinery under cover was a simple matter in comparison.

Fuel

The fuel used in that region is *yarela* (*Azorella madreporica* or *Azorella glebaria*) a sort of moss containing much resin which when dry burns rapidly with good heat and leaves an abundant white ash. Compared with steam coal, 2.7 tons of *yarela* is equal in calorific power to 1 ton of coal. It is found within a zone between 12,000 and 15,000 ft. altitudes and is supplied by contract by Bolivian Indians who bring it to the mines on llamas. Each of these animals is supposed to carry a load of 80 lb. They are useful and interesting beasts and it is said that no one except a Bolivian Indian can manage them. Presumably this is so, judging from the manner in which they stampede when alarmed.

All supplies and material of whatever description at Collahuasi have to be brought up from the coast, the surrounding country being bare and absolutely barren desert, not a single tree or shrub visible. A few tufts of *puna* grass are sparsely scattered over the ground; in the valleys grass is a little more abundant and furnishes food for the llamas for a short time. The wild animals are few. A few troops of vicunas roam the lower large valleys. A fox is occasionally seen, the South American ostriches (*rhea*) run in small batches, chinchillas and viceachas are common. The latter is a small rodent related to the chinchilla, with a head that looks like a cat's, but a rat-like tail. A small rat and a species of partridges are the only other animals to be seen. A curious fact, illustrating that work at high altitudes has advantages as well as disadvantages, is that there are no vermin to be found outside of stable. There are no flies, fleas, bugs, or mosquitoes at any time of the year.

The two headings of the Mount Royal tunnel at Montreal, met on December 10. It took 15 months and 4 days to drive the 8 by 12 and 10 by 12-ft. headings a distance of 3¼ miles through a great variety of rock.

Overburden stripped at the Nevada Consolidated copper mine, during the last quarter of 1913, totaled 982,689 cubic yards. The cost was \$308,519, or 31.4c. per yard.

*The Chilean peso fluctuates in value, but may be roughly taken at 18½c.

Third Beach Line at Nome, Alaska

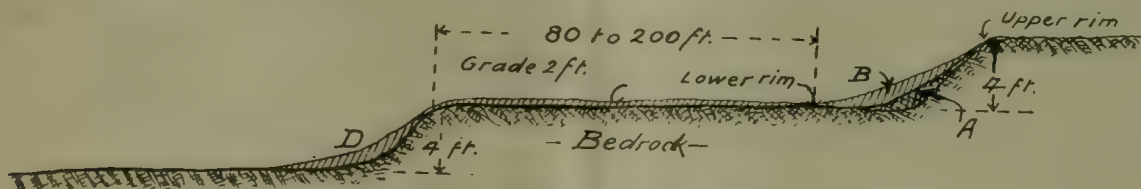
By ARTHUR GIBSON

The auriferous gravel deposit or pay-streak, known as the 'Third Beach Line', running on a true course of N. 63° 39' W., with a magnetic variation ranging from 18 to 20° E., situated about three miles north of Nome on Seward Peninsula, Alaska, and extending for a distance of 5.1 miles, is no doubt one of the greatest freaks of nature discovered in the present age.

The original discovery of the beach line was made by Sam Samson, now residing at Stevenson, Washington, who started to sink a shaft on the Cyrus Noble placer claim (shown on the map opposite, directly east of No. 4 above Discovery on Bourbon creek) in November 1901. Being a poor man and without the

pay-streak, which was 60 ft. wide, December 24, 1905. The news of Mr. Samson's discovery did not become public until in January 1906, after which all available thawing plants were placed in commission and the pay-streak of the Third Beach Line was definitely traced and located for its entire length of five miles, before the opening of navigation in Bering Sea, five months later.

The present surface of the ground shows no indications of water action. It is uneven and the depth from the surface to the pay-streak varies from 20 to 124 ft. The surface ground consists principally of glacial silt or 'muck,' averaging six to ten feet in depth.



PROFILE OF THE BEDROCK ALONG THE PAY STREAK.

necessary funds to procure a steam thawing plant and fuel, he had to adopt the extremely slow process of thawing the perpetually frozen ground by burning willows in the bottom of the shaft, reaching bedrock at a depth of 95 ft. in May 1902, after six months of hard work. The gold discovered in this shaft was very fine flour gold in a layer of ruby and black sand about one and one-half inches thick, eight feet above bedrock. Being without funds and unable to interest anyone of means, Mr. Samson had temporarily to abandon this work about August 1, 1902.

J. C. Brown commenced prospecting his placer claim, No. 1 below Discovery, on Little creek (at the extreme westerly end of the Third Beach Line and about $1\frac{3}{4}$ miles west of the Cyrus Noble claim) in August 1904, and on September 19, 1904, he discovered a very rich pay-streak in the northeasterly portion of his claim, which upon investigation proved to be a beach formation.

During the spring of 1905 the same rich pay-streak in similar formation was traced and discovered by laymen on the adjoining claim toward the east, known as the 'Portland Bench.'

Mr. Samson by this time succeeded in raising the necessary funds to secure a steam thawing plant and fuel to thaw out his old shaft, which had filled with surface water and frozen solid. He commenced this work November 1, 1905, and after searching bedrock he drifted northerly 22 ft., where he tapped the pay-streak of the Third Beach Line on December 6, 1905. He continued driving northward and cross-cut the

Although in a few instances the gravel comes to the surface, the ground between the glacial deposit and the pay-streak was as a general rule composed of gravel and sand; in a few places intersected with streaks of clay and quicksand.

The Pay-Streak

The heavy line on the map indicates the pay-streak of the Third Beach Line; where the same line is fulldrawn the pay-streak was found intact, that is, had never been disturbed and showed distinctly the original stratification of the ancient beach dipping toward the sea. Here the overlying ground was always found frozen all the way from the surface to the bedrock, independent of depth. Where the heavy line is dotted, the original pay-streak had been washed out of place by the action of water channels. In such places gold was scattered over a large area in layers on bedrock too thin to be recovered at a profit. In addition, the overlying ground was in these cases thawed and water-logged, requiring heavy timbers to prevent caving and large pumps to keep the workings dry, thereby increasing the operating expenses beyond profitable limits. Only one exception to this rule occurs, that is, so far as the thawed ground is concerned: on the Four Corner placer claim, where the old water-channel has ceased running and the ground from the surface to bedrock has frozen after washing out and scattering the pay-streak.

The figure above shows a profile of the bedrock along the pay-streak of the Third Beach Line, which indi-

ates terraces worn down by the action of the waves. The main pay-streak is shown at A and B: A shows the heaviest concentration containing the most gold; B the leaner part; and C and D indicate the 'slough-over' or finer gold carried down by the concentrating action of the waves. The drop-offs on the terraces were about 4 ft. high, and the flats, ranging from 80 to 200 ft. in width, had a grade of about 2 ft. in the entire width.

Bedrock at the lower rim of the main pay-streak, as indicated on the above sketch, was always 78.6 ft. above the present mean sea-level in Bering Sea, independent of what material the bedrock consisted, whether true rock formation or clay, the latter known as false bedrock. True bedrock consisted mostly of schist, intersected with quartz stringers, rarely containing any gold; limestone and black slate occurred in a few places. False bedrock consisted of clay or clay and sand mixed.

The material making up the main pay-streak was principally composed of well washed and rounded quartz pebbles in size from sand to pebbles of 2 to 3 in. diameter. The mineral concentrations contained besides gold a great deal of black sand and pyrite and various other minerals in smaller quantities. With very few exceptions all gold extracted had to be amalgamated, in order to save the fine gold and more readily separate it from the heavy iron sand.

Peculiarities of the Pay-Streak

The peculiarities of this pay-streak were: (1) its general course was a perfectly straight line from one end to the other, although its width ranged from 25 to 60 or 70 ft., and in one or two instances as much as 200 ft.; (2) its lower rim elevation above present mean sea-level in Bering Sea was always 78.6 ft. along its entire length; and (3) wherever the ancient beach was found intact and in place it was never found lacking in gold, and the overlying ground was always frozen independent of depth. The question of how 100 ft. or more of gravel could be deposited on top of this ancient beach without disturbing its original stratification in the least, will ever remain a mystery.

The greatest thickness of the main pay-streak averaged from 18 in. to 2 ft. In one or two cases it was as much as 6 ft., but only for a short distance. The 'slough-over' pay-streak, indicated by shaded areas on the map, seldom exceeded 14 inches in depth and contained only gravel of low grade.

The main pay-streak contained exceedingly rich gravel in certain parts. Pans yielding as high as \$500 were not uncommon on a few claims. On one particular claim the pay-streak averaged 35 ft. in width and 18 inches in depth, of which 110 lineal feet produced over \$360,000; or more than \$3000 per lineal foot: approximately \$1500 per cubic yard. The total production of the entire pay-streak of the Third Beach Line including the 'slough-over,' based on avail-

able data, is a little over \$10,000,000; or an average of \$400 per lineal foot of the entire pay-streak, approximately \$500 per lineal foot of the pay-streak in place and actually mined.

With very few exceptions, all gold produced by claims on the Third Beach Line was very fine, particularly in the extreme eastern portion around Otter and McDonald creeks, where it was flour gold that could only be saved by amalgamation. The fineness averaged 900 in the western portion, 888 in the central portion, and 906 in the eastern portion of the pay-streak.

Millwork at the Brunswick Consolidated Mine

During 1913 the 20-stamp mill of this property at Grass Valley, California, crushed 15,334 tons of ore, with the following details:

Duty per stamp per 24 hours, tons.....	2.364
Quicksilver fed to batteries, ounces.....	11.713
Amalgam recovered, ounces	28,204
Bullion produced, ounces	11,461
Concentrate produced, tons	269
Pyrite in ore, per cent.....	1.75
Average value per ton.....	\$56.00
Cost of freight and treatment of concentrate, per ton of concentrate	15.97
Cost per ton of ore milled	0.28
Cost of crushing and concentrating ore, per ton.....	0.79
Bullion charges, per ton	0.044
Total mill costs	1.071
Value of ore before milling, per ton	13.92
Recovery by amalgamation and concentration	13.58
Recovery, per cent	97.60

The ore is crushed through a No. 0 punched tin screen equal to about 45-mesh wire screen, which accounts for the low duty per stamp but excellent recovery of gold.

Water Consumption at Kalgoorlie Mines

During October 1913, 11 mines, comprising the Kalgoorlie & Boulder Mines Water Trust, purchased 35,655,000 gal. of water from the Western Australian Government at \$1.68 per 1000 gal., as follows:

	Ore treated,		Water used,	
	tons.	Process.	gallons.	
Associated	11,368	Dry	3,139,000	
Associated Northern	1,216	Dry	1,293,000	
Chaffers	mining only	.....	214,000	
Golden Horse-Shoe	29,716	Wet	5,327,000	
Great Boulder Perseverance....	20,012	Dry	2,246,000	
Great Boulder Proprietary....	18,006	Dry	5,742,000	
Ivanhoe	20,712	Wet	3,650,000	
Kalgoorli	10,875	Dry	2,772,000	
Lake View & Star.....	18,982	Wet	5,391,000	
Oroya Links	12,360	Wet	3,494,000	
South Kalgorli	9,780	Dry	2,387,000	

All of these mines are equipped with high-class steam boilers, engines, and water-saving appliances.

Fire damaged the power-plant of the Mt. Morgan mine, Queensland, during December, necessitating a shut-down for several days.

Application of Three-Phase Motors to Winding Engines and Hoists

By C. ANTHONY ARLETT and H. M. LYONS

*A three-phase motor cannot be built for a very low speed without its power factor being bad, which tends to upset the regulation of the supply system, and for this reason where three-phase motors are driving winding engines they nearly always run at higher speeds than the drums, and are geared to them. In the Ward Leonard or Ilgner system, however, where a direct-current motor is used, this is almost invariably direct coupled to the drum.

The speed of a three-phase motor is controlled by varying the resistance in the rotor circuit so that all three-phase winding engine motors are naturally slip-ring motors, while the direction of rotation is reversed by interchanging two of the connections to the stator, so that a reversing switch must be provided for this purpose. The main control lever for a small three-phase winder does not move backward and forward in a quadrant with a straight-line motion, but the quadrant has two parallel slots connected by a cross-slot. When the main control lever is moved along the cross-slot it operates the oil switch and reverses the motor. When it is moved along one of the parallel slots it speeds up the winding engine in one direction, when it is moved along the other slot the winding engine speeds up in the other direction. With larger winders the reversing switch is operated electrically, and the control lever moves backward and forward in a straight slot in a quadrant. The winding engine is at rest when the lever is in the middle position and as the lever passes through the middle position it makes an electrical contact which actuates the reversing switch.

The Three-Phase Induction Motor.

In order to explain the differences between the control of a three-phase winder and that of a Ward Leonard winder, it is necessary to refer briefly to the behavior of a three-phase induction motor when resistances are connected in the rotor circuit. When the stator of a three-phase motor is connected to the power circuit, and the rotor revolves, a voltage is produced in the rotor proportional to the difference between the synchronous speed and that at which the rotor is rotating, and this voltage causes a current to flow in the rotor which produces the turning moment. If a resistance is connected in the rotor circuit, there will be a certain drop in pressure across it proportional to the current in the rotor and to the value of the resistance and, consequently, the rotor must fall in speed to provide sufficient voltage to overcome this drop in pressure, so that the current and

turning moment which the motor is giving is maintained. If the amount of resistance is increased the motor will naturally drop more in speed. If the motor is required to give a less turning moment, requiring a reduced current in the rotor, the drop in pressure across the resistance becomes less and the motor will speed up until the balance between the rotor voltage and the drop in pressure is restored, until finally at light load the speed of the motor will approximate to the synchronous speed. Thus, if the proper resistances in the rotor circuit of a three-phase induction motor are connected to reduce the speed by a given amount for a definite turning moment, the speed of the motor will increase if the turning moment which it has to give decreases, and it will decrease if the turning moment increases.

Control of Speed

It will thus be seen that while with a Ward Leonard or Ilgner winder, the winder runs at a definite speed for each position of the control lever, and the speed of the winder is independent of the load in the cages, with a three-phase winder the speed does not solely depend on the position of the control lever, but also depends on the turning moment which the motor has to give, so that for a definite position of the control lever the speed may vary according to the position of the cages in the shaft and according to the load that is being hoisted, for as the loaded cage is being hoisted, its weight becomes more and more balanced by the weight of the rope attached to the empty cage.

With the three-phase winder, therefore, the manipulation of the levers would be different as different loads are being hoisted, and it is therefore impossible to employ cams on the depth indicator to limit the acceleration and to bring the loaded cage to a slow speed by the time it reaches the bank. In the three-phase winder, therefore, is a return to the case of a steam-engine where the wind is entirely in the hands of the driver and reliance must be placed in his skill for the safe handling of the plant.

Where the speed of a three-phase induction motor is controlled by placing resistances in the rotor circuit, and the motor is giving a definite turning moment, the same amount of power will be taken from the supply system whatever the speed of the motor may be. The turning moment multiplied by the speed gives the amount of power which the motor uses and the remainder of the power is wasted in the resistances. Thus the three-phase motor involves great waste of power.

Fig. 1 is a power diagram for a three-phase winder with a cylindrical drum winding at the rate of 270 tons per hour from a shaft 1600 ft. deep, the maximum

*From a paper on 'Electrical Driving of Winding Engines and Rolling Mills' read before the Canadian Society of Civil Engineers and the Canadian Mining Institute.

speed being 40 ft. per second. The shaded portions of this diagram represent the power which is wasted in the resistances of the starter in starting and stopping the motor, and in this particular case the useful

be more than the energy wasted in starting and stopping the three-phase winder.

Advantages of Three-Phase Winder

The three-phase winder is advantageous:

- (1) Where the capital cost of the plant is a prime consideration, as the total cost of the three-phase winder is from 20 to 35% lower than that of a Ward Leonard winder.
- (2) Where the starting and stopping is infrequent and long runs at full speed are required, as is particularly the case with slope haulage.
- (3) Where the winder is working intermittently, when, if a Ward Leonard set were installed it would have to run for long periods without doing any work.

The three-phase winder is disadvantageous:

- (1) For vertical shafts, as it cannot be fitted with the safety appliances used with the Ward Leonard winder.
- (2) Where the winds are short and the winding speed is high; that is, large outputs.
- (3) Where the power station from which the winder is supplied is relatively small, because in the case of a three-phase winder the load comes on instantaneously, and not gradually as with the Ward Leonard winder, so that the three-phase winder would disturb the regulation of the electrical supply system.
- (4) Where there is a long transmission line between the power station and the winder, and the fluctuations in demand of a three-phase winder would cause considerable variation in voltage. This would not only have a bad effect on other plant supplied in the same circuit, but would have an adverse effect on the three-phase winder itself, because the turning moment which a three-phase motor can exert is proportional to the square of the voltage, so that a small drop in voltage could greatly reduce the turning moment which a three-phase motor could give, and in bad cases it might even be found difficult or impossible to start the winder until the regulation of the system was restored.

There are three methods by which the load can be lowered with a three-phase winder: (1) by controlling the speed with the mechanical brakes; (2) by lowering at such a speed that the motor is run above its synchronous speed and so acts as a generator and returns power to the supply system; (3) by reversing the connections to the motor so that it is giving its turning moment in the reverse direction to the rotation, and controlling the speed by the use of the ordinary control lever with reverse current.

The first of these methods is objectionable, as it produces a large amount of wear and tear on the brakes, and it is difficult to design the brake paths

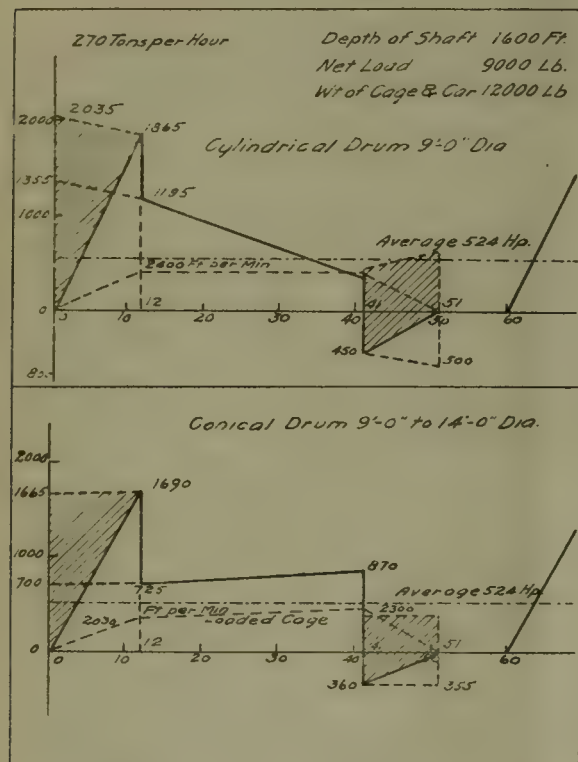


FIG. 1.

work done by the winder is 524 hp. minutes per wind. The amount of energy wasted in the starter is 325 hp. minutes per wind. Taking into account the efficiency of the three-phase motor, the energy taken by the winder from the supply system is 910 hp. minutes per wind. The average efficiency of the electrical plant, therefore, is only 57.5%. Fig. 1 shows how large the power losses are in starting and stopping a three-phase winder. It also illustrates a case that is much more suitable for a Ward Leonard or Ilgner winder than a three-phase winder, and as the loss in starting and stopping a three-phase winder is very great, it will be seen that it is most advantageous to employ a three-phase winder where the starting and stopping is infrequent, and where there is a long run at full speed, when the three-phase winder is economical, or where there is a considerable interval between winds. These are practically the conditions of a long slope haulage.

Under such conditions a three-phase winder can easily prove more economical in power than the Ilgner or the Ward Leonard winder, because, with the latter, the motor generator set would have to be kept running continuously and this involves an unceasing though small expenditure of power, so that the energy taken to run the motor generator set can easily

so that the heat generated is dissipated and burning of the brake blocks is prevented.

The second method is economical in power, but it is difficult to control because the electrical braking action does not take effect until the speed of the motor has exceeded synchronous speed. The motor must first be switched on in the lowering direction when the motor power is increasing the acceleration due to gravity, and in some cases to prevent this acceleration being too great the speed has to be checked with the mechanical brake. As soon as the motor exceeds synchronous speed the electrical brake will take effect and the speed of the motor will increase until it is four or five per cent above synchronous speed, which is higher, of course, than the ordinary hoisting speed, and the motor will remain practically steady at this speed and act as an induction generator, returning power to the line. It is not possible to use this generating effect to bring the cage to rest, but the lever may be brought back past the mid-position so that the cage is brought to rest by giving the motor the reverse current, but while the lever is being moved over there is no electrical braking effect whatever, and to prevent the cage increasing in speed it has to be checked with the mechanical brake. It will thus be seen that this method of control is distinctly difficult and should only be used in the case of long winds, such as slope haulage, where there is plenty of time to execute these manoeuvres.

The third method by which the connections of the motor are reversed, so that it is exerting its torque against the rotation, is extremely wasteful, because the motor takes power from the line in proportion to the turning moment which it is exerting, as well as the power which is given out by the winder, corresponding to the work done by the loads in descending.

As an example of this, attention may be called to the lowering diagram, with reverse current, shown in the figure. The amount of energy given up by the lowering of the load is 20,900 hp. seconds. The amount of energy taken by the motor from the supply is 42,900 hp. seconds. Therefore, in order to exert the braking effect on the winder, and to absorb the power given up in lowering the load, which amounts to 20,900 hp. seconds, the starter has to dissipate 63,800 hp. seconds. It will easily be seen, therefore, that when a load is lowered in this manner the amount of energy which the starter has to dissipate is very large, and in order to enable lowering to be carried out in this way it would, in many cases, be necessary to employ a much larger starter than is required for controlling the winding engine when hoisting. This method of lowering is the easiest to control, and for this reason, although it is very wasteful, it is generally adopted for large three-phase winders.

Starter and Controlling Resistances

From what has been stated above it will be seen that for the control of large three-phase winding en-

gines, resistances have to be provided which will dissipate a considerable amount of power. In the case illustrated in Fig. 2, 325 hp. will have to be dissipated

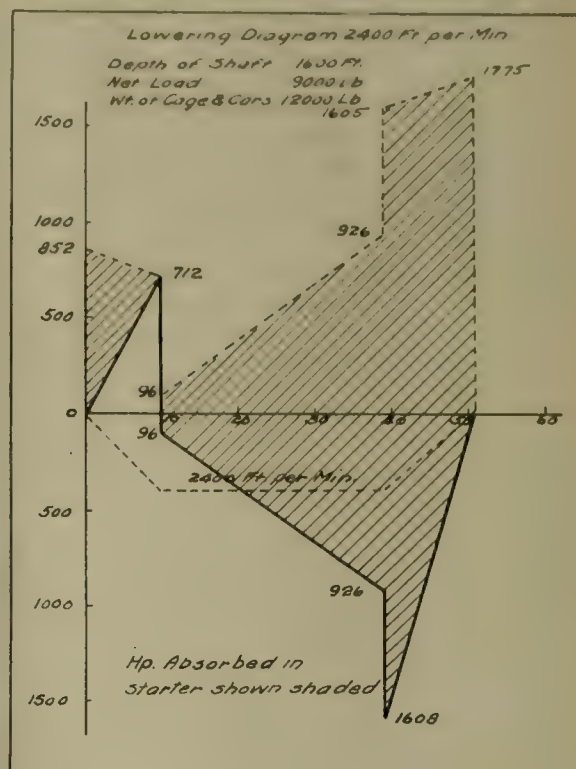


FIG. 2.

continuously, and means have to be adopted for absorbing this power in the controlling resistance and carrying away the resultant heat developed, while, at the same time, the controlling resistance is of a form which can be easily operated by the driver.

A very usual type of controlling resistance is a liquid resistance and consists of two tanks arranged vertically one above the other, in the upper tank of which are fixed the electrodes which are connected to the sliprings of the three-phase motor. When the winder is at a standstill the liquid is practically all contained in the lower tank, but is being continuously pumped into the upper tank by means of a small motor-driven pump, from which it flows back into the lower tank over a movable weir. In starting the winder the switch in the stator circuit is first closed by the control lever, and then, as the control lever is moved over, this weir is gradually raised, thereby raising the level of the liquid round the electrodes in the upper tank and reducing the resistance in the rotor circuit. This enables a very large controlling resistance to be operated easily by the driver without the complication of electrical auxiliary gear, etc. The liquid in the lower tank is cooled by means of water circulating through a coil of pipes, which forms a ready way of carrying away the heat generated in this tank.

Emergency Gear

A three-phase winding engine is provided with a mechanical brake, which is brought into action by means of a weight attached to a lever, but the brake is normally held away from the brake drum by air pressure. If this air pressure fails, then the weight brings the brake on to the brake drum and stops the winder. As the speed of a three-phase winder for a given position of the control lever depends on the load which is being hoisted, it is not possible to provide cams on the depth indicator in order to slow down the cage before it reaches the bank. The proper slowing down of the cage depends on the skill of the driver, but an over-wind device is fitted both in the shaft and on the depth indicator, and in case the cage over-runs the bank it cuts off the power from the motor and applies the brake by means of the emergency gear. An emergency lever is provided on the driver's platform by which he can cut off the power and apply the brake, stopping the winder immediately in case of necessity. In case the power supply fails the brake is at once applied through the emergency gear.

With the three-phase winder the speed for hoisting men cannot be limited automatically, as in the case of a Ward Leonard winder, and the speed depends entirely on the skill of the driver.

For shaft and rope inspection the slow speed is obtained by leaving a very large amount of resistance in the rotor circuit of the motor, but as the speed at which the winder runs for a given position of the control lever depends on the turning moment which is being exerted, and as the turning moment varies continually from the commencement of the wind, owing to the adjustment of balance produced as one rope is wound on and the other rope is wound off, the speed can only be maintained constant by the driver continually adjusting the position of the control lever and the winder cannot, as in the case of the Ward Leonard system, be left alone to maintain the speed at which it has once been set. These slow speeds are the cause of considerable waste of power in the controlling resistances and may require that additional large controlling resistances should be installed in order that slow speed runs may be made, which if frequently made will materially reduce the overall economy of the three-phase winder.

Three-Phase Commutator Motors

The three-phase commutator motor has somewhat similar characteristics to those of a direct current series motor, that is, it develops a large turning moment at the moment of starting, and as the load decreases the speed rises until at no load the motor will attain a dangerous speed unless it is properly controlled. The motor has a large overload capacity and does not stop even under very heavy overloads but only slows down. The speed of a three-phase commutator motor can be closely regulated, within wide limits, by shifting the brushes on the commutator, and

the efficiency and the power factor are high throughout the whole range of speed regulation. A mechanical device can be fitted to the motor which by shifting the brushes prevents the speed rising above a determined value, however small the load may be.

A powerful and easily regulated braking effect can be obtained electrically by moving the brushes back through the neutral position, and when braking in this manner, especially when lowering loads, the motor acts as a generator and will return about 70% of the mechanical energy to the line as electrical energy. The direction of the rotation of the motor can be reversed by moving the brushes to the other side of the neutral position, but it is desirable at the same time to reverse the stator current in order to prevent sparking at the commutator. The stator can be constructed for any reasonable line voltage, but as the commutator can only be made for comparatively low voltages, it is usually necessary to install a transformer between the stator and the commutator. There are constructional reasons which make it difficult to build very slow speed three-phase commutator motors, so that such a commutator motor is usually geared to the winding mechanism.

Arrangement of Winder and Motor

The arrangement of a winder with a three-phase commutator motor is very simple. The winder is controlled by a single lever which shifts the brushes on the commutator and operates the change-over switch. The commutator motor shares with the three-phase induction motor the disadvantage that for a definite position of the control lever its speed depends on the load in the cage, consequently, the safety devices employed with such a motor are very similar to those used with a three-phase induction motor, and protection is afforded by the release of the emergency brake and the interruption of the supply circuit in case the motor or winder is overloaded, or in any other contingency. The three-phase commutator motor possesses the great advantage over the induction motor that its power factor at full load is about unity and the power factor maintains its high value practically for the whole range of speed regulation, so that the conditions for the electrical supply circuit are very favorable.

The actual full load efficiency of the three-phase commutator motor is about 5% less than that of the corresponding induction motor, but the commutator motor can be started and its speed can be regulated without loss of power, and during braking periods or periods of lowering a load, 70% of the mechanical energy can be returned to the supply system as electrical energy, so that the total efficiency of a winder driven by a three-phase commutator motor can be better than that of a corresponding winder driven by a three-phase induction motor.

As a winder driven by a three-phase commutator motor can be started without loss of power, the power taken by such a motor rises gradually from the

moment of starting to the end of the acceleration period, so that there is sufficient time to enable the generators in the power house to follow the load fluctuations. Such winders, therefore, can conveniently be supplied with current from comparatively small power stations provided that the generating sets are fitted with modern voltage regulators.

The capital cost of a winder provided with a three-phase commutator motor is higher than that of a winder provided with a three-phase induction motor.

The following are some particulars of the largest winders fitted with a three-phase commutator motor which have come to the authors' knowledge:

Depth of wind	1,650 ft.
Weight of load	7,000 ft.
Maximum winding speed.....	1,575 ft. per minute
Output	94 tons per hour

This winding engine is driven by two 310-hp. three-phase commutator motors, having a synchronous speed of 300 revolutions and a maximum speed of 370 revolutions. This winding engine is supplied from a three-phase, 25-cycle, 500-volt circuit. The authors have no data available regarding the power consumption of this winding engine. A smaller winding engine driven by a three-phase commutator motor gives an average power consumption of 1.4 kilowatt hours per shaft horse-power, which compares very favorably with other electrical systems of winding.

The Zinc Corporation, operating a mine, mill, and a flotation plant at Broken Hill, New South Wales, will double the capacity of its lead mill at a cost of \$248,000. It is intended to construct the plant so that it will be possible to change the process from the treatment of lead ore to the treatment of zinc ore, or vice versa. At present, the Lyster process, a modification of the flotation process, is treating 100 tons of slime per day hitherto thrown away, slime from the treatment of the lead ore as it comes from the mill, high grade and mixed with lead concentrate. The Corporation is now securing nearly 90% of the original lead content of the ore in the form of a high-grade lead concentrate, 7% of the recovery being due to the Lyster process, which costs 96c. per ton of material treated. The Horwood process is being applied to a certain by-product from the zinc concentrator, the said product being in effect a mixed zinc-lead concentrate. This residue is subjected to a slight roast, and upon being treated by flotation it yields, on the one hand, a fine zinc concentrate, and on the other a good lead concentrate. The application of the Horwood process, in respect of the Zinc Corporation's visible supplies of ore and concentrate, represents very nearly one whole year's production of zinc concentrate; the lead is not quite so much.

Lessees at the Standard mine, Bodie, California, covered 282 ft. of development last year, producing 229 tons of ore, paying a royalty of \$16.55 per ton.

Natural Resources Survey of New Mexico

The Natural Resources Survey of the state of New Mexico dates from 1900, and while no funds have been appropriated at the last two legislative sessions, the geological division is still active and doing valuable work.

The act for the establishment of a conservation commission and a natural resources survey provides that three persons, no two from the same judicial district, shall be appointed by the Governor for terms of one, two, and three years, and that reappointees shall hold for three years each. The Governor and the director of the survey, who is the state geologist, are also members of the conservation commission. The chief duties of the commission are to make an inventory of the state's resources and provide for their conservation through conferences with the federal commission and remedial legislation.

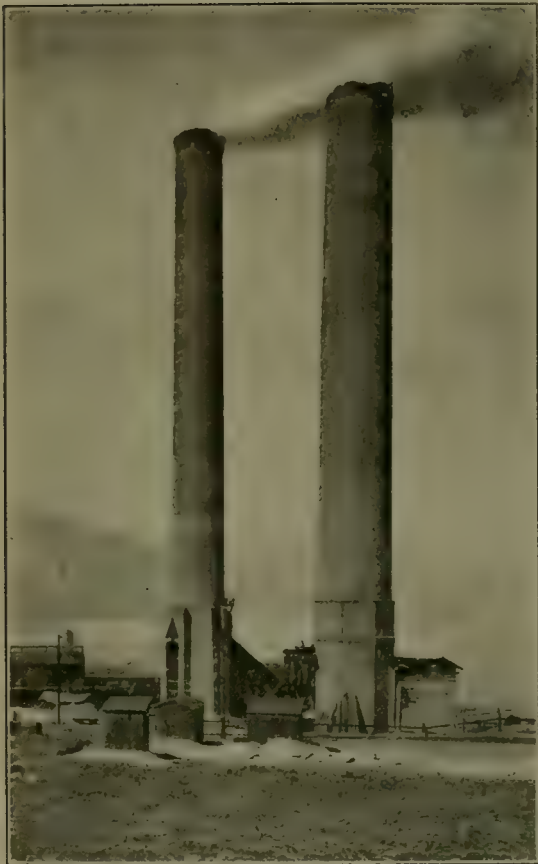
The specific objects of the survey are: (1) the study of the structural and economic geology, with special reference to the value and accessibility of the various products for mining and manufacturing purposes. (2) The physical and chemical analyses of soils. (3) The collection of climatological data. (4) The establishment of topographical control with complete survey of irrigation areas. (5) The study of surface and ground water resources. (6) The collection of biological data. (7) The making of such other researches as the board may direct. (8) The dissemination of this information by publication, correspondence, and addresses. (9) The cooperation with the U. S. Geological Survey, Department of Agriculture, Forestry Service, and other federal bureaus wherever benefit may accrue to the state. The head of the geological department of the state university holds the position of state geologist and is director of the resources survey and chief of the division of geology. The divisions of agriculture and mining engineering are controlled by the respective colleges in the state, while the division of water resources and irrigation is in charge of the state engineer. The director and chiefs of divisions constitute the staff of the survey.

Expeditions were made and a brief report printed out of the original fund of \$1500 which was appropriated for the expenses of the commission for the years of 1909 and 1910, but the limited issue is now exhausted. No other report has since been made, but the Governor has renewed the personnel of the commission, who are serving without remuneration.

The state geological survey is cooperating with the U. S. Geological Survey in the collection of non-metallic mineral statistics of the state. It is also occupied from time to time in the classification and valuation of mineral land for county taxes, and in the inspection of deposits on grant lands and elsewhere when the results are more or less of a public benefit. Expenses in these instances are paid by those desiring the services.

Razing the Steptoe Valley Stack

By D. BOYD-SMITH, Jr.



THE STACK (ON THE RIGHT) BEFORE RAZING.

For the past two years the stack for the roaster building of the McGill plant has been in very bad condition due to the action of the acid in the smoke. This action has continued slowly but none the less surely for some time past, and through its eating effect on the brick had caused parts of the stack to fall; in some cases brick fell inside and either stopped the draft entirely or so impaired it that other arrangements had to be made to take care of the smoke until the débris could be removed. Finally the conditions reached that point where it was deemed advisable to build a new stack. This work was started and completed under the direction of S. S. Sorensen, the chief engineer, and under the direct supervision of Alma Ek as engineer in charge. On the completion of the new stack it was decided to destroy the old one, and this work was given to J. D. Watson, civil engineer for the company, under whose supervision the plans were laid and successfully carried out as herein described. The stack was originally 250 ft. in height

with an inside diameter of 18 ft., the thickness of the walls varying from 13 in. at the top to 50 in. at the bottom as is shown in Table I.

TABLE I

From base up 40 ft. 30 to 50 in. due to octagonal shape.			
Next 10 ft.....	27 in.	Next 10 ft.....	19 in.
" 10 ft.....	25 in.	" 40 ft.....	17 in.
" 10 ft.....	23 in.	" 60 ft.....	15 in.
" 10 ft.....	21 in.	" 60 ft.....	13 in.

At the time of its destruction the stack had been eaten away until it was only 190 ft. high with a thickness of approximately 10 in. at the top, and it is quite logical to expect that the same amount of decrepitation had taken place on the inside throughout its entire height. On the south side of the stack and 20 ft. above the concrete foundation, there was an opening 10 ft. wide and 15 ft. high, from the top of which started a series of cracks ranging from 10 to 50 ft. in length and extending to the top. The north and east sides were in approximately the same condition. The west side, however, showed a consid-



TELESCOPING EFFECT PRODUCED BY THE EXPLOSION.



COLLAPSE AND REMAINS OF STACK AFTER DYNAMITING.

erably worse condition than any of the other three. On this side small cracks, such as were on the other sides, started at the base and extended upward to within 50 ft. of the top where the largest crack in the stack began. This crack gradually widened until at the top there was an opening from 3 to 3½ ft. wide. Due mainly to this crack on the west side there was a very pronounced swelling in the last 40 or 50 ft. when viewed from the north to south, but not so noticeable from the east and west.

The stack at the time of its destruction was estimated to weigh approximately 2,016,000 lb., and from this weight the following method of dynamiting was decided on by Mr. Watson as that best suited to the conditions. Eleven holes were drilled 7½ ft. above the concrete foundation, as is shown in the sketch, and of the sizes shown in Table II.

TABLE II

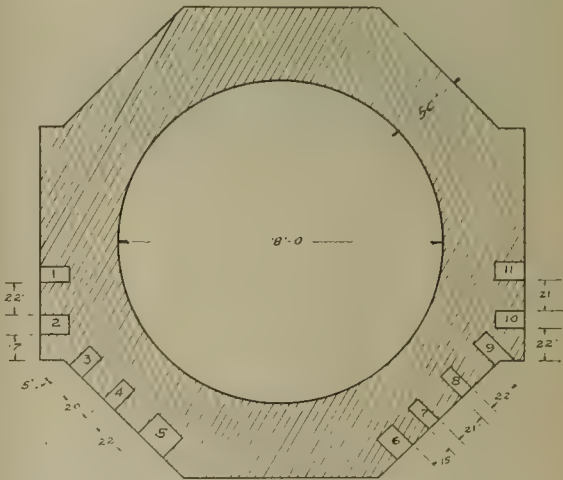
Hole No.	Width, Height, Length.		
	in.	in.	in.
1	11	9	23½
2	13	9	24
3	12	8½	24
4	12	8½	24
5	24	6½	24
6	14	9½	25
7	9½	9½	22½
8	9½	9½	23
9	12	9½	23
10	12	7	22
11	12	6¾	23½

It was decided that approximately 200 lb. of Hercules E.L.F. 40% would be sufficient to do the work, and how well calculated the amount was is graphically shown by the photographs. The holes were loaded in the following manner. Each hole was first loaded with its apportioned share of powder, in the middle of which was a stick containing an electric detonator with a 35-ft. lead. The detonator was inserted about 3 in. into its stick of powder. After each hole had been loaded in the manner above stated, great care being taken to see that the powder was in

a most compact mass, a black plastic converter mud was used to wad the holes. This was tamped thoroughly around the powder and out to the surface of the stack, making a very solid charge. The amounts of powder placed in each hole, together with the total, are shown in Table III.

TABLE III

Hole No.	Powder, lb.	Hole No.	Powder, lb.
1	14.0	7	8.5
2	16.3	8	12.9
3	13.3	9	23.7
4	13.8	10	13.8
5	26.2	11	13.1
6	34.5		
Total			
190.1			



PLAN OF STACK SHOWING ARRANGEMENT OF HOLES FOR FIRING.

The electrical connections for firing the blast were made by R. E. Middagh, chief electrician for the company, and were as follows: The eleven holes were connected in series and then to a line running approximately 500 ft. to a switch connected to the 110-volt lighting circuit. This switch was equipped with plug

fuses, which were not put in until the last minute in order that under no condition would there be an accident due to premature explosion.

When everything was ready, on March 1, the word was given and the switch was thrown, setting off one of the most successful shots of its kind ever fired.

The way in which the stack fell is well worth mentioning. From pictures taken at the time, some of which accompany this article, it seems that the shot blew out the entire base above the concrete foundation and up about 30 ft. The stack then fell straight down until its lower edge hit the foundation, at which time it seems to have telescoped on itself, making one of the most spectacular and successful falls on record. It is well to record here that in spite of the apparent bad condition of the stack in general, and the top in particular, that practically no cracks appeared until it had started to telescope; neither was much of the top loosened, although some little of the latter did fall. The entire stack fell in a pile about 50 ft. in diameter, with the exception of a few bricks which scattered to a distance of about 80 ft., due chiefly to the force of the explosion.

The new stack situated 145 ft. west by south and the two oil reservoirs situated 100 ft. north by east were not damaged. Two bricks fell through the roof of these reservoirs and constituted the entire damage done by the shot except for the destruction of some light wires which were in the danger zone and were not attempted to be saved.

Mining in the Choco District, Colombia

The gold-mining district extends from the junction of the Negua and Atrato rivers south to the mouth of the San Juan. Almost all the deposits are alluvial. There is only one large company at work in the field, formed with British capital, which is extensively sampling with drills and tunnels on the Condoto river, an affluent of the San Juan.

Most of the gold and platinum exported is obtained by native women, working two or three hours per day. They use the antiquated ground-slucing process as a preliminary to get rid of the coarser gravels and then with their *bateas* separate the metals from the sand and gravel. The *batea* is a wooden pan, shaped like a very shallow inverted cone 18 in. diameter and 3 in. deep at the centre, with two small handles or knobs on the rim. The women handle the *bateas* with great dexterity, throwing off the gravel and sand by a rotary motion and leaving the gold and platinum dust in the common centre. Another method of mining that is extensively employed by these women is diving into 3 or 4 ft. of water for the sand and gravel containing the metals and bringing it up in the *bateas*. This method is usually more remunerative than the sluicing process.

The gold workings have existed for centuries, but little has been done in the development of the district. The river gravels were being washed by the Indians

long before the advent of the Spaniards, and this region furnished much of the gold that was carried back to Spain. In those days the value of platinum was unknown, and when the Indians brought the metal down to the Spanish headquarters in Quibdo the platinum was thrown away. Large finds of this discarded metal have been made recently in Quibdo, and frequently the earth excavated for foundations has yielded sufficient platinum to pay for putting up the building. The natives were beginning to pan even the streets, thus uncovering large amounts of mud, which was injurious to health. A decree was therefore promulgated in 1913 prohibiting any further washing of earth in the streets of Quibdo.

Besides the *batea*, the only tools used are the *almocafre* and the *barra*. The former is a kind of hoe 4 in. wide, tapering in a curve to a sharp point that extends back toward the operator. The handle is approximately 18 in. long and 1½ in. diameter. This tool costs 80c. to \$2, the price depending upon whether it is made of iron or steel. The *barra*, which takes the place of a pick, is a small iron or steel crowbar, 1¼ in. diameter and 32 to 40 in. long. A *barra* of iron with a point of steel costs \$1.20 to \$2, while one entirely of steel costs \$2.80 to \$3. The price of a *batea* varies from \$1 to \$2. All the tools are locally made except a few of the *barras*. Since every woman in the mining district is a miner, it might be advisable for American tool manufacturers to investigate this market. Better quality tools could doubtless be sold in the Choco at lower prices than those quoted, but the styles offered should be identical with the ones now in use.

By a law that went into effect in 1910, foreigners are not allowed to denounce or purchase mines in the Choco, but mining property can be leased for a long period or obtained on other advantageous terms. It is expected that within a few years mining on a large scale will be begun in this district. Even under the primitive mining conditions of today the Choco stands second only to Russia as a producer of platinum and the prospects under improved methods are considered favorable.

Mining prospectors should come supplied with shovels, picks, tools, canned goods, guns, and ammunition, as it might be difficult to obtain anything but fresh provisions in Quibdo at reasonable prices. Laborers can be hired for 50 to 70c. and canoes for 20c. per day.—*Daily Consular Report*.

Banking and blowing-out iron blast-furnaces have quite different meanings. The former refers to an interruption in the making of pig iron, for a day or a week or two, when the furnace is filled with coke and kept at a red heat by a light blast. This costs only a few hundred dollars. When a furnace is to be idle for a month or more, it is emptied and allowed to get cold. Blowing-out costs several thousand dollars, and every furnace must be blown-out once in three years or so for relining.

Filter-Press Operation

By A. W. ALLEN

The displacement of valuable solution from residue in the operation of a chamber filter-press is generally effected by one of two means. Where all solid plates are low pressure, the outlets are always open to discharge and no drain cocks are necessary. The pulp is forced under pressure into the press and the solution filters through the cloths which hang between the solid plates and the hollow frames. The former have a channelled surface to facilitate the even flow of solution from the filtering area. Cake formation starts over the whole surface of the cloth and continues until the frame is completely filled with caked slime. A distinct line is traceable vertically through the centre of each cake. This line constitutes a zone of division which is noticeable when the presses are being discharged 'dry' by hand. The displacement of residual solution carrying metal is effected by a wash operating through the same channels as those traversed by the pulp and charge solution. The wash solution or water enters the filling port in each frame, traverses the zone of division in each cake, and passes through the cake on either side of the centre line, through the filter-cloth, and thence to the discharge launder. The same system of washing may follow the part filling of the frame so that a clear space is left between the separate cakes formed on each cloth. In this instance, however, the advantages of a slightly higher washing efficiency are more than counter-balanced by the fact that satisfactory removal of the excess wash left in the hollow space is a difficult matter. Compressed air is only partly effective in reducing such moisture content because, however applied, it will find its way through the top of the cake where there is a minimum moisture content to the avoidance of the lower portion where there is an excess. In a dry discharging press this method results in a sloppy residue, and, under any circumstances, an unnecessary loss of wash. In the second method of operation the low-pressure plates alternate with high-pressure plates and the outlets from the latter are controlled by suitable valves. The low-pressure plates, as in the other system, are open to discharge at all times. During filling all discharge valves are open but as soon as the cake is formed the high-pressure plate discharge valves are closed and wash is forced in, through a separate channel, to the high-pressure plates. This solution finds its way through the cloths over the high-pressure plates and diagonally across the cake of slime, through the cloths covering the low-pressure plates, and thence to the discharge launders. Given similar conditions of operation it has been found that the efficiency of operation by either method is dependent on the thickness of the frames into which the cakes are formed, that is, the thickness of the cakes themselves. The cross-washing system, with high-pressure plates, gives excellent results where the thickness of the cake is not too great. On the other

hand, the median washing system is preferable where it is more economical or necessary to form thick cakes. As in all other classes of filters and filter-presses, the efficiency of displacement is largely affected by the thickness of pulp being handled, rapid cake formation being the surest preventative of a segregation of coarser material in the lower portion of the frames.

Hoisting at the Argonaut Mine

By M. W. VON BERNEWITZ

Both steam and electric hoists are operated at the mines along the Mother Lode of Amador county, California, but that at the above property, at Jackson, is of more than passing interest. The main shaft is down 4100 ft. on the incline, from the surface to 1600 ft. being at an angle of 63°, and from 1600 to 3900 ft. it is 58°. The hoist is on the hanging-wall side, and from centres of the drums to the head-frame sheaves is 300 ft., slack in the ropes being taken care of by three sets of grooved idlers. The machine was built by Knight & Co. of Sutter Creek, whose works are about three miles from the mine. It is a geared hoist, the pinions having 22 and the spur wheels 108 teeth, both with 3-in. pitch, with diameters of 21 and 108 in. respectively. The two drums are 6 ft. diameter



SURFACE VIEW OF ARGONAUT MINE.

with a 35-in. face each, and carry 7 layers of 1½-in. diameter crucible-steel rope. There is a post brake on each drum flange, and also brakes on two flywheels on the pinion shaft. Clutches are operated by hand levers.

To drive the hoist, there is in front, to one side, a Westinghouse induction motor, type H.F., of 500 hp., 440 volts, 60 cycle and 3 phase, running at 440 r.p.m. at full load. On its shaft is a 42-in. diameter grooved pulley for twenty 1¼-in. hemp ropes, driving a 96-in. diameter wheel on the hoist pinion shaft. These ropes are in reality endless in two sections running over ten grooves each, having the usual tension pulleys on a frame above. They have been in use so far for 2½ to 3 years. The motor is controlled by a master switch and a Westinghouse liquid (2% soda solution) rheostat, and has the usual safety and

recording devices. The ore-skips will hold four tons. The mine is equipped with electric signals and telephones.

In case of mishap to the electric motor, the hoist may be driven by water power, there being a 6-ft. Pelton wheel, operated under a 240-ft. head, from two lines of 18-in. pipe, 1900 ft. in length. A pulley on the Pelton shaft drives another on the hoist pinion shaft by five 2-in. ropes. A chart showing the power absorbed in hauling from various levels was to have accompanied these notes, but on account of changes in the shaft of late, this cannot be procured at present.

A similar although a little more elaborate hoist is used at the South Eureka mine, only instead of there being one motor there are two 400-hp. General Electric motors coupled to the small rope pulley which in turn drives the pinion shaft. Results from this style of power transmission are entirely satisfactory.

Ore and Dump Train Service*

1. All enginemen, firemen, brakemen, switchmen, and others in train service must be familiar with the rules and regulations and the signal rules, color signals, hand, flag, and lamp signals, and engine whistle signals common to general railroad practice, and particularly as prescribed by the Nevada Northern Railway Co., with whose main line the Company's pit, yard, and dump tracks make connection.

2. Enginemen must signal by whistle when approaching track connections, road crossings, and curves where view is obstructed, and also when nearing steam-shovels in pit, and any and all places in and around the workings where men are at work on or near tracks.

3. Never start engine without first ringing bell.

4. Headlight to the front and rear of all engines must be displayed at night.

5. Under no circumstance must headlight be concealed while engine is moving.

6. Any defect or improper condition of the engine must be reported by engineman to the master mechanic, and at end of each shift such repairs as are required must be entered on the work book.

7. Any defect, bad order, or impaired condition of hand-holds, grab-irons, footboards, brakes, or other equipment of cars or engines found or noted by an employee must be reported promptly to his foreman or to master mechanic.

8. Employees must not remove any of the appliances from an engine or car for convenience in switching, or for any other purpose, thereby endangering the safety of themselves and others.

9. Employees must not attempt to make couplings of cars, or engine and car, if coupling apparatus is found out of order. If examined and found in bad order, report same at once to master mechanic.

10. The dangerous and unnecessary practice of trying to make a coupling with the foot, by kicking the drawbar as cars approach, is positively forbidden.

11. Employees are prohibited from going between moving cars to uncouple, open, close, or arrange knuckles or couplers, or for any purpose whatever.

12. In all service stops of car or cars in train on main tracks, sidings, or service tracks, when engine is cut off, all brakes must be set and cars blocked to hold the train.

13. Employees must not stand between the rails and attempt to get on the front or rear end of an engine or the end of a car as it approaches them. All engines and cars are equipped with grab-irons and when necessary for employees to board moving trains they must stand outside of rails and get upon side of car or end of footboard of engine.

14. Employees must avoid walking on tracks, and are hereby warned that they must not rely upon others to notify them of approach of train.

15. To avoid the danger of being struck by rocks, coal, or other article falling from moving cars, employees must not remain near the track when trains are passing.

16. Employees, other than the regular train crews, are prohibited from riding upon ore or dump trains without special permit from the superintendent. And employees so riding on permit are strictly prohibited from jumping on or off trains or engine while train is in motion.

17. Car repairers, trainmen, or other employees, while working under cars, must make it an absolute rule to protect themselves by flag or light.

18. Track foremen are instructed to keep all frogs, switches, and guard-rails properly blocked. It is the duty of all employees, for their own protection, to report promptly the absence of necessary blocking.

Danger From Falls of Rock

By far the greatest source of danger in tunnel work is from falls of rock. These can be prevented in a large measure by promptly and adequately supporting the roof. Insist that necessary timbering be done, and always keep a supply of lumber for this purpose. Timbering is laborious, and it either takes the men of the tunnel crew from their regular work or requires extra men. If extra men are used, they add to the confusion in the heading, and as their work is done at the same time as the other work of the tunnel, it seriously hinders either the drillers or the shovelers, or both. So, although you may suspect that the roof is dangerous, you may be tempted to delay timbering—possibly until an accident brings the necessity forcibly and unavoidably to the front. Remember that all necessary timbering cannot be done too soon, and that any delay seriously jeopardizes the lives and limbs of the men who have to work under a roof improperly supported.—Miners' Circular 13, Bureau of Mines.

*From the book of 'Rules and Regulations' of the Nevada Consolidated Copper Company.

Discussion

Readers of the MINING AND SCIENTIFIC PRESS are invited to send their department for the discussion of technical and other matters pertaining to mining and metallurgy. This feature welcomes the expression of views contrary to its own policy and is not intended as a medium for the publication of original research. Discussion of any contribution should be limited by its probable interest to the readers of this journal.

Geology of the Kalgoorlie Goldfield

The Editor:

Sir—In reply to the leading article in the *Mining and Scientific Press* of July 12, 1913, and your request that I should add some remarks to the articles on the 'Geology of Kalgoorlie' by Mr. Maclaren, it is needless to say I have much pleasure in discussing that gentleman's work. But I do so with much diffidence, for I highly appreciate the excellent work carried out by Mr. Maclaren on this field, with which there is nothing to compare. Moreover, I owe much to his courtesy and generosity. As a matter of fact our views coincide very closely. But the work carried out since the publication of my book on the 'Geology of Kalgoorlie' in 1912 has brought to light certain points which do not entirely agree with the views of Mr. Maclaren, if I have read this article and reports correctly, and which I venture to think may be of some importance to the future of this field.

Furthermore, as pointed out in your editorial of July 12, the question of nomenclature is one that requires settling, in the interests of managers, in order that the maps may all have the same set of names for the rock formations in each mine, a factor to my mind of prime importance.

NOMENCLATURE

The importance of this subject has just been referred to, and I think the time is now ripe for a settlement of the question. But unless two authorities agree, or one is entirely accepted, there is no hope of finality being reached. Detailed arguments will be used when discussing each rock, but it is clear that Mr. Maclaren admits the chaotic condition of rock nomenclature, for in speaking of quartz-dolerite (quartz-diabase) he says: "Many pairs of names are now engaged in a battle for existence, and it will be a generation before these struggles are ended." I think this remark could well have been extended, for, apart from pairs of names, the nomenclature of the older greenstones and other rocks will perhaps be several generations before finality is reached. Take for instance the calc-schist. Mr. Maclaren admits, "The name calc-schist has a very general significance and gives no clue to the original character of the rock, which may have been tufts or ashes or lava flows." (I called the same rock metamorphic tuft). These remarks clearly show the difficulty surrounding the subject. Furthermore, I think all geologists are agreed upon the impossibility of different authorities

giving the same name, though they may agree in every other respect, to highly altered rocks in the Archean Complex.

Quartz-Dolerite. (My 'quartz-andesite', Maclaren's 'quartz-dolerite greenstone or chloritic rock with micropegmatite'. This is Mr. Maclaren's quartz-dolerite greenstone. It forms the country rock of the chief mines on the field, and is in consequence perhaps the most important.

In order to show the diversity of opinion with regard to the name of this rock, apart from the fact that we all agree as to its constituents, I give the following names applied by different authors:

Maclaren	Quartz-dolerite greenstone
Larcombe and Judd	Quartz-andesite
Simpson	Prophyllite
Gibson	Quartz diabase
Card	Acid eruptive

Mr. Maclaren says: "It has not been found possible finally to determine the original character of the rock from a single specimen, and it is only after the consideration of several hundreds of rock slides that the character of the original rock has been reconstructed. It has, therefore, been necessary to indicate that the freshest rock now to be found is yet a much altered one; and this has been fulfilled by the selection of the term 'quartz-dolerite greenstone'; that is, a somewhat indefinite rock derived from quartz-dolerite and one that would fall into the old, useful, field group of greenstones."

These remarks clearly indicate the difficulty in finding a name. I called the same rock quartz-andesite, and my reasons for doing so are well summed up in the following remarks on page 306 of my book, as follows: "The most important result of the examination of these deep-seated rocks is to show that they are undoubtedly holocrystalline, and contain a very large amount of felspar. It consequently follows that the practically irresolvable base in the specimens from the higher levels is produced by the decomposition of the minerals in the parent rock to carbonates, chlorite, sericite, etc., certain crystals remaining as apparent phenocrysts."

Maclaren says: "It is this porphyritic appearance, together with the destruction of the other original minerals, that has led Judd and others to describe the rock as a quartz-andesite." It therefore appears that I followed the same course as Judd, and being practically the first extensive writer on this field I was at a loss what to call this rock, which I realized was an intermediate stage between quartz-gabbro, quartz-dolerite, amphibolite, and such highly changed rocks as the graphitic slates and quartz-sericite carbonate rocks. Moreover G. W. Card, government mineralogist in New South Wales, repeatedly made use of the terms 'matrix', 'base', 'groundmass', and 'interstitial matter', when describing this rock after a thorough microscopic investigation.

As regard 'quartz-diorite', there is no doubt this name might well be used by the older school. But Harker is now doing away with this name, which I think is a good scheme. He would now say altered-dolerite instead of quartz-diorite. I therefore think if we refer the country rock of the Golden Mile to its original, then the name quartz-dolerite used by Mr. Maclaren is the best, and should be generally adopted.

Bleached Dolerite.—(My 'granophyric-dacite', Maclaren's 'bleached and carbonated rock with micropegmatite.') This is a characteristic pinkish rock, varying in texture from coarse to fine grain. It has practically the same constituents as the quartz-dolerite, but contains less chlorite, often none, and more carbonates and sometimes sericite. I called it granophyric-dacite because the leaching of the chlorite from the quartz-andesite (quartz-dolerite) seemed to show up the granophyric texture. I have regarded this rock as being in part due to a slight differentiation in the original magma, and in part to a process of leaching. Having adopted the name quartz-dolerite I suggest that this particular pink and grey variety might for shortness and convenience be regarded as 'bleached dolerite'. These bleached forms of the quartz-dolerite are very characteristic, and at the same time they have certain economic significance, so that I venture to think this name will be very useful.

Aphanite.—(My 'aphanite', Maclaren's 'non-chloritic carbonated and sericitic rocks, with micropegmatite and schistose varieties'). The use of this term has led to a considerable amount of controversy, but continued experience has caused me to adhere to it. When I speak of aphanite I mean the dense, compact greenish rock, which is only an altered form of the quartz-dolerite surrounding the lodes. In boring on the western side of the field it has served as an invaluable indicator of the presence of lodes, particularly in the Great Boulder and Horse-Shoe mines. Of course, all lodes do not have this aphanitic product along their walls especially on the eastern side of the field, but on the western side it may be over 100 ft. thick and is exceedingly characteristic and important.

This rock at deeper levels is indistinguishable from the felsite (albite-porphyry), and its recognition has, I hope, proved of considerable economic importance to the Horse-Shoe mine. For what was apparently taken for felsite, an unfavorable rock as regards lode formations, has proved to be aphanite. As an illustration, the 1900-ft. level of the Great Boulder mine at the main shaft appears to be surely in felsite, but microscopically the evidence is strongly in favor of aphanite or altered quartz-dolerite, probably close to the western or hanging wall of the felsite. For at deep levels the edges of the felsite are often aphanite. The recognition of this fact has considerably reduced the thickness of the felsite.

The word 'aphanite' is often used in an adjectival sense (aphanitic), meaning not apparent to the unaided eye whether crystalline or not. But I see no reason why

the term 'aphanite' should not be applied to a rock wholly aphanitic, for James Geikie uses the term aphanite for a compact diorite and modern text books, such as Iddings, include for field purposes all aphanitic rocks, whose component crystals are so small that they cannot be seen and recognized by the unaided eye, under the general heading of 'Aphanites'.

A study of the Horse-Shoe plans shows the importance of this rock as an indicator in boring, and as it is easily separated from the quartz-dolerite in cores, and as it is the most favorable lode carrier on the field, I respectfully ask for the acceptance of the term aphanite, or a single term that every one will use, for this quartz-sericite-carbonate rock is one of those that may perhaps never receive a place in rock nomenclature.

Slates.—(My 'carbonaceous slates'; Maclaren's 'graphitic slates') There is no difference between Maclaren and myself as far as the name applied to the black bands in the altered quartz-dolerite is concerned, so at this point there is nothing further to be said. But later I shall discuss the different classes of 'slate', their influence on lode formations and the possible origin of the carbon.

Felsite.—(My 'felsite-porphyry', Maclaren's 'albite-porphyry'). This is Maclaren's albite-porphyry and I called it felsite-porphyry because it is essentially a felsite, though at times small crystals of felspar are observable. Continued examination at deep levels convinces me that felsite is the best name, for it is rarely that phenocrysts are observed even with the microscope. I therefore trust that the term felsite will be adopted. On account of the importance of this rock a somewhat detailed account of its occurrence and relation to lode-formations will be given later.

Cale-Schist.—(My 'metamorphic tuff'; Maclaren's 'cale-schist'). As far as the actual nature of this rock is concerned Mr. Maclaren and myself are in accordance, for although he calls it cale-schist he believes it to be metamorphic tuff. The indefiniteness of the name has already been referred to, for Maclaren says: "Cale-schist is an indefinite rock characterized by abundance of secondary carbonates . . . and gives no clue to the original nature of the rock." Furthermore my experience has been that the rock is for the most part massive, and not a schist at all except in local areas. Mr. Maclaren evidently recognized this fact, for he says: "This dike (rock) has been provisionally termed cale-schist though the schistosity is not strongly marked."

I am more than ever convinced that the cale-schist is a phase of the older greenstones, and as first suggested to me by my student, F. W. Rowe, probably represents the altered edge of the fine grained amphibolites along their contact with the quartz-dolerite. Consequently, whatever origin is finally attributed to the fine grained amphibolites must be the same for the cale-schist. Perhaps the original was a tuff though it may yet prove to be a lava flow. However, as the term cale-schist has got such a hold on the mining public of Kalgoorlie,

and it is shorter than metamorphic tuff, I trust the term will be allowed to remain. Its economic significance and position on the field will be again referred to.

PROPOSED CLASSIFICATION

Having regard to the foregoing arguments, I respectfully suggest that mine managers will see their way clear to finally adopt the following amended rock classification, with which it is my earnest hope Mr. Maclaren will agree, as I feel sure he will in the interests of all concerned. I can only once more repeat the concluding paragraph in my book, published in 1912: "It is to be hoped, in the interests of all concerned, that in writing of the Golden Mile, geologists will come to a compromise and agree on a definite name, not only for this rock, but also for each of the other five characteristic rocks on the Kalgoorlie field, and thus prevent the confusion that must otherwise inevitably arise, especially among those who are not familiar with geological nomenclature." If this were done we would be doing much in the interests of all who by their loyalty, energy and enthusiasm are endeavoring to uphold the great mining industry."

AMENDED CLASSIFICATION OF KALGOORLIE ROCKS

Maclaren.	Larcombe.	Geological Survey.	Amended classification.
	OLDER GREENSTONES		
Calc-schist	Metamorphic tuff...	Calc-schist	Calc-schist
	NEWER GREENSTONES		
Peridotite	Peridotite	Peridotite	Peridotite
Pyroxenite	Pyroxenite	Basic amphibolite	Pyroxenite
Quartz dolerite greenstone (chloritic rock with micropegmatite)	Quartz-andesite	Quartz-diorite	Quartz-dolerite
Bleached and carbonated rock with micropegmatite (granite of the miners at Kalgoorlie)....	Granophyric dacite. Carbonated-diorite		Bleached dolerite
Non-chloritic carbonated and sericitic rock (with micropegmatite and schistose varieties)....	Aphanite	Carbonated quartz diorite...	Aphanite
Albite porphyry	Felsite-porphyry ..	Felspar porphyry	Felsite
'Slates'	'Slates'	'Slates'	'Slates'
Porphyrite	Porphyrite	Porphyrite	Porphyrite

Since writing the above it is my pleasing duty to say that Mr. Maclaren has read my statements, and, after conferring on the subject he has asked me to say that he entirely agrees with my amended classification. I think we owe a great debt of gratitude to him for compromising in this way, and I sincerely trust managers and all concerned will adopt the new rock classification. For in years to come, when perhaps trouble may arise, and all maps are colored or marked according to this scheme, geologists will probably be able to give valuable advice.

For many years it has been my ambition to have this matter settled, and personally I cannot thank Mr. Maclaren sufficiently for coöperating with me and thus bringing order out of chaos as far as the Kalgoorlie rocks are concerned, for I feel sure he has thereby materially helped the furtherance of our great mining industry.

C. O. G. LARCOMBE.

Kalgoorlie, January 12.

What Is the Matter With Prospecting?

The Editor:

Sir—In some of the replies to your question, "What is the matter with prospecting?" there is much food for thought. The subject is one of moment and should be thoroughly gone over and a remedy found. That there are new fields still unexploited, ample proof exists. That the prospector finds it hard to interest anyone, is clear, and just why is the question. Some of the answers seemingly touched lightly upon the most vital point—money for prospects—dismissing the subject by saying there seemed to be plenty for that purpose. Where is it? Just what are the proper methods to apply for it? Where may the prospector apply for it? Since the boom days, prior to 1907, I have found money for opening up a prospect getting scarcer all the time, until at present there seems to be none. Why is this?

I ascribe it to the advent of the automobile as the main reason. The many millions now sunk in the 'auto' once was available for opening a prospect. Prior to the advent of the 'auto' it was no difficult matter to find a man who would 'take a chance with the prospector to open up a property. Surface showings

would induce him to rely upon his own judgment and take a chance. Veins must be exposed, the ground surveyed, tests made, etc., all of which costs money and time, before the big capitalist will listen to the prospector. Then the matter is referred to the engineer who must be able to see and measure, and test. He does not permit romance, adventure, prospector's visions, borne of hope, to enter into his report. Facts, figures, and measurements, make entirely different reading as compared with the prospector's description. The result is that many a prospect is lying idle or going begging. The engineer stands between the prospector and big capital. The automobile has taken the little capital. The old style prospector was useful in his way. True, he had failings, was full of visions, indulged in dreams, but nevertheless furnished a means for capital to work on. In discarding him for the engineer and the geologist there seems to have been a great decline in new discoveries and new fields. Some

of the gentlemen ascribe this dearth to no new fields, territory exhausted, etc. There is ample proof to the contrary. If the prospector could but connect with this 'plenty of money for prospects.' There are many finds laying dormant, for want of capital necessary for first work and clearings, that they may be 'shown' and referred to the engineer for report. The average prospector has no money; he has plenty of time and energy, but it takes tools, powder, and grub to show up a prospect. The man of small capital who would take a chance is no more. Ready market or assistance has been curtailed by legislation, and the automobile. The former has handicapped his flights of imagination, the latter his source of revenue. Big capital must be 'shown,' where it is not controlled by the old spirit of romance and adventure, hopes, and visions. These led the prospector into all sorts of places, and induced the man of small means to 'take a chance.' It depends upon the geologist and the engineer, with their useful scientific knowledge. But I never heard of either class finding anything; it is always the prospector who shows the way. How, then, help the prospector by government aid? This is impractical, and he doesn't need it. Just show him the 'proper channels' mentioned; just let this 'plenty of money for prospects' come out into view; just deal generously with his hopes, make allowances for his visions and dreams. He is useful, in a way; he cracks many a rock, digs many a hole, penetrates into many places that would be considered foolish, and a waste of time and energy, by the capitalist and capital. Led on by these same hopes, visions, and dreams, that have shown where capital might profit, and the world be benefited. Scientific exactitude and efficiency, conservation of time and energy, is no part of his makeup. These can be brought to bear after he has blazed the way to a 'find' which would lay hidden if left to the geologist or engineer. Not that they couldn't find, but they don't. S. A. Knapp covered the subject well as far as he enumerated. He should have added another statement, thus: "It takes money to open a prospect." This is where the big capitalist 'balks.' The prospector would dig to see. The capitalist wants to 'see' first. The prospector does not count time and money wasted if he gets no immediate returns. He is led by hope and faith to repeated effort, undaunted by failure.

A capitalist wants returns, expects and demands them, and cannot tolerate failures very long. I know of one man who had ten outfits out for him, covering a period of 18 months. Eight returned nothing on his investment. One made enough to cover all his expenditures for the entire number. One found, for him, that which yielded a million and a half in money, and still yields rich returns. He had the nerve to stand up under many disappointments. He 'took a chance' and told me he did not consider the eight that yielded nothing as money wasted; on the contrary, it was well spent, and he would do it again, or would have

continued, but felt that he had found plenty for his needs. He did not consider prospectors an unreliable lot, as was stated by one of your correspondents. It is this latter spirit that is killing off the new finds and fields. Another factor which enters largely between the prospector and large capital is the field representative. Some large mining companies have men out looking for properties. They are capable men, but they cannot see any farther into the ground than the engineer or prospector. They are under salary and it does not behoove them to make very many mistakes. If they cannot see, measure, and test, there is little chance to do business. Even then it is sale only—no partnership with the prospector and letting him share with the developments, but outright control, based on developed showing, if any. The prospector's capabilities are limited; were it otherwise he would not need a financier. I have often heard the term 'crazy prospector' applied to them, and it may seem so to the comfortably housed, scientifically regulated person. But he has been a benefit to the world, and is still useful.

There is a wide, deep chasm between the prospector and capital, which is difficult to bridge. The material once used for that purpose is gone; that is, the promoter and the man of small capital and ambitions. The former is active in real estate, where there seems to be no restrictions upon imagination. The latter is with his automobile.

I am a prospector and speak of conditions as I have found them. Immediately following 1907, the prospector fell into disfavor. But mining is coming into its own again. Let us hope the prospector will also—such at least is the hope I cherish.

C. P. GREENE.

Descanso, California, April 3.

The gold production of Nova Scotia from 1862 to 1910 has lately been published by the Canadian Geological Survey. In 1863 the total gold extracted amounted to 14,001 oz. while in 1867, it amounted to 27,314 oz., when the output began to decrease until 1881 it was but 10,756 oz. It again began to increase and high-water mark was reached in 1898 with 31,104 oz. For several years longer, until 1904, the gold output kept up well, but in that year, 1904, it began to drop and in 1910 the output was but 10,325 oz., or one-third its maximum. For the past year or two the gold output has been on the increase, last year, 1913, to a marked degree.

A windmill, with steel sails and mounted on a steel tower, and having a diameter of 50 ft. has started work in Holland on a drainage scheme. It has a capacity of 64,000 to 70,000 cu. ft. (40,000,000 to 43,750,000 gal.) per hour, and is said to be the largest in the world. Gasoline motors took the place of wooden windmills in 1908, but steel windmills have displaced the motors.

Concentrates

Most of these are in reply to questions received by mail. Our readers are invited to ask questions and give information dealing with the practice of mining, milling, and smelting.

Coal production of Ombilien, Sumatra, Dutch East Indies, was 411,983 tons in 1913, against 408,204 tons in 1912.

Permanganate solutions used in the analysis of iron ores is approximately 22.5 gm. of $K_2Mn_2O_8$ to 8000 c.c. of distilled water.

The weight of a cubic foot of air at an altitude of 3½ miles is approximately half of what it is at sea-level. At an altitude of 7 miles it is less than one-quarter.

Small leaks in newly erected steel tanks may be stopped by filling the tank with water and stirring into this a small amount of cement. Leaks in wood tanks may be stopped with sawdust in the same way.

Dredging costs of the Renong Dredging Co., in Siam, are 5.4c. per cubic yard. Other eastern expenses increase this to 8.2c., while taxes, royalty, agents' commission, selling charges, make it 11.2c., and depreciation and London expenses bring the total to 12.8c. per yard.

Uranium ores of Colorado and Utah do not contain pitchblende as a rule, but the brilliant yellow uranium mineral carnotite, according to E. S. Bastin of the U. S. Geological Survey. The only pitchblende production of the United States is from one locality in Gilpin county, Colorado. The only other places in the world yielding this mineral are the Erzgebirge in Austria and Germany, and Cornwall in England.

Box gives the following formula to calculate loss of head in a pipe-line as a result of friction:

$$h = \frac{g^2 \times l}{(3d)^5}$$

where d = diameter of pipe in inches,

l = length in yards,

h = head of water in feet,

g = gallons per minute.

Paper must be fitted to the purpose for which it is to be used, and this is by no means a simple matter. Recently Arthur D. Little pointed out some of the complexities involved, saying: "A paper for wrapping hardware or a card for mounting silver jewelry may seem to possess every desirable property, and yet be worse than useless because of a trace of sulphur. A printing paper may develop 'whiskers' or clog the type by mineral filler, a coated paper may pick or develop

odor, a cigarette paper may burn badly, a writing paper may allow the ink to spread because the size has been converted into peptones by overheating, a filter paper may fail to hold a fine precipitate or unduly retard the passage of liquid, and so on."

Taking water from a 'dinkey's' tender for a 70.0' Bucyrus shovel, when the supply pump was not working and without delay in digging, has been done as follows, according to the *Excavating Engineer*: Ordinarily the water-supply was pumped through a 1¼-in. pipe-line. Occasionally the supply pump for one reason or another could not be used. A shovel foreman kept his shovel supplied with water without any delay in digging, by taking it from the locomotive's tender. This was done only when loading the car next to the locomotive, the amount in this manner sufficing until the next train of empties arrived. The injector which came on the shovel was found to be big enough for this duty.

It is important that the zinc in precipitation boxes should be evenly deposited in the compartments. To this end the shavings should be spread out into as large and loose a bulk as possible before being packed into the box. If this is not done there is a liability to channeling, especially at the corners. Any short-circuiting will diminish the capacity of the box and will allow the distribution of the deposited metal over a number of compartments rather than the concentration of nearly all the gold and silver in the first compartments. A simple way of finding out as to whether or not any particular compartment has been efficiently packed is to add a few drops of phenolphthalein in alcohol to the solution entering it. Any channeling, as a result of bad packing, will be immediately noticeable by the rapid appearance of a red coloration at the corners of the compartment.

Centrifugal pumps, elevating ore pulp, unless in perfect adjustment and regulated to exactly lift the required amount of pulp, will give an intermittent delivery. This can be remedied in some instances by an alteration in the speed, or by throttling the discharge. The former method is inconvenient, and the adoption of the latter practice results in severe wear at the throttling point. Frenier pumps give a constant and steady discharge if due regard is paid to the principles governing their operation. They are, however, incapable of any adjustment, and to insure satisfactory working the exact amount of pulp required must be provided. Three-throw plunger pumps will give a steady discharge provided that all the plungers are working properly. As soon as one valve works indifferently, the discharge becomes intermittent. The air-lift can be made to give a steady discharge even with a wide variation of feed, provided that there exists ample capacity in the rising main and that the air-supply, both as regards pressure and volume, is not in excess of the required amount.

Special Correspondence

TORONTO, CANADA

CHANGES IN IRON AND STEEL TARIFF.—BENEFITS TO COKE MANUFACTURERS.—FUTURE DUTY ON STEEL SHAPES AND OTHER MILLED PRODUCTS.

On April 6, the Hon. W. T. White, Canadian Minister of Finance, announced a number of minor changes in the tariff, principally affecting the iron and steel industries. The application of the iron and steel manufacturers for a renewal of the bounties on pig iron and steel billets, or a compensating increase in the present duties, was not granted, and the matter of a bounty or other encouragement, for the production of Canadian iron ore, was postponed until next session, the Minister of Finance intimating that in the meantime an inquiry into the iron resources of the country would be made by the Department of Mines. The two most important changes were the reduction of the duty on agricultural implements from 17½ to 12½%, a concession to the demands of the western farmers for free agricultural implements, and the imposition of a duty of \$2.25 per ton under British preferential tariff, and \$3.50 per ton under the general tariff on wire rods formerly free. This is coupled with a drawback provision, under which the manufacturers of the staple gauges of wire fencing receive back 99% of the duty paid on the rods. The wire-rod duty meets the approval of the large manufacturing companies, such as the Dominion Steel Corporation and the Steel Company of Canada, whose rod mills have lately been doing poorly on account of the keenness of American competition, but the smaller plants engaged in rail manufacturing will be injured by an increase in the price of their raw material. Instead of being able to import their rods, they will have to buy from the large manufacturers, against whom they will have to compete in the sale of the finished product. It is predicted that some of the smaller firms engaged in rail manufacturing will be forced out of business. It is not anticipated that the cut of 5% in the duty on agricultural implements will have any serious effect on that industry, which is so firmly established as to be able to export largely, though it will intensify competition in Western Canada with their American rivals, who already supply a large portion of the demand.

The coke manufacturing industry will receive a stimulus from a change in the tariff affecting bituminous coal, which is subject to a duty of 53c. per ton. Proprietors of smelters making their own coke for the smelting of ores previously had a drawback of 99% on the coal duty. This drawback has now been extended to proprietors of coke ovens other than those owned by smelting works when the coke is used for smelting purposes. The Hamilton By-Product & Coke Ovens, Ltd., has for some time had in contemplation the establishment of a large coke-manufacturing plant in Hamilton; but its plans have been in abeyance pending the settlement of the tariff question. Now that they are assured of free coal the erection of a \$2,000,000 plant will be proceeded with at once.

In addition to the changes which go into force at once, the Government is asking for authority to impose at any time, when it considers Canadian manufacturers capable of supplying the market, largely increased duties on the heavier grades of rolled iron or steel angles, beams, channels, and other articles known as merchantable milled products. The lighter products of this sort are well protected; but the tariff on the heavier goods is considerably less because they are not made in Canada to any extent. It is understood that the promised increase of the duty will encourage the Algoma Steel Works and perhaps others to encourage this branch of manufacture.

MELBOURNE, AUSTRALIA

AN OLD VICTORIAN FIELD.—THREE IMPORTANT MINES TO CLOSE.
—MINERAL OUTPUT OF NEW SOUTH WALES AND TASMANIA.
—PAPUA AND THE NORTHERN TERRITORY.

Victoria is promised a great accession of strength by reason of the option that has been taken by the Great Boulder Proprietary company of Western Australia over a number of gold-mining areas in the Stawell district. This is an area where a great deal of remunerative quartz-mining has been done in past years. Perhaps its most famous property was the Magdalacum-Moonlight. The field is traversed by a large dike and it is on the western side of this that the bulk of the work has been done. It is probable that the option-holders will prospect the ground on the eastern side, on



the assumption that there is likely to be an extension of auriferous veins on that side. But presumably the chief attention will be paid to the western ground where the lode channel is about 200 ft. wide and consists of large lenticular masses of quartz. If systematically worked, the large low-grade bodies contained in this channel should be profitable.

The approaching closing down of the Tasmania gold mine at Beaconsfield, Tasmania, will throw 400 men out of employment. The water difficulties, from which the mine has always suffered, have increased of late years, and have been accompanied by an unfortunate decrease in the value of the ore, while also the cost of mining has naturally increased as greater depth has been attained. Twenty years ago the mine was still yielding steadily at the rate of \$20 per ton; now its yield is only about \$8 dwt., and ore reserves are practically non-existent, so that it is not surprising that the directors have decided to close down so soon as the available ore has been depleted. The loss on working for the year ended Sep-

tember 30 last was \$15,000, and cash assets were only \$65,000, and subsequent loss on working has reduced this balance to about \$55,000. The decision to close down has resulted from the report of an engineer deputed by the London board to visit the property. The treatment of accumulated products at the company's reduction works will, however, occupy a period of three or four years and yield a total profit of from \$175,000 to \$200,000.

It is not only in Tasmania that a misfortune has to be reported. Queensland also has its trouble to contend with—indeed, not merely one. First, the Chillagoe company, which has always been in difficulties ever since it came into existence, is once more to the fore. The directors applied to the Queensland government for a loan, but their request was refused, whereupon instructions were given for the closing of the smelting works as soon as the stock of coke on hand was exhausted, and the curtailment of all other expenditure till a supply of coal should be available from the Mt. Mulligan coalfield, which the company has purchased. The trouble between the company and the government has reference to the slow progress in the construction of the Mt. Mulligan railway, and the failure to come to any definite terms regarding the sale of the Chillagoe railway to the government. The company states that the heavy loss it has sustained from the dilatoriness in the construction of the Mt. Mulligan line is such as to warrant its stopping all work rather than continue to go on at a loss.

The other Queensland disaster is the announcement of the approaching suspension of operations at the Great Fitzroy. The falling in price of copper is set down as the principal reason, and it is said that further capital will be required, and that the difficulty of obtaining this is one of the actuating motives for the closing down. The company recently acquired the Lalokie copper mine in Papua, and it seems to be thought that some advantage will accrue through the shutting-down of the Queensland mine until arrangements have been completed for the drawing of supplies of flux from Lalokie. But this reason does not seem to be altogether comprehensible.

The New South Wales statistics for the past year are exceedingly satisfactory, the total value of the mineral output for the year having been \$58,657,000, or nearly 4% advance upon the figures for 1912 which constituted a record for the state. The value of the silver-lead-zinc output has made just about the average increase, standing at \$27,751,000. The advance in copper has been rather more than 3%, and that in tin has been nearly 25%. The coal output was a record, amounting to 10,414,165 tons, an increase of more than 5% over the previous year's total. Gold, on the other hand, dropped a little more than 9%, in common with the decline of this metal throughout all the eastern states.

Tasmania's figures for the past year are also available, but are not of as satisfactory a nature as are those of the 'parent state' [It may be explained by the term 'parent state' that in the early history of Australia, Tasmania and Victoria were subject to New South Wales.—EDITOR.] the value of its total output, \$6,866,000, meaning a decline of more than 5% on the 1912 figures. Gold has dropped nearly 12%, copper close on to 15%, and tin over 2%, while silver-lead has increased its output nearly 4%. These are the only four important contributors to the total.

A report has been made to the Austral Malay Tin, Ltd., by J. Malcolm Newman, on the prospects of gold-dredging in Papua. The report, which is the outcome of five months' inspection and inquiry, is anything but encouraging. He discovered no dredgable area of sufficient size to warrant extensive operations, and declares that the reports as to the value and production of various areas are gross exaggeration. He further says: "From conversations held by me, on the occasions of my previous visits to Papua, with

prospectors, business men, and government officials, I formed the opinion that from various economic causes, notably expensive living and geographical and climatic conditions, resulted in the working of only the very richest ground, and limited operations to small portions only of the auriferous country. My investigations now lead me to the astonishing conclusion that, owing to the efficiency and cheapness of the indentured native labor for such work, combined with the suitable topography and plentiful water supply, alluvial ground can be more cheaply operated in Papua than probably in any country in the world. I am confident that in many places in Papua 'ground sluicing' has been carried on in ground yielding less than 12c. per yard, and 'box sluicing' in ground worth no more than 24c. per yard."

Quite a boom is being made regarding the Pine Creek field in the Northern Territory. A former government geologist of Victoria has pronounced the field to be another Bendigo, so far as formation goes—that is to say, the gold-bearing quartz will be repeated in saddle after saddle as sinking is done. The survey being conducted by the geological branch of the administration of the territory confirms this view, and great hopes seem to be entertained in regard to the future of the field. It has, however, to be borne in mind that Pine Creek suffers from its situation, and though it has proved remunerative in its shallow workings, it has a long way to go before it can be considered another Bendigo. If it had been that up to date, its remoteness would not have prevented it from becoming one of the great goldfields of Australia.

PORCUPINE, ONTARIO

DEVELOPMENTS IN THE NORTH THOMPSON AND OTHER PROPERTIES.—ACTIVITY AT PORCUPINE.

The Associated Gold Mines of West Australia is quite satisfied with the results of the diamond-drilling on the North Thompson gold mine. The vein in the shaft is developing well and assays are satisfactory. The Sally Gold Mines Co. has moved its machinery to a property in Turnbull, and is erecting buildings. Some diamond-drilling will be done on this property as well. A good deal of free gold has been found in a vein on the Bradley Fournier claims in Carscallen township, and the Jamieson claims in Robb township have created considerable interest owing to the showing of gold recently found in them. About 20 or 30 claims have been staked around Jamieson's property in the past three weeks. The Wittsky-Chiry syndicate, in Whitesides township, is sinking its shaft to 100 ft., when 200 ft. of cross-cutting and driving will be done.

The Porcupine camp is busier than it has been for the past two years, and all promising prospects are being examined with a view to purchase. The McIntyre, in driving the Pearl Lake cross-cut at the 600-ft. level, has driven 100 ft. through a sericite schist without using a drill or explosive of any kind. The schist is so soft that it can be picked down fast enough to keep the trammers busy. An investigation is being held regarding the lack of water during the worst part of the recent severe fire at Timmins, when the Hollinger bunkhouses and several other buildings were destroyed. The origin of the fire is a mystery, but it is believed to have originated in one of the bedrooms of the western bunkhouse.

Over 900 tons of nickel ore was shipped from the Alexo mine in March. Mining is done by an open-cut and drift down 80 ft. Sixteen mines contributed to the March shipments from Cobalt. Ore reserves in the Tough Oakes mine are estimated by F. C. Loring at 15,000 tons, worth a profit of \$48 per ton. Five important veins have been proved, two of which are high grade. Geological conditions are favorable for their extension. Sixty feet below the Cobalt Lake's 225-ft. level, a winze is opening 3 in. of 2000-oz. silver ore.

NEW YORK

MEETING OF THE AMERICAN ELECTROCHEMICAL SOCIETY.—INSPIRATION ORE RESERVES.—FIFTY YEARS' COPPER PRICES.—TONOPAH BELMONT, CHINO, AND RAY REPORTS.

The feature of last week was the annual meeting of the American Electrochemical Society, which was held on April 16, 17, and 18. The headquarters of the society was at the Chemists Club, 52 East 41st street. The topic for Thursday morning, following the annual business meeting (at which the election of officers was as follows: president, F. Austin Liddbury; vice-presidents, Carl Hering, W. D. Bancroft, and William Brady; managers, H. C. Parmelee, W. R. Whitney, and C. G. Fink; treasurer, P. G. Salom; and secretary, Joseph W. Richards) was a symposium on power problems in electrochemistry. C. P. Steinmetz discussed the characteristics of electrical energy as affecting chemical industries, after which the problem of power transmission *versus* utilization in local electrochemical industries was presented by P. Sothman. F. A. J. Fitzgerald described some economies in the use of electric furnaces, and power for electric-furnace work was discussed by W. S. Horry. The power problem in the deposition of metals was discussed by Lawrence Addicks and H. E. Longwell, after which F. D. Newbury outlined the sources of direct current for electrochemical processes. The afternoon session was opened with an experimental lecture by W. D. Bancroft on electrolytic flames, followed by two papers on the use of the electric furnace in steel metallurgy by C. A. Hansen and E. B. Clarke, and two papers on zinc smelting by George C. Stone and W. R. Inalls. A paper on the advantages of southeastern Alaska for electrochemical industries, by W. P. Lass, was read by title. The address by the retiring president, E. F. Roeber, preceded the smoker in the evening, and he was later presented with a stoneware loving cup of 1½ gal. capacity, signifying his great thirst for knowledge as well as his great capacity. The most amusing feature of the evening was a series of wireless telegrams from 'Carranza Chemico' Bancroft, 'Francisco Villa' Saunders, and 'Victoriano Huerta' Parsons, in regard to the metallurgical treatment to be adopted by a zinc mine which was supposed to have been bequeathed to the society. All day Friday was devoted to a steamer trip to the plants of the American Smelting & Refining Co., United Lead Co., and W. C. Clark Wire Works. Luncheon was served on the steamer and an excellent opportunity for seeing these important plants was afforded. The session on Saturday was held at Columbia University, and chiefly centred around the leaching of copper ores. The progress in leaching and electrolytic treatment of copper ores in South America was described by E. A. C. Smith. A number of papers were read by title, followed by interesting discussion. The dinner at the Chemists Club in the evening concluded the session.

In the annual report of the Inspiration Copper Co., the general manager, C. E. Mills, states that the 600-ton flotation plant which has been in operation for over three months has yielded a concentrate more free from silica than was expected from the results in the 50-ton plant. No figures as to the percentage of recovery attained are given in the report, but they are known to be high, and that the management is highly gratified by the results. The present design of the mill involves a preliminary concentration on tables. The total development work done so far amounts to 119,609 ft., and the total tonnage of ore developed is as follows: 45,000,000 tons of sulphide ore, averaging 2% copper; 28,322,000 tons of sulphide averaging 1.26% copper; 12,500,000 tons of oxidized material averaging 1.34% copper; and 2,876,000 tons of mixed sulphides and oxides, averaging 1.24% copper. An issue of 5% convertible bonds has been authorized as already noted, in order to provide the additional funds required for a branch railroad, more land, a

steam power-plant, and various other items not included in the original estimates.

Charles F. Brooker, who has been for 50 years connected with the American Brass Co., was the guest of honor at a dinner given by the Copper Producers at Sherry's on April 14. In his 50 years' association with that Company, Mr. Brooker has bought over 2,500,000,000 lb. of copper, at an average price of 14.95c. per pound. The fact is of interest as indicating that the present price level of copper is not below normal, since the present cost of production is much below the average for the half century.

The Tonopah Belmont Development Co.'s report for the year ended February 28, 1914, shows that reserves amount



BELMONT MILL, TONOPAH, NEVADA.

to 517,117 tons of positive, probable, and possible ore. The mill treated 172,646 tons yielding gold and silver worth \$4,199,133. Net earnings were \$2,015,588, and dividends \$1,650,000.

The Chino Copper Co.'s report for 1913 shows that 50,511,661 lb. of copper was produced from 1,942,700 tons of ore. The revenue was \$7,621,419, net operating profits \$3,190,293, and dividends \$1,919,070. Reserves total 90,000,000 tons of 1.8% copper ore.

In 1913 the Ray Consolidated Copper Co. milled 2,365,296 tons of ore yielding 53,745,937 lb. of copper. The revenue was \$7,899,721; net operating profit, \$2,497,219; and dividends, \$1,631,504. Reserves total 80,746,973 tons averaging 2.2% copper.

WASHINGTON, D. C.

CONGESTION OF LEGISLATION THREATENS MANY BILLS RELATING TO MINES AND MINING.—THE RADIUM BILL.—MINING EXPERIMENT STATIONS.—MINERAL ON INDIAN LANDS.—LEASING AND MINE CODE COMMISSION BILLS.

Legislation in Congress is becoming so congested that the likelihood is strong that none but the more important bills will pass at this session, and therefore the minor legislation, such as new mining laws and proposals, stands little chance of reaching the President for his signature. At such times as these a slight obstruction is usually fatal. Legislation by unanimous consent is hard to effect. Of course, such bills go over to the short session, but if a disputed bill cannot obtain favorable consideration at the long session, such as the present one, its chances are very poor in the short session of three months. The proposed mining legislation is about in this boat. Those who are promoting it are naturally optimistic, but one can see from the reports of progress made that the rowing is hard.

The radium bill seems to have more of a chance than the other bills. If a vote can be reached, the bill may possibly pass the Senate. Several senators, however, oppose it on the ground that it is too wide open in character, and is, moreover, "hysterical legislation." The Taylor bill for min-

ing experimental stations, such as those in the Department of Agriculture, is to go on the House calendar with a favorable report from M. D. Foster, of Illinois, who is chairman of the House Committee on Mines and Mining. The plan involves an appropriation, and Congress may be loth to pass the bill on this account. Only as a sop to the mining interests and the desire to favor the popular chairman of the committee is the bill likely to procure an unexpected immediate enactment into law. The bill in the Senate known as S. B. 587, and relating to the disposal of coal and mineral deposits in Indian lands, has been put on the Senate calendar with a favorable report which says that the coal and deposits of other minerals in the lands which the bill will affect belong to the Indians, and the Indians should have the benefit of the proceeds from the deposits, whether such deposits are disposed of by sale or by leasing or by any other method. This, it is stated, will not be merely declaratory of the purpose of the Government to hold such deposits in trust for the Indians, but would also prevent the disposal, inadvertently or otherwise, of such deposits so as to deprive the Indians of the proceeds that are rightly theirs. The bill by Senator Walsh of Montana to encourage and promote the mining of coal, phosphate, oil, gas, potassium, and sodium on the public domain (a leasing bill) has been referred to the public lands committee. Senator Walsh made no objection. He had hoped to retain charge of his own measure as chairman of the mines and mining committee, but the public lands committee, which has been becoming a bit jealous of the inroads on its domain by the mines and mining committee, rose up to assert its prior rights, and the Senator yielded rather than stir up prejudice against his bill. The bill by Senator Smoot of Utah, providing for a commission to codify and suggest amendments to the general mining laws of the land, is to go through the Senate, according to all accounts. It has been put on the calendar. It is announced that mining engineers are for it, although believing that the commission ought to be larger than it is planned to have it. Senator Perkins, of California, has presented to the Senate, petitions of the Chamber of Mines and Oil of Los Angeles, favoring the withdrawal of mineral lands from the present boundaries of the Colorado River Indian Reservation and restoring it to entry under the U. S. mining laws.

GUADALAJARA, JALISCO

REDUCED OPERATIONS AT DOS ESTRELLAS MINES, EL ORO.—THE AGUASCALIENTES SMELTER AND ORE SUPPLIES.—SILVER FOR COINAGE.—OIL DEVELOPMENT AT TAMPICO.

Operations at the Dos Estrellas gold mines, in the Talpukahua district of Michoacan, for years the most important producer in Mexico, have been reduced to a great extent, and according to advices from Talpukahua more than 1200 men have been dispensed with. Reduced value of the ore and increased expenses, including additional taxes and direct contributions as a result of present conditions in Mexico, are given as the reasons for this step. It is understood that considerable exploration work will be undertaken. For a number of years the Dos Estrellas mines produced approximately \$1,000,000 per month, and half that sum, or \$6,000,000 per year, was paid in dividends. In the early days of Dos Estrellas, only Francisco Fournier, the French engineer who developed the mines, had faith in their possibilities, and Dos Estrellas stock was for sale on the streets of El Oro and Mexico City, and sold at ridiculously low prices. M. Fournier has been the principal Dos Estrellas stockholder since that time, and has received millions in dividends from operations.

The Aguascalientes smelter of the American Smelting & Refining Co. was forced to suspend its limited operations recently, after exhausting its supplies of coke and fuel oil,

but since that time a big shipment of coke has reached the plant, and while there is still a scarcity of fuel oil, operations have been resumed. The smelter management has raised the treatment rates, claiming that it can no longer afford to handle ore and concentrate at the former charges, and existing contracts have been broken. Due to this, and to the uncertainty of operations at Aguascalientes, some of the mining concerns that ordinarily would ship there are arranging for export shipments. The Casados Mining Co., of the Hostotipaquilla district of Jalisco, has made a shipment of high-grade ore to Swansea, Wales, and it is probable that the concentrate of the Cinco Minas Co., of the same district, will go there. The Amparo Mining Co., of the Elizatlan district of Jalisco, continues to ship its concentrate and high-grade ore to the Selby smelter in California. The Amparo dividend rate has been raised from 4 to 5% per quarter, and the disbursement to stockholders this year will be \$400,000, against \$320,000 last year.

The recent arrangement between the Huerta government and the Sociedad Afinadora de Metales, the French refining company of Mexico City, by which the silver bullion received



EL FAVOR PROPERTY, SHOWING WALL BUILT TO KEEP OUT BANDITS.

by the latter was to be delivered for coinage, and a considerable quantity of *tostones* (50-centavo pieces) turned over weekly to the mining companies supplying the silver, did not remain effective long, due to a financial hitch between the government and the refining company. Only two shipments of coin were made to the mining companies interested. Mining companies in various districts still are forced to pay a premium for much silver needed for payrolls.

A great oil development in the Tampico territory during the last few years has finally resulted in a large crop of Mexican oil companies, and at present there is much oil excitement in Mexico City and other cities of the country. Considerable money is being invested in oil stocks. The big gusher brought in recently by the Corona Oil Co., a subsidiary of the Royal Dutch-Shell, is estimated to have a capacity of 187,000 bbl. per day, making it the world's greatest well. The Casiano No. 7 well, of the Huasteca Petroleum Co., one of the Doheny subsidiaries, which was brought in in September 1910, has produced to date nearly 29,000,000 bbl. of oil, which gives it the world's record for production.

The No. 7 level of the Mololoa mine, in the Hostotipaquilla district, on the Soledad orebody, has been opened. In January this mine produced 651 tons of ore worth \$25,100, returning a profit of \$14,048 from treatment at El Favor, in the State of Jalisco.

A 20-ton concentrating plant has been ordered by La Dicha Mining & Milling Co. for the old Dolores mine, in Ixtlan del Rio district of Tepic. W. H. Hackett is manager.

General Mining News

ALASKA

A shipment of 250 tons of copper ore from the Mother Lode copper mine, near McCarthy, has been sent to the Tacoma smelter. It will average nearly 60% copper. A lot of 198 tons in April returned 59.83%, netting \$147.41 per ton, and after freight was deducted, \$24.363. A branch line from the Copper River & Northwestern railway to the mine is needed badly. The United Copper Exploration Co. has copper properties near the Kuskulina glacier, and along Porcupine creek on Copper mountain, and T. W. Lynch has arrived to conduct prospecting during the season.

FAIRBANKS

At a depth of 60 ft., Tyndall and Finn have opened 4 ft. of ore, worth up to \$1000 per ton, from their Bondholder claim at the head of St. Patrick creek. A good number of prospectors have been busy in this area.

JUNEAU

The following new electrical machinery is to be installed in mines in this district: Two 18-ton bar-steel locomotives for underground and surface haulage for the Alaska Gas-tineau Mining Co. These locomotives were especially designed for a low height in order to permit them entering the mine. One 5½-ton storage-battery locomotive for 30-in. gage, equipped with two V-50 motors and 68 cells of A-10 battery, for the Alaska Juneau Mining Co. These will be supplied by the Westinghouse Electric & Manufacturing Company.

KNIK

The 900 tons of Mutanaska coal mined for the U. S. Bureau of Mines was delivered to a good landing above Old Knik on March 6, and is ready for shipment south for testing. J. Dalton and 10 men did this work of transporting the fuel. He estimates the cost of mining and freight at about \$65,000. The coal was mined last summer under the management of George Evans.

NOME

The annual dog-team race for the All-Alaska Sweepstakes, from Nome to Candle and return, 412 miles, was won on April 16 by Johnson in about 81 hours.

The Behring Dredging Co. recently closed a contract with the Union Construction Co., of San Francisco, for a 2½-cu-ft. close-connected bucket-dredge, to be erected on its property on the Kougarok river, where heretofore over \$750,000 has been spent for mining machinery in an unsuccessful attempt to handle the ground. Engine distillate will be used as fuel on the boat, which will be equipped with two Western gas-engines, and a gas-engine-driven electric lighting set. One of the salient features of this installation will be the arrangement of the screen and flume, by which the amount of water necessary to be pumped for washing purposes is reduced to a minimum and allowing the gold-saving tables being kept under lock and key, thus obviating the necessity of keeping a man in the flume to move the large boulders. This design is featured exclusively by the Union Construction Co. The dredge will be shipped to Davidson's landing on the Seward Peninsula this summer, and hauled over the ice during the winter. In this way everything will be on the ground ready for erection in the early spring of 1915, and practically a full season's operation will be obtained the same year.

PORIT WELLS

A clean-up of the Granite Gold Mining Co.'s 7-ft. slow-speed Lane mill, from a 12-day run, about 200 tons, yielded gold worth \$8500. The mine is on Hobo bay in this district. The

ore was mined from an adit and shaft 190 ft. below the surface. The ore-shoot is 7 ft. wide in the shaft. Thirty men are employed.

ARIZONA

GILA COUNTY

(Special Correspondence).—Two furnaces are running at the Old Dominion plant. The basic converter, which is handling all the matte from the furnaces, has made over 23,000,000 lb. of copper without any lining repairs being necessary, and it is still in good condition. The concentrator is milling up to its full capacity. In the construction department, work on two big concrete slime-thickening tanks has been completed, and a Dorr thickener installed. A pump station, to contain two 1200-gal. per minute Aldrich quintuplex electric pumps, is being cut on No. 18 level of the mine. Equipment for motor haulage on No. 12 is nearly complete.

Globe, April 18.

(Special Correspondence).—Concreting the main east shaft of the Inspiration mine is well under way, the work being started at the 400-ft. level.

Miami, April 18.

GREENLEE COUNTY

The original plans of the Arizona Copper Co.'s concentrating plant called for a capacity of 3000 tons per day; but it has been decided to increase this by another 1000 tons. The present tonnage is about 2000 per day, and in July the new plant should be finished.

PINAL COUNTY

(Special Correspondence).—The Reymert, now being developed by the Gunn-Thompson interests, is 8 miles southwest from the Magma. It is located on a large, well defined and continuous vein, from which a good deal of silver-lead ore was extracted in early days. A 20-stamp mill remains on the property. The vein is from 10 to 60 ft. wide, is highly silicious, and its loose, leached structure indicates an oxidized zone of considerable depth. For this reason, the development of the vein wholly by hand work has not yet been productive of definite results, but it is believed that there may be a large sulphide zone beneath. Several weeks ago the shaft had reached a depth of about 350 ft., and because of the vertical position of the vein, material from the lode was being taken from the bottom. This vein material indicated that the oxidized condition of the surface virtually obtains unchanged at the depth so far reached. The superintendent, Thomas Tighe, is optimistic about the mine at depth. Because of the open nature of the large vein, former miners would select a portion containing several stringers of rich silver ore, and drive along this ore; but at the present price of silver, such work would not be profitable.

Superior, April 16.

The Magma Copper Co., at Superior, is to install nine A.C. squirrel-cage motors, totaling 267 hp. and 90-kva. transformer capacity, for operating the copper concentrating mill being built by the General Engineering Co. An interesting point in connection with this installation is that the energy for operating the motors, of Westinghouse make, will be supplied from the Roosevelt Dam power scheme.

YAVAPAI COUNTY

(Special Correspondence).—About 100 men are examining the placer ground located east and northeast of the Hassayampa river from the 'Garden of Allah.' The area covers about 72 square miles. Past work and the prospects of good returns are encouraging.

Wickenburg, April 16.

YUMA COUNTY

(Special Correspondence).—There has been a lively rush of miners to a gold discovery made by E. Osborne at Mineral Hill, about 20 miles northeast of this place.

Bouse, April 16.

CALIFORNIA

AMADOR COUNTY

The new tailing disposal scheme of the Kennedy company, at Jackson, is in full operation and giving satisfaction. In



TAILING WHEEL HOUSES FOR THE KENNEDY SCHEME.

another issue of this journal, full details of the plant will be given, and also the tailing problem of the district generally will be discussed.

LASSEN COUNTY

Mining around Doyle is increasing in activity. Rich ore is coming from the Lakeview claim of Truscott and McNab. The Martin claims are showing copper, lead, and silver. Those owned by Daly and Bruce were sold to Nevada people.

MARIPOSA COUNTY

(Special Correspondence.)—L. A. Schrowen, of Los Angeles, and David Upton returned from Mt. Pinoche, on the south fork of Merced river, where they have been for several days sampling the Little Wonder group of 14 gold-bearing quartz claims, owned by Messrs. Kylburg, Caterwood, and Blair. They brought in several large sacks of samples. The bonding price is \$45,000.

Clyde S. Longyear, representing the E. J. Longyear Co. of Minneapolis, Minnesota, who are manufacturers of diamond core-drills, was in Mariposa recently consulting owners of a copper property who contemplate using core-drills for determining its deposits at a depth of 2000 ft. Core-drills have been used in the Green Mountain district. David Ross, of Stockton, was in Mariposa recently, securing an extension of 60 days on his option bond to purchase a group of copper claims. There are about 600 acres of copper claims with gossan and surface indications promising a large deposit of copper. This property is situated two miles southeast of Mariposa, where there are sites for adits which will give them 600 ft. of backs. The Mariposa Mines Development Co. has taken a bond on the Diltz, Spencer San Log, and W. Y. O. D. quartz mines owned by S. J. Harris, the county surveyor; also the Breen claim owned by G. J. Bertken and the Mountain Queen and Number Three, quartz mines owned by D. E. Johnson. They will put a pump in the winze and sink on the ore-shoot, which is 20 in. wide and showing 12 in. of high-grade ore. This mine was worked by the former owners in a dilatory fashion, the walls were porphyry, and probably \$60,000 was mined from pockets.

The Original Mining Co., of Merced, which is successfully operating its mine and mill, situated below El Portal on the Merced river, under the management of Frank X. Egenhoff, has taken over two new groups of claims, the Golden Rule and Moon Stone, and have a day shift working on each group. Local stockholders at Merced think highly of the property and management. There are many other rich farming towns whose citizens could be successfully operating a good gold

mine in Mariposa county. There are plenty of good mines here awaiting intelligent development.

The Mt. Galins mine, near Hornitos, is under bond and being pumped out by Los Angeles and Denver people under the management of A. M. Gillespie. The surface equipment and machinery on this property is in good order. The Mary Harrison was pumped out and sampled last week, the samples being forwarded to San Francisco. There are seven men developing the Hondurant property near Colterville. This property is on the east or slate belt, from which millions have been mined in Mariposa county. The most notable mine on this belt in Mariposa county is the John Hite, at Hite Cove, on the south fork of the Merced river. This mine is credited with between \$3,000,000 and \$4,000,000, and while it is now idle, there is no doubt that the right man will some day open this mine and get good returns. It is 1555 ft. deep, operated by water-power, and the vein is 14 ft. wide at the 1500-ft. level. J. L. Dearborn, of Richmond, California, has become interested in the Judkins and Weston property, and has arranged to buy the 10-stamp mill from the Joshua Hendy company and settle the lumber bills accrued by the Los Angeles people in building this mill. They have 100 tons of ore which will be milled as a test. The Joshua Henry company will send a millman, and this test run will be watched with unusual interest owing to the fact that the former operators made a complete failure. Judkins and Weston are first-class miners and Mr. Dearborn is an experienced business man well up on ore treatment, and it is expected there will be an agreeable surprise in store for some of the Mariposa people when the clean-up is made. C. F. McElligott, of Princeton, is running 10 stamps on a waste dump of the Princeton mine.

Mariposa, March 26.

Some remarkable specimens of leaf gold in quartz have been found in a cross-vein at a depth of 150 ft. in the Hondurant mine, near Coulterville. The other ore in the mine is 'spotty' in character. There is a mill of 10 light stamps on the property, which is owned by A. L. Adams. The Comet Mining Co., of Los Angeles, owning a mine at Jerseydale, will start work and mill 1000 tons of ore as a test. Sampling the mine averaged \$12 per ton. The vein is from 30 to 36 in. wide, and between two adits there is estimated to be 7400 tons. The old Merced group, near Coulterville, is opened to about 1000 ft. Eastern people are said to have secured an option on the claims. Lessees at the Pine Tree mine have had the following returns: 128 tons yielding \$575, 24 tons for \$365, 15 tons for \$720, and 18 tons for \$160.

NEVADA COUNTY

The North Star main shaft has reached a total depth of 6000 ft. on the incline, or about 2250 ft. vertical. The first clean-up of the Golden Center mine yielded \$5000, and a shipment of selected ore was worth \$528 per ton. The Brunswick Consolidated company is to install three 100-kva. oil-insulated, self-cooled transformers of Westinghouse make.

SHASTA COUNTY

The Guggenheim interests have bonded 1400 acres of gold-bearing ground south and west of Igo, 900 acres from the Happy Valley Land & Water Co., and 500 acres from C. A. Russell and partner. The new owners are preparing to prospect the ground, with a view of putting in a dredge.

Porter and Thompson spent \$21,000 in building and installing a dry-land dredge. They operated it a month or so, but it was found that the cost of operation was more than the profits. Their dredge is under attachment.

At a depth of 700 ft., and in an adit 3700 ft. long, a large electric hoist is being installed in the Gladstone mine in the French Gulch district. Mining is being done at a depth of 1100 ft. below this station.

SISKIYOU COUNTY

The Great Northern mine, on Humbug creek, is to be re-

opened by A. C. Kaiser. Rich ore is being extracted from the Carson-Kradel claim in the Oro Fino district. The Onyx jade mine, near Happy Camp, has been sold by D. C. Collier and S. Ferry to the Californite Company of San Diego.

COLORADO

EAGLE COUNTY

Developments in the Eagle district are said to be distinctly promising. The Lady Belle and South Dakota have been shipping good silver ore; lessees in the former have recently cut what is thought to be the main ore-shoot; the Lady Belle No. 4 is producing from a good vein; the Extension will soon make shipments; work has been resumed at the North Dakota; the Best Chance and Dakota Extension are busy on development, the former having opened ore; the Eagle King incline shaft is to be sunk deeper, the bottom being in low-grade ore just now; and steady prospecting is being done at the Montana.

It is reported that a mill and cyanide plant will be erected at the Lady Belle mine, there being enough ore opened to justify this step.

GILPIN COUNTY

The property of the 50 Gold Mines Corporation at Black Hawk has been acquired by a Colorado syndicate headed by John B. Selvidge. The new concern is known as the Fifty Consolidated Gold Mines Co. The claims include the Bobtail, Fliske, Gregory, Pederson, and Cook, which have been opened to 1300 ft. and have produced a large quantity of gold, silver, and copper. Extensive development is to be done by the new Company. The Continental Mines, Power & Reduction Co. has driven its Lombard adit about 3000 ft., to cut several veins. A modern 20-stamp mill is ready for work.

LAS ANIMAS COUNTY

On April 20, at Trinidad, there was a collision between coal miners and the state militia, resulting in 30 of the former being killed.

LAKE COUNTY (LEADVILLE)

This district is producing an average of 2200 tons per day of all classes of ore; of which 25,000 tons per month goes out of the camp for treatment. Good progress is being made at the new zinc smelter. With the advent of spring, prospectors are preparing to start work in the district.

From 6 to 36 in. of ore has been opened in the Little Johnny, and a carload returned 18 oz. gold per ton.

TELLER COUNTY (CRIPPLE CREEK)

A shipment of ore from the Cresson mine, worth about \$40,000, was recently sent to the smelters under an armed guard.

THE SAN JUAN

Silverton people expect a busy season this year. The Sunnyside mine has resumed work since the fire and snowslide last December. Nothing is being done at the Buffalo Boy, both sides to the dispute mentioned in this journal of July 19, 1913, being inactive. Nearby is the Intersection, which is producing 30 tons per day of ore averaging \$16.48 gold and \$3.10 silver per ton, which is treated in a 10-stamp mill. At Middleton the Hamlet mill will start in a week or so. The S. D. & G. Leasing Co. is milling ore from the Silver Lake mine at the Iowa mill. The railway to Gladstone will soon be opened.

IDAHO

BLAINE COUNTY

The Willbert mine, on the Little Lost river, is developing into a good one. Eight feet of 35% lead ore has been opened by an adit. The mill is at present shut down.

CUSTER COUNTY

The ore deposits in the northwestern part of this county

are thoroughly described by J. B. Umpleby in *Bulletin* 539 of the U. S. Geological Survey.

SHOSHONE COUNTY

The Idora Hill mine and mill, on Sunset peak, near Wallace, is shut down owing to shortage of funds to continue work. The debt is \$30,000. The new mill at the Frisco mine is treating zinc ore during one shift per day. Copper glance has been opened in the National mine, near Mullan, which contains both native copper and native silver.

The long raise from the lower adit of the Bunker Hill & Sullivan mine, connecting with the Caledonia workings, was completed on April 15. This will greatly aid mining in the latter mine. The unit of the Bunker Hill & Sullivan mill which is being repaired for use of the Caledonia company is almost completed, and it is anticipated that operations at the mine will be commenced in a few days. Net earnings of the Interstate-Callahan company in March were \$34,000.

MONTANA

SILVERBOW COUNTY

For driving mine-ventilating fans, the Anaconda company has ordered 14 alternating-current motors, totaling 290 hp., from the Westinghouse Electric & Manufacturing Co. The Amalgamated Copper Co. will pay a dividend of \$1.50 per share on May 25. At 2400 ft. in the Tuolumne mine the shoot is 140 ft. long, showing at each end, respectively, 18 in. of 12% copper and 12 oz. silver, and 72 in. of 5% copper and 12 oz. silver ore.

During March the Butte-Duluth leaching plant produced 75,000 lb. of copper. The new 1000-ton per day crushing plant may be completed in 30 days.

MISSOULA COUNTY

After several years of litigation, Spokane men are planning to reopen the old Amador mine at Iron Mountain, in the east Coeur d'Alenes. It is said that about \$750,000 was spent for a 50-ton smelter, 10-mile railway, large water-power plant, and developing an orebody to 750 ft. Stock boomed to \$4 per share, heavy assessments were made, and litigation resulted. A concentrating plant may be erected. E. V. Lambert is president of the company.

NEVADA

ESMERALDA COUNTY

There is more activity in the Cuprite district, 14 miles south of Goldfield, than for some time past. The Jupiter claims have given good assays of copper-silver ore. Other claims being prospected are those of the Kurien-Smith-Evans syndicate.

HUMBOLDT COUNTY

At a depth of 260 ft. from the surface, high-grade ore has been opened in the Buckskin National mine.

LINCOLN COUNTY

The mines at Pioche produced about 2000 tons of ore worth \$30,000 last week. The Prince Consolidated contributed 1400 tons, while the Mendha-Nevada, Providence, Exploration lease, Day-Bristol, Amalgamated Pioche lease, Oregon Short Line lease, and Nevada Mark made up the balance.

MINERAL COUNTY

The Goldfield Consolidated Mines Co.'s option on the Aurora Consolidated's mines expired on April 18, and no business resulted, according to Jesse Knight of Utah.

NYE COUNTY

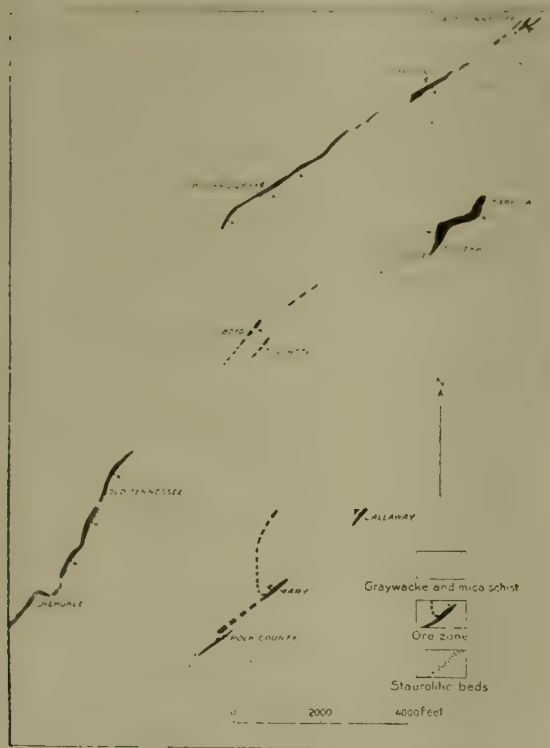
The Pioneer Consolidated Mines Co. will install a 6-ft. Huntington mill in its 10-stamp mill in the Pioneer district. According to the consulting engineer, J. K. Turner, the present plant is treating 30 tons of ore per day with 82% recovery. The slime contains \$2 in gold per ton, and efforts are being made to increase the saving to 90%. Twelve feet of

ore is being mined in a raise above 256 ft. The annual report of the North Star Mining Co. for 1913 shows the following: Development, 2963 ft., at \$6.76 per foot; ore mined, 3225 tons, value \$58,966; mining costs, \$2.56 per ton; sinking, \$22.72 per foot; and net profits, \$45,845. The American Carrara Marble Co., of Carrara, sent a carload of marble, containing 200 cu. ft. to Los Angeles. This is its first shipment. The Tonopah Extension company's revenue in February was \$48,981, and expenses \$40,070. March returns are as follows: Belmont, 15,294 tons, yielding 340,878 oz. bullion and a profit of \$153,611; Tonopah Mining, 11,793 tons, yielding 227,375 oz. bullion, 126 tons of concentrate, and a profit of \$128,120; Jim Butler, 2870 tons for a profit of \$34,580. A tubemill head broke at the West End mill last week, resulting in a shut-down for 4½ days.

TENNESSEE

POLK COUNTY

(Special Correspondence.)—F. R. Carter, of Chattanooga, who owns 160 acres of land, presumably copper bearing, about



COPPER DEPOSITS AT DUCKTOWN. THE ARROWS INDICATE DIP OF THE LODES. (AFTER U. S. G. S.)

a mile northeast of the Ducktown Copper, Sulphur & Iron Co.'s plant at Isabella, has formed an exploration company and is prospecting the property by diamond-drilling. No results have yet been published. The property is only about a half-mile southeast of the East Tennessee mine of the Ducktown company, but it may be too far to the east to be within the known ore-bearing zone.

Ducktown, April 15.

UTAH

BEAVER COUNTY

The Sheep Rock mill is to be enlarged by the Sheep Rock Leasing, Mining & Milling Co. The March return was gold worth \$3000. The main shaft of the mine is down 200 ft. A recent sampling of the ore opened returned good assays.

UTAH COUNTY

High-grade gold-silver ore is being mined from 700 ft. in the Grand Central mine at Thistle, that at present averaging 2 to 4 oz. gold and 80 to 200 oz. silver per ton with a little lead and copper. An option has been taken on a tailing dump of over 200,000 tons, at the Eureka Hill mine by Brayton Campbell and C. M. Dull. A cyanide plant will probably be erected to treat 200 tons per day. The tailing assays 5 oz. silver, 0.05 to 0.06 oz. gold, 1% lead, and 0.01% copper.

SALT LAKE COUNTY

The Utah Copper Co., at its Magna mill, is to install four 15-hp. slow-speed vertical D.C. motors for direct connection to agitators used in experimenting with the oil-flotation process. This is a new application especially developed by the Westinghouse Electric & Manufacturing Co. after considerable testing. About 50 tons of low-grade copper ore, containing a good percentage of iron, is being mined daily from the Commercial mine at Bingham. A raise from the Niagara adit level to the old workings of the Commercial will greatly improve ventilation.

WASHINGTON

CHIEHAN COUNTY

(Special Correspondence.)—The Golden Eagle company's mine and mill has been leased by F. Le Roi Thurmond, who will start operations at once. It is proposed to change the name of Blewett to Phoenix.

Blewett, April 7.

FERRY COUNTY

Extensive development of the Anchor, Curlew, and Panama groups of 19 claims, situated two miles north of Curlew, is to be done by the Phoenix Gold & Copper Mining & Milling Co. The main adit is in 900 ft. Ore has been opened in three places in the first 500 ft. of the lower adit, and a large vein 40 ft. wide was opened at 500 ft. At 820 ft., 5 ft. of shipping and 20 ft. of milling ore was also cut. At about 1500 ft. another vein should be opened.

CANADA

According to the manager of the Canadian Klondyke company, Charles Boyle, 300 to 400 men, about the full complement for the operating season, are now employed at the various properties. No. 4 dredge was expected to start about March 24, and the others soon after. The Yukon Gold Co. has begun preliminary work for the season. The annual report of the territorial assayer at Whitehorse, William Sime, covers the twelve months up to March 1, 1914. A total of 885 samples were sent in from 13 different districts, and 1082 determinations made. The most development done in any lode mine was in the Pueblo, 7 miles from Whitehorse, and owned by the Atlas Mining Co. From the 6, 130, and 200-ft. levels, 36,662 tons of copper ore was sent to the smelters. The shaft is down 365 ft., and 28 prospect holes were drilled totaling 3796 ft. An average of 100 men was employed. The Humber claims in the Windy Arm district, Whirlwind, Tally-Ho, Buffalo Hump in the Wheaton River district, and at several in the Mayo and other districts, were actively prospected.

The Yukon Gold Co. has taken options on eight or nine miles of ground along the Sixtymile valley, lying in a continuous tract, mostly between the mouth of Glacier and the mouth of Twelvemile creeks. Two drills are being taken out over the winter road to prospect the ground immediately. C. A. Thomas is manager for the Company.

COSTA RICA

February operations at the Abangarez Gold Fields mine resulted in the treatment of 5323 tons of ore, yielding bullion worth \$29,007. There was a loss of \$20,246, making this \$38,316 for the two months of the current year.

Personal

THEODORE HOOVER has gone to Burma.
ROSS B. HOFFMAN is back from London.
WILLIAM DE L. BENEDICT is in San Francisco.
H. L. HOLLISTER was in San Francisco this week.
LEWIS A. WRIGHT was in San Francisco last week.
C. W. PURINGTON has returned to London from Italy.
LIONEL LINDSAY of San Francisco leaves for London, May 1.
WILLIAM KNOX returned to San Francisco from London this week.

FRED J. SIEBERT of Reno, Nevada, will leave soon for Santiago de Chile.

H. B. BARTING was at Salt Lake City last week on his way to Ely, Nevada.

J. H. MACKENZIE visited the Buckskin National Gold Mining Co.'s property recently.

RENU KANDA is examining a gold deposit in Korea for the Hasami Gold Mining Company.

DAVID HOFFMAN has returned to Butte, Montana, after an absence of two years in the Congo.

Mail for CHARLES NOURSE, L. C. MOTT, and F. C. MOORE is waiting for American address at our office.

J. D. HUBBARD of Chicago, vice president of the Goldfield Consolidated Mines Co., is in San Francisco.

J. H. HARTLEY, of Berkeley, California, is examining properties in Plumas and Sierra counties, California.

J. A. UDDEN has been visiting Alabama, Pennsylvania, and other eastern states, but will soon be back at Austin, Texas.

VICTOR ZIEGLER has accepted a position as assistant professor of geology and mineralogy at the Colorado School of Mines.

E. F. GRAY, general manager of the Consolidated Copper Mines Company, at Ely, was at Salt Lake City last week on his way to London.

Z. B. HARTLEY, formerly with the Aguacate Mines Co. of Costa Rica and the Cacamuya Mines Co. of Honduras, sailed for Ecuador, S. A., last month.

N. M. WADE has been appointed general manager, and JOHN H. EGGBES superintendent, for the Rochester Mines Co., Rochester Weaver M. Co., and Nenzel Crown Point M. Company.

GEORGE H. GARREY, recently connected with the American Smelting & Refining Co. as chief geologist, has opened an office as consulting mining geologist and engineer at 115 Broadway, New York City.

B. BRITTON GOTTSBERGER, general manager of the Miami copper mine, gives the following names as members of the staff in 1913: F. W. MACLENNAN, assistant manager, in charge of mining; F. W. SOLOMON, mill superintendent; and RALPH P. YERNA, assistant mill superintendent.

Among those registered at the New York convention, American Electro-Chemical Society, were: LAWRENCE ADDICKS, C. L. BRYDEN, A. S. DWIGHT, CARL HERING, J. B. HERRESHOFF, L. D. HUNTOON, W. MCA. JOHNSON, R. L. LLOYD, D. A. LYON, H. C. PARMELEE, CHARLES L. PARSONS, THOMAS T. READ, G. A. ROUSH, W. O. SNELLING, H. N. SPICER, BRADLEY STOUGHTON, G. C. STONE, and JOSEPH STRUTHERS.

COLUMBIA UNIVERSITY will celebrate the fiftieth anniversary of the founding of the School of Mines on May 28 and 29. There will be a great gathering of engineers. On the morning of May 29, in the gymnasium, there will be a meeting at which honorary degrees will be granted and there will be talks on modern engineering by well known engineers. In the afternoon will occur the first lecture in the 'Chandler Foundation' by a distinguished chemist, and the celebration will close at night with a banquet at the Waldorf Astoria, where eminent alumni will speak.

Society Meetings

Name.	Date.
MAY	
American Iron and Steel Institute	22
Chemical, Metallurgical and Mining Society of South Africa, Mining Exhibition, Johannesburg.....	19-29
Geological Society of America (Cordilleran Section), Seattle	21-23
Institution of Mining and Metallurgy, London.....	21
Mining and Metallurgical Society, San Francisco.....	4
National Fire Protection Association	5-7
JUNE	
American Institute of Electrical Engineers	22 or 26
American Society for Testing Materials	23-27
American Society of Mechanical Engineers.....	end of June
Colorado Scientific Society, Denver.....	6
Franklin Institute, Philadelphia	end of June
Society for the Promotion of Engineering Education	29 to July 2
AUGUST	
American Institute of Mining Engineers, Salt Lake City	10-14
SEPTEMBER	
American Chemical Society	9-12
American Institute of Electrical Engineers.....	not fixed
Colorado Scientific Society, Denver.....	3
OCTOBER	
American Institute of Electrical Engineers.....	9
American Iron and Steel Institute	23-24
Colorado Scientific Society, Denver.....	3
NOVEMBER	
American Institute of Electrical Engineers	13
Colorado Scientific Society, Denver.....	7
DECEMBER	
American Institute of Electrical Engineers	11
American Society of Mechanical Engineers	7-8
American Museum of Safety	11-20
Colorado Scientific Society, Denver.....	5 and 19
Geological Society of America, Philadelphia.....	29-31
Society of Gas Lighting (annual meeting).....	10
Society of Naval Architects	11-12
JUNE 1915	
Sixth International Congress of Mining, Metallurgy, Applied Mechanics, and Practical Geology, London	
SEPTEMBER 1915	
American Institute of Mining Engineers, San Francisco	27-30
Engineering Congress, San Francisco.....	20-25

Schools and Societies

The CHEMICAL, METALLURGICAL, AND MINING SOCIETY OF SOUTH AFRICA will visit the De Beers diamond mines, at Kimberley, early in July.

The MICHIGAN COLLEGE OF MINES held a class-day address to graduates of 1914 on 'Mining Coal Above the Arctic Circle,' by the Hon. John Munro Longyear, on April 16. Work at the mines on Spitzbergen, north of Europe, was covered by the speaker.

The CHICAGO ENGINEERS' CLUB had a membership of 386 on March 1, 1914, of whom 301 are resident members. The revenue during the year ended February 28, 1914, was \$31,671, including \$1772 from the previous year. The term ended with a balance of \$543. A number of lectures and excursions were held.

The Metal Markets

LOCAL METAL PRICES

San Francisco, April 23

Antimony	9 — 9½c
Electrolytic copper	15½—15¾c
Pig lead	4.05—5.00
Quicksilver (flask)	\$38.50
Tin	40½—42 c
Spelter	6½—6¾c
Zinc dust, 100 kg. zinc-lined cases, 7½ to 8c per pound	

EASTERN METAL MARKET

(By wire from New York)

NEW YORK April 23. All metal markets are quiet and weak. Copper has declined every day, and remains the same, while spelter is slightly below last week's quotation. Copper stocks continue to puzzle speculators. Amalgamated copper is the strongest stock on the Exchange at present. American Smelting & Refining shares rose from 65 to 66 on news from Mexico. It is said that the Anaconda Copper Mining Co. has offered to purchase the assets and business of the International Smelting & Refining Co., and to exchange its stock for stock of the International on a basis of 3.33 shares of Anaconda for one share of International, upon condition that the International will immediately call a special meeting of stockholders to take action upon the proposal to sell its assets to the Anaconda company and liquidate. The International has a smelter in Utah and is erecting another in Arizona. Its present indebtedness is \$9,000,000, and this would be increased to \$11,500,000 by the new plant, necessitating the issue of stock to clear the debt and provide additional capital. Tin is irregular at 35.15 to 35.60c. per pound. The trouble in Mexico affected stocks in London and Europe, there being heavy trading. Bar silver is steady at 26.93d. per ounce. Copper and tin were firm at 64 6s.3d. and 161 5s. per ton respectively.

SILVER

Below are given the average New York quotations in cents per ounce, of fine silver.

Date	Average week ending	1913.	1914.
Apr. 16.....	58.25	58.23	58.04
" 17.....	58.25	58.04	58.06
" 18.....	58.25	58.06	58.02
" 19 Sunday.....		58.02	58.45
" 20.....	58.37	58.45	58.39
" 21.....	58.50	58.39	58.35
" 22.....	58.50	58.35	
Monthly averages.			
Jan.	1913.	1914.	
Jan.	63.01	57.58	58.70
Feb.	61.25	57.53	59.32
Mch.	57.87	58.01	60.53
Apr.	59.26		60.88
May	60.21		58.76
June	59.03		57.73

Pixley and Abell, of London, writing on April 2, state that they are glad to be able to announce that the whole of the silver, amounting to about \$14,500,000, which was taken over by the syndicate formed for that purpose on the failure of the Indian Specie Bank early in last December, has now been sold. Had this syndicate not been formed, and had all this silver been thrown on the market by forced sales, the result would have been disastrous not only to producers and others connected with the metal, but to all merchants trading with China. Without the huge holdings of the Indian Specie Bank, the market has during the past four months acquired a healthier and more normal tone, and, with a very small speculative account open, the general position is far sounder than it has been for some years past.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date	Average week ending	1913.	1914.
Apr. 16.....	3.80	3.80	3.80
" 17.....	3.80	3.80	3.80
" 18.....	3.80	3.80	3.80
" 19 Sunday.....		3.80	3.80
" 20.....	3.80	3.80	3.80
" 21.....	3.80	3.80	3.80
" 22.....	3.80	3.80	3.80
Monthly averages.			
Jan.	1913.	1914.	
Jan.	4.28	4.11	4.35
Feb.	4.33	4.02	4.60
Mch.	4.32	3.94	4.70
Apr.	4.36		4.37
May	4.34		4.16
June	4.33		4.02

COPPER

Quotations on copper as published in this column represent average wholesale transactions on the New York market and refer to electrolytic copper. Lake copper commands normally 1½ to 1-½c. per lb. more. Prices are in cents per pound.

Date	Average week ending	1913.	1914.
Apr. 16.....	14.15	14.11	14.04
" 17.....	14.15	14.11	14.01
" 18.....	14.10	14.11	14.18
" 19 Sunday.....		14.11	14.28
" 20.....	14.05	14.11	14.46
" 21.....	14.00	14.11	14.27
" 22.....	14.00	14.11	14.07

Monthly averages.

1913.	1914.	1913.	1914.
Jan.	16.54	11.21	11.21
Feb.	14.93	11.46	15.42
Mch.	14.72	11.11	16.23
Apr.	15.22		16.31
May	15.42		16.08
June	14.71		14.25

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending	1913.	1914.
Mch. 26.....	39.00	39.00
Apr. 2.....	39.00	38.50

Monthly averages.

1913.	1914.	1913.	1914.
Jan.	39.37	39.25	41.00
Feb.	41.00	39.00	40.50
Mch.	40.20	39.00	39.70
Apr.	41.00		39.37
May	40.25		39.40
June	41.00		40.00

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date	Average week ending	1913.	1914.
Apr. 16.....	4.90	4.90	5.13
" 17.....	4.90	4.90	5.10
" 18.....	4.90	4.90	5.10
" 19 Sunday.....		4.90	5.13
" 20.....	4.90	4.90	5.10
" 21.....	4.90	4.90	5.00
" 22.....	4.90	4.90	4.90

Monthly averages.

1913.	1914.	1913.	1914.
Jan.	6.88	5.14	5.11
Feb.	6.12	5.22	5.51
Mch.	5.91	5.12	5.55
Apr.	5.52		5.22
May	5.23		5.09
June	5.00		6.07

Zinc sulphide ores, at Joplin, Missouri, are now selling for \$35 to \$40 per ton, basis of 60% metallic zinc, compared with \$40 to \$44, basis, for the corresponding period of 1913. Lead ore brings \$15 per ton, basis of 80% metallic lead, compared with \$52.50 a year ago. Calamine brings \$16 to \$19, basis of 40% metallic zinc, compared with \$19 to \$20 a year ago. The average shipments of sulphide ores for 1914, to date, are 4920 tons per week, calamine 320 tons, and lead 910 tons. The average weekly valuation of all ores is \$240,000.

TIN.

New York prices control in the American market for tin, since the metal is almost entirely imported. San Francisco quotations average about 5c. per lb. higher. Below are given average monthly New York quotations, in cents per pound:

Monthly averages.

1913.	1914.	1913.	1914.
Jan.	50.45	37.85	40.70
Feb.	49.07	39.76	41.75
Mch.	46.95	38.10	42.45
Apr.	49.00		40.61
May	49.10		39.77
June	45.10		37.57

SILVER OUTPUT of the Kongsberg mines, Norway, during the year 1912-1913 was 8459 kg. (270,680 oz.) fine metal, and 1137 kg. (36,380 oz.) in ore, the whole worth \$183,000.

PIG IRON PRODUCTION of the United States in March was 2,347,867 tons.

UNFILLED ORDERS of the U. S. Steel Corporation on March 31 were 4,653,825 tons, against 7,468,956 tons a year ago.

The Stock Markets

SAN FRANCISCO STOCKS AND BONDS (San Francisco Stock and Bond Exchange.)

April 22.

BONDS

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Associated Oil 6s.....	90 1/2	—	Natomas Consol. 6s.....	—	25
Natomas Con.....	33	11	Pac. Port. Cement 6s.....	100	—
Unlisted.	—	—	Santa Cruz Cement 6s.....	43 1/2	—
Ass. Oil 6s.....	—	85	Union Oil.....	—	88
General Petroleum 6s.....	46	—			

STOCKS

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Amalgamated Oil.....	77	—	General Petroleum.....	6	8
Associated Oil.....	38 1/2	—	Noble Electric Steel.....	10c	1
Giant.....	83 1/2	84	Natomas Consol.....	53c	—
Pac. Cst. Borax, com.....	57 1/2	—	Pac. Port. Cement.....	90	94
Pacific Crude Oil.....	—	3 c	Riverside Cement.....	63	—
West Coast pfd.....	112 1/2	—	Santa Cruz Cement.....	40	46
			Stand. Port. Cement.....	19	—

NEVADA STOCKS

(By courtesy of San Francisco Stock Exchange.)

April 23.

Atlanta.....	\$ 21	Montana-Tonopah.....	\$ 84
Belcher.....	30	Nevada Hills.....	25
Belmont.....	7 1/2	North Star.....	24
Con. Virginia.....	15	Ophir.....	23
Florence.....	52	Pittsburg Silver Peak.....	32
Goldfield Con.....	140	Round Mountain.....	25
Goldfield Oro.....	11	Sierra Nevada.....	10
Halifax.....	80	Tonopah Extension.....	197
Jim Butler.....	91	Tonopah Merger.....	56
Jumbo Extension.....	24	Tonopah of Nevada.....	670
MacNamara.....	403	Union.....	08
Mexican.....	110	Victor.....	31
Midway.....	31	West End.....	79
Mizpah Extension.....	10	Yellow Jacket.....	25

CALIFORNIA STOCKS

(Latest Quotations.)

	Bid.	Ask.		Bid.	Ask.
Argonaut.....	\$2.50	—	Central Eureka.....	\$0.48	\$0.50
Brunswick Con.....	1.05	—	Mountain King.....	—	0.50
Bunker Hill.....	1.90	—	South Eureka.....	—	1.50

COPPER SHARES—BOSTON

(By courtesy of J. C. Wilson, Mills Building.)

April 23.

	Bid	Ask		Bid	Ask
Allouez.....	\$ 37	37 1/2	Mohawk.....	\$ 40	41
Ariz. Commercial.....	43	44	Nevada Con.....	143	144
Butte & Superior.....	32 1/2	34	North Butte.....	24 1/2	25
Calumet & Arizona.....	62	62 1/2	Old Dominion.....	48	49
Calumet & Hecla.....	416	420	Oseola.....	72	72 1/2
Copper Range.....	36 1/2	36 3/4	Quincy.....	57	58
Daly West.....	2	2 1/4	Shannon.....	6 1/2	5 1/2
East Butte.....	10 1/2	11 1/2	Superior & Boston.....	1 1/2	1 1/2
Franklin.....	42	5	Tamarack.....	3	3 1/2
Granby.....	75 1/2	75 1/2	U. S. Smelting, com.....	30 1/2	30 1/2
Greene Cananea.....	28	28 1/2	Utah Con.....	9 1/2	10
Isle-Royale.....	17	17 1/2	Winona.....	3 1/2	3 1/2
Mass Copper.....	3 1/2	3 1/2	Wolverine.....	38	39

NEW YORK CURB QUOTATIONS

(By courtesy of E. F. Hutton & Co., Kohl Building.)

April 23.

	Bid.	Ask.		Bid.	Ask.
Braden Copper.....	8	8 1/2	La Rose.....	1 1/2	1 1/2
Braden 6s.....	160	165	Masson Valley.....	2 1/2	2 1/2
B. C. Copper.....	1 3/8	2	McKinley-Dar.....	61c	63c
Con. Cop. Mines.....	1 1/2	1 1/2	Mines Co. Am.....	2 1/2	2 1/2
Davis-Daly.....	1/2	5/8	Nipissing.....	6 1/2	6 1/2
Ely Con.....	3	6	Ohio Copper.....	1/4	1/4
First National.....	1 1/8	1 1/8	Stand. Oil of Cal. 290.....	293	293
Giroux.....	1/2	1	Tri Bullion.....	1/4	1/4
Hollinger.....	16 1/2	17 1/2	Tuolumne.....	5/8	5/8
Iron Blossom.....	1.15	1.18	United Cop. com.....	1/4	1/4
Kerr Lake.....	1	4 1/8	Yukon Gold.....	2 1/2	2 1/2

NEW YORK STOCK EXCHANGE

(By courtesy of J. C. Wilson, Mills Building.)

April 23.

	Bid	Ask		Bid	Ask
Amalgamated.....	\$ 73	73 1/2	Miami.....	\$ 22 1/2	23
Anacosta.....	33 1/2	34	Nevada Con.....	14 1/2	14 1/2
A. S. & R., com.....	60	60 1/2	Quicksilver, com.....	1 1/2	2
Calif. Pet., com.....	20	22	Ray Con.....	20 1/2	20 1/2
Chino.....	39 1/2	39 1/2	Tenn. Copper.....	32 1/2	32 1/2
Guggenheim Ex.....	51 1/2	51 1/2	U. S. Steel, pfd.....	108 1/2	108 1/2
Inspiration.....	14 1/2	16 1/2	U. S. Steel, com.....	67 1/2	67 1/2
Mexican Pet., com.....	60 1/2	60 1/2	Utah Copper.....	63 1/2	64 1/2

LONDON QUOTATIONS

(By cable, through the courtesy of Catlin & Powell Co.,

New York.)

April 23.

	£	s.	d.		£	s.	d.
Alaska Mexican.....	1	7	6	Mexican Eagle, com.....	1	15	0
Alaska Treadwell.....	8	5	0	Mexico Mines.....	4	17	6
Alaska United.....	3	2	6	Messina.....	1	8	9
Arizona.....	1	18	9	Oroville.....	0	12	6
Camp Bird.....	0	11	3	Pacific Oilfields.....	0	2	6
Cobalt Townsite.....	2	5	0	Rio Tinto.....	70	12	6
El Oro.....	0	12	6	Santa Gertrudis.....	0	12	6
Esperanza.....	0	15	0	Tanganyika.....	2	5	0
Granville.....	0	10	0	Tomboy.....	1	2	6
Kern River Oilfields.....	0	8	9				

AUSTRALASIAN

April 23.

	£	s.	d.		£	s.	d.
British Broken Hill.....	2	1	3	Mount Elliot.....	3	15	0
Broken Hill Prop.....	1	17	6	Mount Lyell.....	1	7	6
Golden Horse-Shoe.....	2	11	3	Mount Morgan.....	3	2	6
Great Boulder Prop.....	0	15	0	Walhi.....	2	6	0
Ivanhoe.....	2	15	0	Walhi Grand Junc.....	1	6	3
Kaikurua.....	1	17	6	Zinc Corporation, Ord.....	1	0	0
Mount Boppy.....	0	12	6				

PYRITE AND SULPHURIC ACID PRODUCTION IN 1913

The production of pyrite in the United States in 1913, according to W. C. Phalen of the U. S. Geological Survey, was 341,338 long tons valued at \$1,286,084. For 1912, the output amounted to 350,928 long tons valued at \$1,334,259, a decrease for 1913 in quantity of 9590 long tons and in value of \$48,175. The production in the leading states—Virginia and New York—diminished slightly; in California there was an increased production; and in Wisconsin, the output also continued to increase. The imports of pyrite for consumption during the calendar year 1913 were 850,592 long tons valued at \$3,611,137. These figures show a notable decrease in quantity. According to actual returns for the year 1913, the production of sulphuric acid in the United States was 3,538,980 short tons of 50° acid, valued at \$22,366,482. This output does not include a small amount of fuming acid, but does include by-product acid, that is, acid obtained in the smelter industry. The acid produced at copper and zinc smelters in 1913 amounted to 790,296 short tons of 50° acid, valued at \$4,346,272. These figures are final, so far as the Survey's present information goes.

MINERAL PRODUCTION OF TASMANIA IN 1913

The past two years' production of this Australian state shows the following:

Product.	1913.	1912.
Bismuth.....	£1,627	£2,646
Coal.....	25,367	24,568
Copper and ore.....	375,664	440,444
Gold.....	141,876	161,300
Shale.....	130	—
Silver-lead ore.....	319,997	309,098
Osmiridium.....	12,016	5,742
Tin.....	531,983	543,103
Wolfram.....	7,040	6,601
Total.....	£1,415,700	£1,493,502

PETROLEUM PRODUCTION OF THE DUTCH EAST INDIES, mainly Borneo and Sumatra, was 1,503,660 tons in 1913.

Company Reports

SUDAN GOLD FIELD COMPANY, LTD.

This Company has a large concession in the Sudan, 30 miles of light railway, a 10-stamp mill and cyanide plant. Development in 1913 totaled 5304 ft. Ore reserves are estimated at 42,862 tons, an increase of 15,862 tons. About 1600 tons of high-grade ore was opened in a folded portion of the vein. The plant treated 17,049 tons of ore yielding \$190,000. The year's profit was \$29,000, from which \$24,000 was written off for depreciation and other work.

BARRAMIA MINING & EXPLORATION, LTD.

This Company's property is situated between the River Nile and the Red Sea in upper Egypt. The mine is characterized by small rich pockets of ore, one in 1913 producing 59 tons with 480 oz. gold, and another 84 tons yielding 1192 oz.; but there were few opened during the past year. Ore reserves are estimated at 16,500 tons averaging \$10 per ton. The mine is opened to 503 ft. below the adit level. The 10-stamp mill crushed 4300 tons in 1913, yielding gold worth \$85,000. After deducting royalty, the profit was \$15,000, and a dividend of \$11,500 was paid.

CORDOBA COPPER COMPANY, LTD.

This Company operates in Spain, and has a complete reduction plant, including the Murex magnetic process. In 1913, development totaled 12,955 ft., and ore reserves show an increase, now amounting to 206,489 tons of 3% ore. At 1410 ft., the lowest level, higher grade ore has been opened than above. The shaft is being sunk to 1545 ft. Ore mined amounted to 119,069 tons, yielding 3500 metric tons of blister copper. Sales realized £231,451, and the net profit was £83,321. Dividends totaled £40,000. Results were considerably above those of the previous term.

RIO TINTO COPPER COMPANY, LTD.

During 1913 this great mine in Spain produced a total of 1,859,571 tons of 2.19% copper ore. Metal output at the mines was 21,062 tons, while the total sent to market as copper and in pyrite was 36,320 tons, or 81,356,800 lb. The net profit was £1,673,372, of which £1,487,500 was paid in dividends, and £185,872 was carried forward to the current year. Strikes interrupted the work, reducing the ore mined by 547,398 tons, and copper yield by 3500 tons. The average price received for the metal was £68 5s. 9d., against £73 1s. 3d. in 1912. Shareholders got 75s. per share instead of 90s. for the previous term.

RICO-WELLINGTON MINING COMPANY

This Company operates at Rico, Dolores county, Colorado, with headquarters at Provo, Utah. The report for 1913 shows that the remodeling of the Pro Patria mill was completed, with an auxiliary power-plant. Since starting it, 5178 tons of lead-zinc ore has been milled, with 92% extraction. Development totaled 4132 ft., making 12,963 ft. to date. A complete survey was made of the surface of the claims, and this has been checked with the mine workings, and will help underground work. The physical condition of the mine has been improved, and the future is encouraging. Besides the lead-zinc ore, there was produced 786 tons of lead and 4804 tons of copper ores. Ore sales realized \$152,271. Costs totaled \$5.83 per ton.

BROKEN HILL SOUTH SILVER MINING COMPANY

The second half-year's work of this Australian company enabled two dividends, amounting to £140,000, to be paid, and a balance of £142,523 carried forward. Development in

the mines totaled 2036 ft., including 4317 ft. of diamond drilling. Filling distributed underground amounted to 54,951 cu. yd. at a cost of 80c. per yard of filling, and 25c. per ton of ore mined. The 725-ft. level contributed 12.6% of the 170,980 tons of ore raised, 6% from 825 ft., 33.5% from 970 ft., 40.2% from 1070 ft., and some from 625 and 1170 ft. Ore reserves above 1170 ft. are 3,350,000 tons. The mill treated 148,957 tons averaging 14.7% lead, 7.3 oz. silver, and 14.5% zinc, according to the report of the manager, W. E. Walnwright. The revenue from all sources was £354,786. During the period, the rainfall was 3.93 in., and water consumption 30,107,000 from various sources. Details of costs and other work will be given in another issue of this journal. There were 1387 men employed.

ONTARIO SILVER MINING COMPANY

This Company operates at Park City, Utah, and the report deals with work done in 1913. All of the development consisted of opening and prospecting old stopes and adjacent ground on and above the 1500-ft. or drainage level. A good deal of ore was opened in one of the three stopes. Connections have been made between this and the 1500 to the 1100-ft. levels. Ore was to have been shipped to the Daly West mill, but it was destroyed by fire at the end of the year, and work will not be resumed to any extent for several months. Ore mined was 1184 tons, returning \$16,359. The Mines Operating Co. has a lease on part of the mine above the 900-ft. level, and last year's work was not very satisfactory. The Ontario company's revenue was \$47,324, and expenditure \$49,011. Cash assets total \$338,678.

SENECA-SUPERIOR SILVER MINES, LIMITED.

The annual report of this Cobalt company contains the following information for 1913: Development totaled 5653 ft., and 4200 cu. ft. of stations, according to R. H. Lyman, the manager. The No. 2 shaft was sunk to 200 ft., affording good ventilation. On No. 3 and 4 levels the east and west drifts were driven 270 and 210 ft. respectively on the vein. A cross-cut at 100 ft. depth opened high-grade ore. The consulting engineer, W. E. Segsworth, states that there are four levels opened in rich ore, and on No. 2 level, 440 ft. has opened 3 in. of 3500-oz. ore; No. 3 level averages 2300 oz. per ton over 2½ in.; while at 334 ft., or No. 4 level, the vein is 1½ in. wide averaging 960 oz. per ton. Ore reserves contain about 3,460,000 oz. silver. The output during the past 11 months was 1,085,774 oz. The cost was 13.2c. per ounce, of which 6.92c. was for mining; 5.58c. for surface, and 0.7c. for depreciation. The profit for the year was \$288,954, of which \$263,136 was paid in dividends. The balance carried forward, including that brought forward, was \$85,290.

AMERICAN ZINC, LEAD & SMELTING COMPANY

This Company operates mines at Joplin, Missouri; Mascot, Tennessee; and in Wisconsin, and zinc smelters at Caney and Dearing, Kansas, and at Hillsboro, Illinois. The report covers the year 1913. The president, H. S. Kimball, reported that the condition of the zinc industry was extremely unsatisfactory. Average prices of spelter at St. Louis in 1912 and 1913 were 6.93 and 5.5c. per pound respectively. At the beginning of 1913 the Caney and Dearing smelters were operating at 83% capacity, and the Hillsboro had just been started. The stock of ores at these plants was 11,506 tons, costing \$500,669, being purchased during the period of high prices in 1912. This stock was written down at a heavy loss. No profits resulted from the Hillsboro smelter for many reasons. A falling-off in demand for spelter caused an accumulation of stocks at all plants. In June 1913 the Kansas plants were reduced to 33% capacity, and shut down in December. The Joplin mines are low grade, and could only be operated at part capacity, against a good profit made in 1912. The Wisconsin mines, in which the Company holds 60% interest,

made a fair profit. Developments in the Tennessee mine were satisfactory; and during the last quarter of 1913 the mill treated over 1000 tons of ore per day. The tailing finds a ready market for railroads and farms. The year resulted in a loss of \$304,630, though a dividend of \$85,600 was paid. Cash and liquid assets total \$1,709,870, and liabilities \$2,061,145, apart from property account and capital stock.

THE WOLFRAM MINING AND SMELTING COMPANY, LTD.

This Company owns 11 concessions, with an area of 1257 acres, and equipment, situated about five miles from Silveiras in the province of Beira Baixa, district of Astello Branco, Portugal. The report for the year ended September 30, 1913, gives the total amount of ore broken as 22,909 tons. Shipments realized \$120,000 less than in the previous year, due to a slight decline in the output, owing to flooding during the greater part of the year, of No. 10 vein at Panasqueria, where the richest ore is recovered. Another reason was the presence of tin in ore mined at Barroca Grande and Panasqueria South, which, up to the time of closing the accounts, could not be dealt with. A quantity of tin and wolfram concentrates accumulated and it became necessary to purchase a magnetite separator for the separation of these two minerals. This machine was put into commission during the latter part of the last month of the financial year and is working satisfactorily. The balance available for distribution was \$34,000, out of which a dividend of 5% for the year, was paid on January 31, 1914.

SHANNON COPPER COMPANY

The mines and reduction works of this Company are at Metcalf and Clifton, Greenlee county, Arizona, and the report covers the 16 months ended December 31, 1913. The general manager, J. W. Bennie, states that development totaled 13,600 ft. There were no new developments during the year at the Shannon mines proper. An important discovery, however, was made at one of the Company's outside claims, known as the Alaska mine, about half a mile from the Shannon mines. The discovery was made by the Arizona Copper Co. through one of its mines which adjoins the Alaska. As far as developed, the ore is 30 ft. wide, averaging for the full width over 8% copper. Although this new shoot is of important size, and will probably furnish a substantial tonnage of high-grade ore, more development will be necessary to determine its extent or value. At the other outside claims, from which the ore shipped averaged much lower in copper this financial year, as compared with the preceding year, higher-grade ore is again showing in the lower workings, which will, in the near future, tend to increase the average copper yield of the shipments from that property.

The Company is still carrying on its leaching experiments, and, although encouraging, the process cannot yet be considered commercially a success. It is hoped that leaching in some form will become adaptable, not alone in treating the Shannon tailing, of which there are over a million tons containing over 20 lb. of copper per ton, but also in treating at a profit from one to two million tons of semi-oxidized ore carrying 2 to 2½% copper, which can be mined from the Shannon Hill at a low cost.

The mines at Metcalf produced 364,584 tons of ore, of which 361,084 tons was treated, with 73,223 tons of ore from outside properties, yielding 18,793,724 lb. copper, 3412 oz. gold, and 169,197 oz. silver. Net profits were \$476,440, from a revenue of \$3,152,412 and profit of \$32,829 from the Shannon Arizona Railway Co. A dividend of \$150,000 was paid in January 1913. Net current assets over liabilities are \$381,236, exclusive of \$284,000 railway bonds purchased. Costs were higher than before by 20c. per ton. There were no changes at the smelter. Basic converters have been used for nine months during the term.

Decisions Relating to Mining

NO TITLE TO WATER UNDER MINING LOCATION

The location of a mining claim on land in which a spring arose will give the locator no claim to the water flowing from the spring in a natural channel as against an appropriator; for title to such flow in the state of Nevada can only be acquired by appropriation and application to a beneficial use.

Campbell v. Goldfield Consolidated Water Co. (Nevada), 136 Pacific, 976. December 12, 1913.

IMPROPER VERIFICATION

Verification of an application for patent cannot be made outside of the land district wherein the claim sought to be patented is situated, and a notary public who is also acting as attorney for the applicant in the patent proceedings is disqualified to attest such verification. Entry will be denied for non-compliance with these rules.

Home Mining Company (Land Department) 42 Land Decisions, 526. November 12, 1913.

MINING CLAIM—DEFECTIVE PATENT PROCEEDINGS

Where the notice of an application for patent under mining laws as published and posted, embraces a tract not covered by the application, the notice and all proceedings had thereon are null and void as to that tract; and the defect cannot be cured and the entry permitted to stand by subsequent amendment of the application to include the omitted tract.

Pocatello Gold and Copper Mining Co. (Land Department) 42 Land Decisions, 550. November 5, 1913.

MINERAL SURVEY—TIE LINE—TWO-MILE LIMIT

Paragraph 135 of the mining regulations contemplates that each individual claim of a contiguous group embraced in the same survey shall be connected with a public survey corner of the United States location monument not more than two miles distant; and where only one claim of such group is connected to a public survey corner within the two-mile limit, and the remainder are connected by tie-lines more than two miles in length, an entry allowed for such group may be permitted to stand only as to the claim within two miles of the public survey corner and will be rejected as to the others.

Lloyd Searchlight Mining and Milling Co. (Land Department) 42 Land Decisions, 485. September 8, 1913.

SURFACE AND MINERAL TITLES—ADVERSE POSSESSION

The surface of the earth and the minerals underneath the surface may be severed by a deed, or reservation in a deed, and when so severed they constitute two distinct estates. The mineral interests being part of the realty, the estate in them is subject to the ordinary rules of law governing real property. The presumption that the party having possession of the surface has the possession of the subsoil containing the minerals does not exist when these rights are severed. The owner of the surface can acquire no title to the minerals by exclusive and continuous possession of the surface, nor does the owner of the minerals lose his right or his possession by any length of non-user. He must be disseized to lose his right and there can be no disseizin by any act which does not actually take the minerals out of his possession. The owner of the surface can acquire title against the owner of the minerals underneath by no acts or continuous series of acts that would not give title to a stranger.

Hoilman v. Johnson (North Carolina), 80 Southeastern, 249. December 10, 1913.

Recent Publications

MINERAL RESOURCES OF THE PHILIPPINE ISLANDS, 1912. Issued by the Division of Mines, Bureau of Science, Warren D. Smith, chief of division. P. 76. Ill., maps.

TEETH OF A CESTRACIONT SHARK FROM THE UPPER TRIASSIC OF NORTHERN CALIFORNIA. By Harold C. Bryant. P. 4. Ill. University of California Publication. Berkeley.

CARNEGIE INSTITUTION OF WASHINGTON. Annual report of the director of the geophysical laboratory, Arthur L. Day. P. 25. Abstract from *Year Book* No. 12, for 1913.

GOVERNMENT OWNERSHIP OF ELECTRICAL MEANS OF COMMUNICATION. Letter from the postmaster general, A. S. Burleson to the Senate, January 31, 1914. P. 147. Washington, 1914.

PHYSICAL CHEMISTRY OF SEGER CONES. By Robert B. Sosman. P. 17. Ill. Reprint from *Transactions of the American Ceramic Society*.

NEW CRYSTALLINE SILICATES OF POTASSIUM AND SODIUM, THEIR PREPARATION AND GENERAL PROPERTIES. By George W. Morey. Reprint from the *Journal of the American Chemical Society*. P. 16. Ill.

STATISTICS OF THE MINERAL PRODUCTION OF ALABAMA, 1912. Compiled from 'Mineral Resources of the United States,' by Charles Arthur Abele. Bulletin 14. P. 51. Geological Survey of Alabama, 1913.

OBSERVATIONS OF THE DAUPHINÉE EXPERIMENT AND CAPILLARITY IN RELATION TO CERTAIN GEOLOGICAL SPECULATIONS. By John Johnston and L. H. Adams. Reprint from the *Journal of Geology*. P. 15. Ill.

FIFTH ANNUAL REPORT OF THE FLORIDA STATE GEOLOGICAL SURVEY. E. H. Sellards, state geologist. P. 306. Ill., maps, index. Tallahassee, 1913. There is a good deal of valuable data on phosphates in this publication.

ALASKA IN 1913. Report of the governor, J. F. A. Strong to the Secretary of the Interior. P. 99, map. Washington, 1913. This interesting report covers everything done in the territory during the fiscal year ended June 30, 1913.

THE MINERAL RESOURCES OF OREGON. Vol. 1, No. 1. P. 61. Ill. Corvallis, January, 1914. This is the first of a series of publications by the Oregon Bureau of Mines and Geology. An abstract appeared in this journal of March 28.

THE AMERICAN TELEPHONE AND TELEGRAPH COMPANY. Annual report for 1913. P. 68. New York, 1914. In the Bell system in the United States there are 8,133,017 stations. The gross revenue was \$215,300,000, and dividends \$30,300,000.

THE MINING INDUSTRY OF IDAHO, 1913. Compiled by Robert N. Bell, state inspector of mines. P. 225. Ill. Boise, 1914. An abstract of this interesting report appeared in this journal of March 28, and further notes will be made from it.

IRON MINING AND AGRICULTURE. Souvenir edition of *The Mining Journal*, Marquette, Michigan. P. 80. Profusely illustrated. Contains a great deal of interesting matter on the above subjects, especially the iron ore industry.

INDUSTRIAL RESEARCH IN AMERICA. By Arthur D. Little. Presidential address before the American Chemical Society, Rochester, New York, September 1913. Reprint from the *Journal of Industrial and Engineering Chemistry*. P. 23.

SIXTH BIENNIAL REPORT. State Geological Survey of North Dakota. A. G. Leonard, state geologist. P. 165. Ill., maps,

index. Bismarck, 1912. This covers the work of the Survey during 1909 and 1910.

THE COAL RESOURCES AND GENERAL GEOLOGY OF THE POUND QUADRANGLE, IN VIRGINIA. By Charles Butts. Bulletin IX. P. 61. Maps, index. Prepared in cooperation with the U. S. Geological Survey by the Virginia Geological Survey. Charlottesville, 1914.

FIRST AID TO THE INJURED. Report and accounts of the Transvaal Centre of the St. John Ambulance Association, for the year ended September 30, 1913. P. 24. Ill., table. Johannesburg, 1913. A total of 2415 men were instructed, 2010 were examined, and 1869 passed during the term.

PREPARATION OF METALLIC COBALT BY REDUCTION OF THE OXIDE. By H. T. Kalmus, assisted by C. W. Day, C. Harper, W. L. Savell, and R. Wilcox. P. 36. Ill. Department of Mines, Ottawa, Canada, 1913. This gives the results of researches on cobalt and cobalt alloys, conducted at Queen's University, Kingston, Ontario, and may lead to the recovery of these minerals from ores at Cobalt.

MINERAL RESOURCES OF THE UNITED STATES, 1912. Part I—Metals. P. 1079. Ill., index. U. S. Geological Survey, Washington, 1913. This volume includes details of metal production which were published in pamphlet form during the past year and were extensively quoted in this journal from time to time. The authors who contributed are as follows: E. W. Parker, W. T. Thom, J. P. Dunlop, E. F. Burchard, D. F. Hewett, H. D. McCaskey, B. S. Butler, C. E. Siebenthal, A. H. Brooks, V. C. Helkes, C. G. Yale, C. W. Henderson, C. N. Gerry, W. C. Phalen, Frank L. Hess, J. S. Diller, and David T. Day.

U. S. Bureau of Mines publications, Washington, 1913 and 1914:

REPORT OF THE DIRECTOR OF THE BUREAU. Joseph A. Holmes, for the year ended June 30, 1913. P. 118. Map. This volume deals with the work of this department since its establishment, and progress of investigations during the past fiscal year. These covered mine-rescue work, saving mineral waste, mine explosions, fuels, petroleum, gas-producers, the laboratories, smelter fume, electric smelting of ores, the staff, and many other subjects, which are published in the technical press from time to time.

UTILIZATION OF PETROLEUM AND NATURAL GAS IN WYOMING. Preliminary report by W. R. Calvert. Also a discussion on the 'Suitability of Natural Gas for Making Gasoline,' by George A. Burrell. Technical paper 57, petroleum technology 13. P. 23.

PRODUCTION OF EXPLOSIVES IN THE UNITED STATES, 1912. Compiled by Albert H. Fay. Technical paper 69. P. 7. A table from this paper was published last week.

PERMISSIBLE EXPLOSIVES. By Clarence Hall. Technical paper 71. P. 12. Contains tabulated matter showing explosives tested prior to January 1, 1914.

COAL-MINE FATALITIES IN THE UNITED STATES. December 1913. With revised figures for preceding months. Compiled by Albert H. Fay. P. 28. There were 425 more men killed during 1913 than in 1912.

THE SAMPLING AND EXAMINATION OF MINE GASES AND NATURAL GAS. By George A. Burrell and Frank M. Seibert. Bulletin 42. P. 116. Ill., index. Describes the apparatus and methods used in this important work. The chemistry of these hydro-carbons is somewhat complex.

HYDRAULIC MINE FILLING. Preliminary report on its use in the Pennsylvania anthracite fields. By CharlesENZIAN. Bulletin 60. P. 77. Ill.

ELECTRIC SWITCHES. For use in gaseous mines. By H. H. Clark and R. W. Crocker. Bulletin 68. P. 38. Ill. The design and use of switches in such mines is very important, and details are given of tests made.

Industrial Progress

CHALMERS & WILLIAMS have taken a contract to build a large modern concentrator for the Daly West at Park City, Utah.

THE CENTRAL FOUNDRY Co. has issued a special booklet descriptive of the valve service and roadway boxes made by that firm.

THE MOUNTAIN COPPER Co. will use two 8 ft. by 36 in. cyl. herringbone-gear driven Hardinge mills in the new concentrator at Keswick in Shasta county, California.

A 'Manual of Electrical Testing' has been issued by the WAGNER ELECTRIC MFG. Co. which describes the instruments, sources of error, and methods of testing alternating and direct current motors, generators, and transformers.

THE CHICAGO PNEUMATIC TOOL Co. bulletins for February and March are devoted to descriptions of the 'Chicago Slugger' drill, the Duntley electric tools, and the Duntley Electric sensitive drilling stand, well known specialties of this firm.

THE DEISTER MACHINE Co. catalogue of concentrating machinery now available, contains descriptions and illustrations of both the single and double deck concentrators made by this Company, and the multiple deck tilting slimer and the cone baffle classifier recently put on the market.

THE NATIONAL TUBE Co. is distributing bulletin No. 11-B, the history, characteristics, and advantages of 'National' pipe; and special circulars on the differences between iron and steel boiler tubes, and a discussion before the Boilermakers' Association committee on iron versus steel tubes.

Catalog 'D' of the ENGLISH IRON WORKS contains complete descriptions of the various Sampson hoists made by that firm in both large and small units, steam or electric driven. It also contains useful tables of horse-power required for lifting various loads, and rules for finding horse-power.

The Bearing, a little monthly published by the ALBANY LUBRICATING Co., devotes its March number to lubrication in connection with mining machinery. A number of detailed statements are given of tests on the relative efficiency of machine oils and Albany grease at various European plants, which show a marked saving in favor of the grease.

THE LIDGERWOOD MFG. Co. reports that Charles H. Locher has handled 6,235,000 cu. yd. of material with Lidgerwood cableways while connected with various contracting firms as partner. This represents a mass three times as large as the concrete placed by Lidgerwood cableways in the Gatun locks at Panama, the largest mass of concrete in existence.

The Isthmian Canal Commission has awarded to the INGERSOLL-RAND Co. the contract to furnish three large direct-connected electrically driven air-compressors of the duplex type, embodying the new Ingersoll-Rogier valve. The combined capacity of these units will be 10,000 cu. ft. They will be placed at the Balboa shops, where the air will be used for general repair work in the shops and also on the new dry dock.

THE A. S. CAMERON STEAM PUMP WORKS announces the following assignment of managers to the branch houses: Birmingham, Ala., American Trust Bldg., H. M. Perry; Chicago, Ill., Peoples Gas Bldg., M. P. Frutchey; Cleveland, Ohio, Williamson Bldg., W. A. Armstrong; Duluth, Minnesota, Providence Bldg., S. H. Hill; Houghton, Mich., Thomas F. Lynch; Knoxville, Tenn., Holston Nat'l Bank, L. F. Thompson; Los Angeles, Cal., W. A. Townsend; Philadelphia, Pa., Arcade

Bldg., Phil. Weiss; Pittsburgh, Pa., Farmers' Bank Bldg., W. B. Brendlinger; St. Louis, Mo., 300 N. Broadway, A. A. Bonsack; Seattle, Wash., Colman Bldg., R. W. Douglass.

THE LINK BELT Co. is now distributing a data book designed to enable users of power to select the correct silent chain drive for their work and to figure exact costs from the price lists published in the book. Besides engineering tables of great value in this connection, the book describes and illustrates many uses of the silent chain. Link-Belt silent chain is a series of links connected by joints which consist of segmental case hardened bushings and case hardened steel pins. The chain is held to be as flexible as a leather belt and as positive as a gear. Its rated efficiency is 98.2% on actual test. It is claimed that it will transmit any amount of power quietly. Over 200,000 installations, we understand, were drawn upon for the information contained in this data book, which may be obtained free from the Company.

The Nome Tramway

In *Leschen's Hercules* for April there is an interesting description of the wire rope tramway used for unloading freight and passengers at Nome, Alaska, and based upon notes furnished by A. H. Kellogg, manager for the John J. Sesnon Co., which owns and operates the tramway. The description in part follows.

Nome lies on the beach of the Bering Sea, but absolutely unprotected from the many storms that occur there during the open season, which is about from June 10 to October 31, and moreover, there are at times strong northerly and north-east winds which reach the velocity of gales. These winds blow the water a great distance out, causing extremely low water and making it absolutely impossible for lighters to get to shore. Owing to the fact of Nome being an unprotected harbor, and Bering Sea shallow, none of the larger vessels can come closer than within two miles of shore, so all of the discharging is done onto lighters from ships.

In order to overcome the danger and difficulty of getting the lighters unloaded, a cableway was built during the winter of 1906-7 and started operation with the first boats of 1907. This has a span of 1400 ft. The shore or head tower is 125 ft. high and the sea tower is 80 ft. high. Both towers are of frame construction, but the sea tower is built on a concrete caisson which is submerged in the water. The caisson was constructed of wooden framework, which was taken out over the then frozen Bering Sea for a distance of about 900 ft., requiring 32 horses to haul it. A hole was cut in the ice and the frame was sunk down into the ice and filled with concrete, and on top of this foundation the tower was built. This caisson is the only thing that has successfully stood up against the violent storms in the Bering Sea during the open season and the action of the frozen sea during the winter months.

In addition to human freight, material of all kinds is handled which includes express, gold bullion, baggage, and the United States mail. During last season nearly 12,000 tons of coal alone was handled. Each season from 30,000 to 50,000 tons of freight is handled and in the neighborhood of 5000 passengers use the cableway for reaching shore. Ordinarily, loads of from three to five tons are handled, but in emergencies as high as 12 tons have been lifted. Freight and passengers are discharged from the ship to lighters two miles from shore, and the lighters are towed under the cableway, which then picks up the loads and takes them ashore. Leschen rope is used on the falls, haul lines, button lines, and slugs and is giving entire satisfaction. Since the construction of this cableway there has practically been no delays in unloading vessels. After the violent storm of October 6, 1913, work of discharging the steamship *Victoria*, which was in the roadstead, was commenced within a few days.

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EDITORIAL

Mediation in Mexico

Mediation in Mexican affairs by the A B C countries of South America is most timely and appropriate. It may not result in settling the points at issue, but that will detract nothing from the courtesy of the attempt, and substantial good will have been accomplished, whether or not the mediation be successful in itself. Despite the insistence of those who have it that order cannot be restored in Mexico except by annexing that country to the United States or establishing a formal protectorate, public sentiment here is adverse to any extension of our boundaries so as to include a Latin American people. This is not generally believed in Central and South America, but it is none the less true. Possibly we deserve no credit for it, since mixed with the idealism that is a real, though often unregarded, factor in American public policy, there are many practical and selfish motives. The sober sense of the American people recognizes that we have not made a conspicuous success in handling the great race problem that we already have, and there is everything to lose and nothing to gain by permitting another such problem to arise. To add to our population 17,000,000 Mexicans would give us a race problem of first magnitude, especially since the addition would necessarily be the result of war and accompanied by much bitterness. Whether the Mexicans be better or worse than the people of the United States does not enter into the problem; there can be no absolute standard for comparison of various races and nations. It is sufficient to know that they are different; different, as Caesar said, in institutions, language, and laws. They do not understand us, and we by no means, as a nation, understand them. We wish them well, but even as neighbors the gulf between their habits of life and thought and ours, has proved to be too deep for any crossing of the people *en masse*. Happily, as always, individual Mexicans are thoroughly liked and appreciated in the United States, and, we believe, individual Americans are equally *persona grata* in Mexico.

A democracy such as the United States, requires for its successful operation a reasonable homogeneity of ideals on the part of those who compose its rank and file. Otherwise the strong few dominate, and it becomes an oligarchy. We have absorbed many alien strains and we shall doubtless continue to do so. Men

of any race or people are welcome so long as they do not come in such numbers as to constitute a threat to our institutions. Many Mexicans live in the United States, especially in the Southwest, and they contribute greatly to its prosperity and are helping to make that part of the country as thoroughly orderly and civilized as any; but it would be a radically different thing to absorb the whole Mexican nation, and none know this better than the people of the United States.

On the other hand, it is equally out of the question for the soldiers of the United States to police permanently an alien country. That is as foreign to our ideals and purposes as to take into our sisterhood of states others dominantly populated by another race. From our own point of view, and disregarding for the moment all questions of right, we are not willing to impose ourselves on an unwilling people. Such sentiment in that direction as was called into being by the Spanish-American war has largely disappeared before the actual difficulties of the situation in Cuba and the Philippines, and in Cuba at least we were not unwelcome. If the American people could be convinced that the Filipinos would maintain a strong, independent, and just government, our forces and officials would be withdrawn instantly. They stay because there is doubt on that point. In nothing does Mr. Wilson better reflect the deep underlying sentiment of the average American home than in his statement that the United States wants no conquests. We do want peace and order. We do want our people, our flag, and our rights as strangers in a foreign country, to be scrupulously respected, and our troops are in Mexico to secure these things. If they go beyond this and 'intervene' it must be to secure for the Mexicans what they themselves want. We cannot stay in Mexico except to execute the Mexicans' will, and, fundamentally and finally, the Mexicans must determine what they will have and then maintain themselves in it. What the Mexicans really want is none too apparent. Seemingly, as in other countries, different Mexicans want different things, and not all can be accommodated. It is by no means certain that either the people or the government of the United States correctly interprets public opinion in Mexico. Such mistakes have been made. It should be remembered that when King Peter came to the throne in Servia he was not recognized by any of the great powers of Europe for more than a year, because of the manner of his accession. Eventually it appeared that he really did represent the hopes and aspirations of Servia. Possibly Huerta represents what Mexicans want, but we doubt it. We must assume that Mr. Wilson has sources of information not open to his vociferous critics of the street corner and country store, and there can be no question of his unselfish and disinterested purpose to live up to the highest ideals of America. If he is in error in thinking it worth while to strive for a larger measure of democracy in Mexico, to set his face against the anachronism of dictators in

Latin America, to hold that it is possible to use even force and retain the friendship of the Mexican people, if, we say, these ideas prove to have been too idealistic for the twentieth century, his effort is none the less honest and commendable. Speaking for ourselves, we do not believe the effort foredoomed to failure, and it is to be remembered that the whole of the President's plan is not yet known. Enough has developed to make it clear that it is his purpose to avoid war by every honorable means, and therefore mediation by Brazil, Argentine, and Chile is welcome. These great countries have passed through many such a crisis as now confronts Mexico. There is a kinship of experience, and with Chile and the Argentine, of race and language, between Mexico and the mediating nations. It is reasonable to assume that if we in our reputed 'duller' Anglo-Saxon manner have misinterpreted conditions, the diplomats of these countries will be able to see the facts and present them to us. It is also possible that the Mexican officials will accept unpleasant truths from those they hold as kinfolk better than from us. In any event, the most hopeful effort at peaceable settlement of the matter will have been made and in event of war the United States will stand in better light before our South American neighbors, a most important matter.

But why war? Mexicans must some day learn to govern themselves. They must give up the easy way of permitting dictators to follow each other in endless succession and impoverish the country. There are able Mexicans and many of them, but they, in the main, stay out of politics. The situation is not greatly different from that in the worst days of boss-ridden American cities. The best men and the average citizen neglected civic duties and a few of the worst ruled. Mexicans are properly unwilling that a foreigner should rule them, but submission to irresponsible local despots is not only as bad in itself, but it may force the very foreign domination that Americans as well as Mexicans are anxious to avoid.

Stripping Frozen Gravel

In gold dredging in the Far North, the cost of stripping is most important. The success or failure of a company may be determined by this important factor. The handling of frozen ground in stripping operations is the subject of a most interesting article by Mr. E. E. McCarthy which appears in *The Mining Magazine* for April. Mr. McCarthy, by reason of long experience in Alaska, is especially fitted to write upon the dredging problems of that country, and he has performed a real service in setting forth in detail the actual experience of the Yukon Gold Company with thawing by stripping. The Canadian Klondyke officials expect to thaw ground at a cost of 10 cents per yard or less. Mr. McCarthy believes them over-optimistic and gives reasons for the doubt that he entertains. The present method of removing the frost from creek gravels, one which has come to be standard practice,

is by the direct introduction of heat by means of steam, except in small workings where the scope of operations will not warrant a steam plant and the ground is thawed by fires. In the *Mining and Scientific Press* of January 17, Mr. Arthur Gibson described this method as used at Nome and analyzed the costs.

At a recent meeting of the Northwest Corporation, Limited, it was reported that 2,000,000 cubic yards of gravel had been stripped, thawed, and made ready for dredging at a cost of 8 cents per cubic yard, and also in the report of the proceedings of the Granville Mining Company, Limited, that the total estimated cost of thawing and dredging the gravels is 10 cents per cubic yard, which is pointed out in marked contrast to the Yukon Gold Company's average cost of over 30 cents for doing a similar work. The proposed method for preparing the ground for dredging is not new, having been tried in both the Klondike and the Forty Mile district, and elsewhere. It consists in removing all trees and brush, and from one to two feet of moss and vegetation which overlies the 'muck'—a mixture of organic material, sand, and silt cemented by ice. For removing this frozen material, the water from the creek is brought to the dredging site by ditches and then allowed to cut through the frozen formation in a series of diagonal or cross ditches and thus sluice away the 'muck.' Sometimes the entire creek is diverted into the frozen ground. The cutting action of the water may be augmented by the use of 'giants', which keep the channels open and wash down the 'muck' as thawed. In this manner the latter is removed to the level of the creek gradient. When the 'muck' overlying the gravel has been removed, the gravel is thawed by exposure to the heat of the sun and in this manner is made ready for dredging.

This apparently simple method of preparing the ground for dredging is not free from difficulties. The moss and vegetation which overlie the 'muck' must be removed, as it will not float, and when it gets into the channels it prevents the water from cutting away the overburden. To get the best results, the course of the creek must be straightened in order to obtain the maximum gradient and most efficient cutting action. The strata of fine sand often found in the 'muck' stop the cutting action of the water in the ditches, and when these strata are thick, plows and scrapers must be used to remove the sand. In no case can the overburden be removed below the creek gradient, and, since as the stripped area increases the grade of the cross-ditches decreases, the carrying power of the water diminishes and more hand labor is required. The supply of water must be abundant.

The experimental work that the Yukon Gold Company conducted on a large scale in 1906-1907 and 1909 was conducted, as pointed out by Mr. McCarthy, under favorable conditions. Nevertheless, difficulties were numerous, and it was demonstrated that stripping and natural thawing could not be relied upon for large-scale operations. The result of this experiment by

the Yukon company, in addition to proving to their satisfaction that the actual stripping operations were fraught with difficulties, showed that the natural thawing of the underlying gravel was by no means satisfactory. Practically all of the ground had to be thawed by steam before the dredge could operate, although the gravel was exposed for almost a season. Gravel which was exposed for more than a season was found to be only about fifty per cent thawed when reached by the dredge. It is not possible to state from the data available what percentage of the thawing was due to stripping operations and how much was naturally thawed before operations began. The belief of the superintendent is that the thawing due to stripping was altogether disproportionate to the expense of the work accomplished. Figures presented by Mr. McCarthy would show that if the Yukon Gold Company had used the natural thawing method in 1913, to strip and prepare the ground for the year's dredging in a season of 120 days, it would require 2360 miner's inches of water daily. With the available supply this work would have required approximately twelve years.

In making a comparison of dredging costs by different companies it is exceedingly difficult, if not impossible, to draw parallels and make deductions as to relative efficiency of methods from the cost per cubic yard of material handled. Local conditions are, of course, the all-powerful factor in working placer properties, and any analogy which does not allow this feature due consideration is ridiculous. One might compare the cost at the Lena Goldfields of about \$8 per cubic yard with that at Natoma of 4½ cents and deduce a relative efficiency of operations which would be absurd. Tabulation of costs of working placer deposits in different parts of the world illustrates the wide range of conditions rather than economy in operation. Representative recent figures are quoted below:

	Per cubic yard.
Bright district, Victoria, Australia.....	5.57 cents
Dawson district, Klondike	29.53 cents
Iditarod, Alaska	64.33 cents
Natoma, California	4.50 cents
New Zealand dredges	4 cents and up
Oroville, California	6.78 cents
Philippine dredges	4 cents and up
Tin dredges in Siam	5.4 cents
Yuba Consolidated, California	4.70 cents
Lena Goldfields, Siberia	\$6 to \$8

There is no standard scale of cost for doing this work. The variation in local conditions is also reflected in the working time. In 1913 the Yukon Gold at Dawson worked 163 days, and at Iditarod 203 days. The Canadian Klondyke company, in the Dawson district, operated 268 days. The difference in working time of the Dawson companies would indicate a marked dissimilarity of local conditions even in the same general district. This spring the Canadian company had been operating for several weeks before the Yukon company began operations.



THE COMMONWEALTH MILL.

Milling Operations at the Commonwealth Property

By E. H. LESLIE

The mine and mill of the Commonwealth Mining & Milling Co. are situated at Pearce, in Cochise county, Arizona, on a branch railroad of the Southern Pacific which extends from Cochise to Gleason, and is connected at Courtland with the El Paso and Southwestern Railway, which has Douglas as its terminal. The property consists of 10 patented mining claims and two millsites, which with an additional leased mill-site of 20 acres, makes the property comprise a total of approximately 230 acres. The operating company is controlled by the Montana-Tonopah Mining Company.

History of the Property

Ore was discovered here by the Pearce brothers in 1894 and in 1896 when the workings had reached a depth of 50 ft. the property was sold for \$275,000 and ore was shipped to El Paso and Pueblo. At this time a 200-ton pan-amalgamation mill was built, which was destroyed by fire in 1900. An 80-stamp mill was then erected on the site of the old mill which continued in operation until 1904, when in December of that year a cave-in at the mine resulted in the suspension of operations. The tailing was then leased by Messrs. Swatling and Smith, and a year later the mine was also leased by these gentlemen and a period of prosperity was entered upon which resulted in a production of approximately \$10,000,000. In 1909 a renewal of the lease was refused by the owners and Messrs. Swatling and Smith bought a controlling interest in the plant and after considerable experimental work decided to remodel and enlarge the milling equipment. At this time, due to defective wiring, the mill was again destroyed by fire and the new owners, having exhausted their resources in the purchase of the property were not in a position to rebuild and the property later passed into the control of the Montana-Tonopah Mining Co. The condition of the property at this time was reported by Llewellyn Humphreys to the Montana-Tonopah Mining Company.*

The new Company has spared no expense again to

*The Commonwealth Mine, by Llewellyn Humphreys. *Mining and Scientific Press*, June 8, 1912.

place the property upon a dividend paying basis and toward this end has improved the mining equipment and method, and erected a new mill, after considerable experimental work, for the treatment of the Commonwealth ores. The mill which was placed in commission last year is at present going through the process of being 'tuned up', and complete metallurgical results are not available for publication. It is anticipated, however, that the near future will see those details of the practice, which go to produce the most efficient results, perfected and a most economic treatment established.

Hoisting Equipment

The fairly low-grade oxidized ore, which is being mined by a shrinkage-stope method, is delivered at the surface through a new three-compartment inclined shaft, which is 5 by 17 ft. in dimension, in 3-ton skips manufactured by the Denver Engineering Works Co. The hoist is an Allis-Chalmers slow speed and double drum type gear connected with a 100-hp. motor. The drums are 54 in. diameter and 36 in. wide, using a 1 1/4-in. rope with a rope speed of 400 ft. per minute. The total unbalanced load is 10,000 lb. The motor is the 3-phase type and operates on a 440 volt, 110 amperes, and 60 cycle circuit at 695 r.p.m. The drums are arranged for balanced or independent hoisting. Double deck cages, as shown in B, Fig. 11, of special design are used for the handling of men, these man-cages being capable of hoisting 18 men at a time. The head-frame is of the 'A' type as shown in A, Fig. 1, and built of structural steel. The frame which was designed for the new 60° incline shaft is 45 ft. high and weighs 37,000 lb. The diameter of the sheaves is 6 ft. The 3-ton skips are 3 ft. by 3 ft. by 7 ft. 5 in. with a 41-in. gage and are fitted with safety catches for 6 by 6 in. guides.

Built in the head frame are two bins for ore and waste which will be seen in the illustration, above which is a 'butterfly' for diverting the material into either of the bins as required. Both bins have inclined bottoms, the waste bin having a capacity of 38 tons and the ore bin a capacity of 21 tons. The waste is discharged through two 24 by 30 in. gates into steel in-

dustrial cars and trammed to the dump. The ore is discharged from the bin through two air-actuated ore-bin gates 24 in. wide with a 28-in. lift, into a 2-ton wooden ear, which is saddle shaped and self-dumping. When the ear is filled it is removed by a C. W. Hunt automatic railway, shown in C, Fig. 1, which has an outside gage of 21 in. The ear passes over a 4-ton weighing scale and is automatically discharged into a circular steel ore-bin of 650 tons capacity. The track over which the automatic tramway operates is 148 ft. long and is supported on a wooden trestle and the ore-bin. The ore-bin is 24 ft. in diameter and 29 ft. high and built of $\frac{1}{4}$ -in. steel plate. This bin serves as a storage and feed bin for the preliminary crushing house, which is at a lower level than the bin and being a hill-side site permits of the gravity handling of the ore.

The ore is drawn from the bin through a 3 by 5-ft. 'finger' gate, which is made of seven wooden fingers with steel lining, and discharged on the feed floor of the No. 6, style 'K', Gates gyratory crusher. One man a shift tends the 'finger' gate and gyratory feed. The crusher discharges into a Gates iron frame revolving screen, which is 40 in. by 12 ft. and makes 18 revolutions per minute. The material passing through the screen, which is through $1\frac{1}{2}$ in., drops into a wooden hopper and thence through a launder chute upon the belt conveyor to the mill bins. The oversize from the screen is discharged into a steel hopper with a deflector arrangement by which the oversize material may be fed into one or both of two No. 4 style 'K' Gates gyratory crushers which reduce the oversize to through $1\frac{1}{2}$ inch. The discharge from the No. 4 crusher is to the same belt conveyor as the undersize from the screen, and the entire product is elevated to the sampling plant and mill bins. The preliminary crushing plant is driven by a 100-hp. motor.

Sampling Plant

A Stevens-Adamson conveyor is used to elevate the ore from the crushing house to the mill. The conveyor is 274 ft. long and 18 in. wide and operates on a 20° incline. Power for the conveyor is supplied by a 15-hp. Allis-Chalmers, 3-phase motor operating on a 440-volt circuit with 19 amperes and making 1150 r.p.m. The discharge is into a hopper at the bottom of which a No. 2 Vezin sampler cuts a 1/10 sample. The Vezin makes 18 r.p.m. The reject then falls upon another conveyor which delivers it to the bins. This conveyor has a length of 95 ft., is 18 in. wide, and is fitted with an automatic self-propelling and reversing tripper. The speed of the belt over the bins is 300 ft. per minute.

Returning to the sampling plant the cut taken out by the Vezin sampler is discharged into a 30 by 14-in. pair of crushing rolls, making 100 r.p.m., the product of which is through $\frac{3}{8}$ in. The discharge from the rolls passes to a revolving drum mixer, the dimensions of which are 30 by 36 in., and operates at 15 r.p.m. The discharge from the mixer passes to a No. 1 Vezin sampler which makes a 1/10 cut, two cuts for each revolution, and revolves at a rate of 25 r.p.m. The sample so taken passes to a second set of rolls which are 18 by 10 in. and reduce the sample to $\frac{1}{8}$ in. These rolls operate at 150 r.p.m. From the rolls the crushed product is discharged into a second drum mixer of the same dimensions as that mentioned above, the discharge from which passes to a No. 1 Vezin sampler which cuts 1/20th part of the discharge for the sample. This Vezin makes 25 r.p.m. The sample thus taken is discharged on the quartering floor, where it is reground in a small gyratory grinder, the sample quartered and sent to the assay office. The reject from the various Vezin samplers is discharged through chutes



FIG. 1. A, HEAD-FRAME; B, MAN CAGES; C, HUNT AUTOMATIC TRAMWAY.

to the foot of a bucket-belt elevator which raises it 52 ft. and discharges upon the belt conveyor which conducts the ore to the mill storage-bins. The elevator is 8 in. wide, fitted with 72 buckets, and has a belt speed of 1400 ft. per minute.

The battery bin is of the standard type and the dimensions are 16 by 16 by 60 ft., with a storage capacity of 800 tons. The ore is discharged at the bottom through six, 24 in. by 4 ft. 4 in. gates to the stamp batteries. The stamp batteries are fed by six suspended Challenge ore feeders. The ore from the feeders passes over 2 by 3-ft. shaking screens with hoppers for the undersize material which is through 3/16-in. holes. This undersize material is by-passed through an 8-in. pipe through the stamp foundations and joins the battery discharge at the front of the mortar box, solution

effects an increase duty. The batteries were built by the Allis-Chalmers Co. and are most efficient both as to construction and operation.

● Battery Foundation

The foundations are adopted from the South African practice, and method of anchoring motor boxes and frames are as shown in Fig. 3. The anchor bolts pass vertically through 2½-in. pipes into the man-way through the centre of the foundation and are thus easily accessible. The mortars of each battery are in this manner rigidly connected with the concrete foundation by 28 anchor bolts. The thickness of the stamp foundation which is between the base of the mortar and the man-way underneath, is 5 ft. For handling the batteries a traveling crane with block and

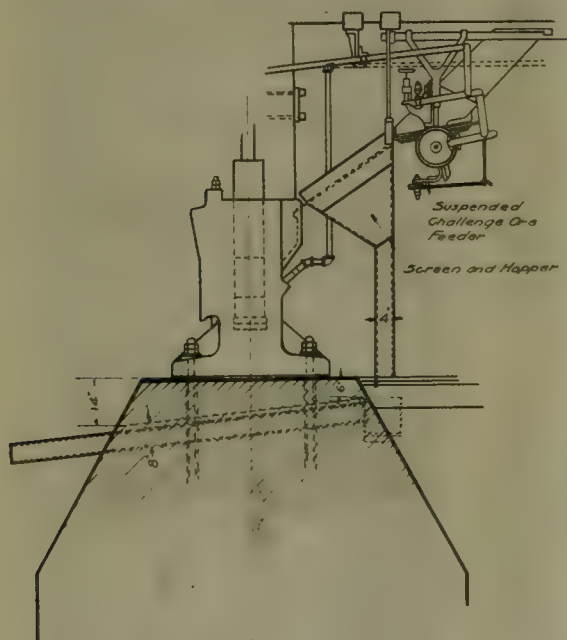


FIG. 2.

being added to this undersize material as it drops into the by-pass. The arrangement of the feeder, screen, and by-pass is as shown in Fig. 2.

The oversize is fed with solution into the mortars of three 10-stamp batteries, the weight of the stamps being 1550 lb., each of which drop 7 in. and make 100 drops per minute. The three batteries are driven by individual Allis-Chalmers 40-hp. motors which operate on a 440-volt and 52-ampere circuit, and make 575 r.p.m. The motors are belt connected to a countershaft which in turn is connected by pulleys and belts with the regular idler pulleys to the cam shafts. The countershaft pulleys are 30 by 17 in. and the cam shaft pulleys are 72 by 17 in. Each battery of ten stamps is operated by two separate camshafts with their individual pulley and belt connections with the countershaft drive. The by-passing of the undersized material amounts to about 10% of the total feed, and thereby

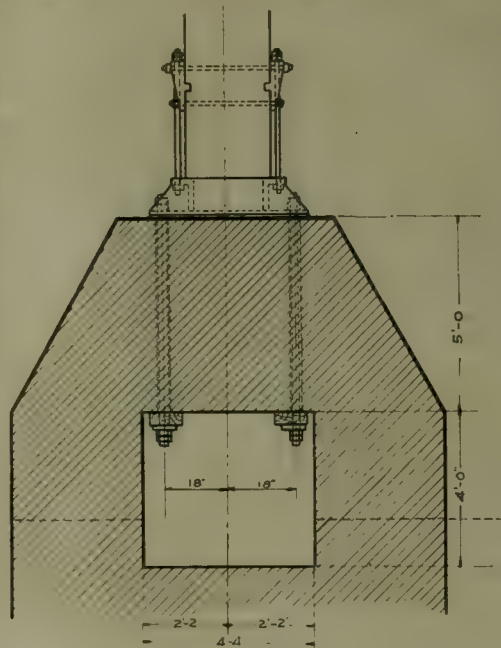


FIG. 3.

tackle has been placed over the stamps. The battery guides are of the 'Ideal' type, which are proving most satisfactory, and 'fingers' are provided for hanging up individual stamps. Four-mesh screens are employed on two batteries and two-mesh screens on the third battery. It is, however, proposed to change all screens to two-mesh. Battery screen analysis on discharge through the four-mesh screen shows the following results.

+ 20-mesh test screen	35.5%
+ 30-mesh test screen	10.3%
+ 60-mesh test screen	9.5%
+ 100-mesh test screen	14.0%
— 100-mesh test screen	31.2%
	<hr/> 100.5%

Screen analysis of discharge through two-mesh battery screen was as follows:

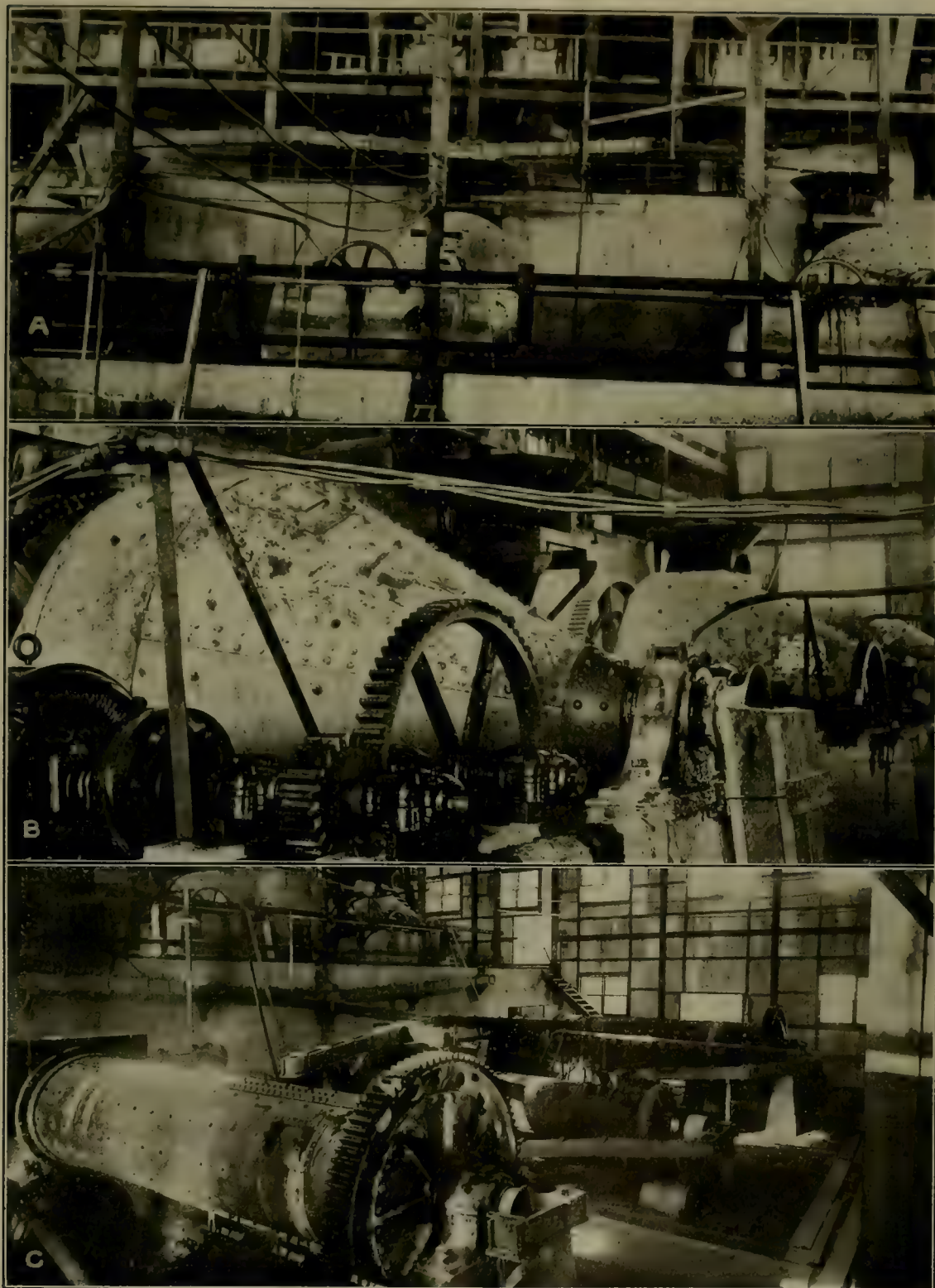


FIG. 5. A, STAMPS AND HARDINGE MILLS; B, HARDINGE MILL DRIVE; C, TUBE-MILLS AND DORR CLASSIFIERS.

+ 20-mesh test screen	43.5%
+ 30-mesh test screen	9.5%
+ 60-mesh test screen	8.5%
+ 100-mesh test screen	12.0%
—100-mesh test screen	27.2%
	100.7%

The estimated stamp duty on the four-mesh batteries was 9.3 tons, which will be materially increased when replaced with two-mesh. The discharge, together with the by-passed material from the stamp batteries, is conducted by launders to three 5-ft. Caldecott cones. The underflow from these cones supplies feed to three 8-ft. by 30-in. Hardinge mills, while the overflow is by-passed and joins the discharge from the Hardinge mills and goes thence to three Dorr classifiers. A cross-section of the Caldecott cones as used in this installation is shown in the accompanying diagram, Fig. 4.

Coarse Grinding Equipment

The Hardinge conical mills are driven by individual 50-hp. Allis-Chalmers motors making 680 r.p.m. The mills operate at 28 r.p.m. Nine hundred pounds of

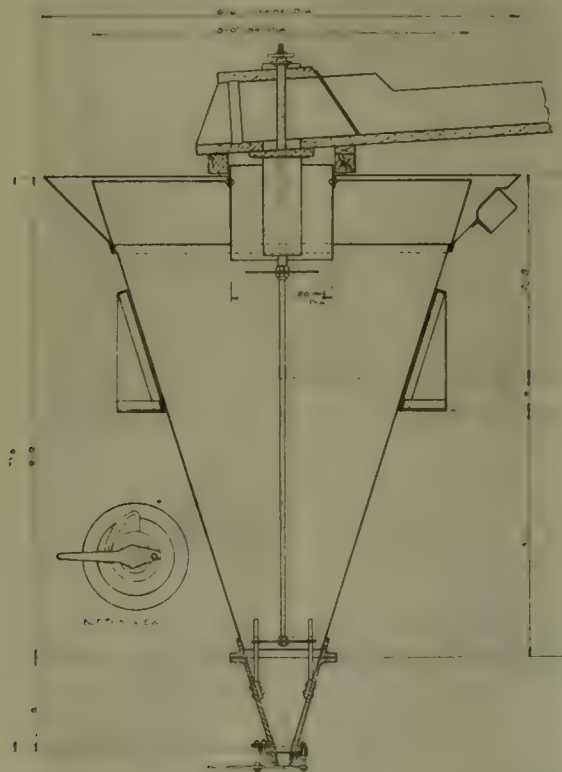


FIG. 4.

Danish pebbles are used in the three Hardinge mills per day and an equal amount are used in the tube-mills. The Caldecott cone feed, motor connections, and gear drive, together with the foundations and arrangement of these mills are as shown in Fig. 5, A and B. The Hardinge mill as a coarse grinding machine has proved a most efficient means for the reduction of ore

in this mill, a representative screen analysis of the feed and discharge shows the following results:

	Feed.	Discharge.
+ 20-mesh	41.5%	6.5%
+ 30-mesh	11.0%	5.5%
+ 60-mesh	10.5%	10.0%
+ 80-mesh	14.5%	21.5%
+ 100-mesh	4.5%	6.5%
+ 120-mesh	5.0%	8.5%
+ 200-mesh	4.0%	7.0%
—200-mesh	9.5%	33.5%
	100.5%	99.0%

The discharge from the Hardinge mills together with the overflow from the Caldecott cones unite and are re-distributed through a system of launders as shown in Fig. 5, C to three duplex Dorr classifiers. These classifiers are driven from a long countershaft, seen in the halftone, by one 5-hp. Allis-Chalmers motor which is operated on a 440-volt circuit at 1150 r.p.m. The three classifiers and three tube-mills, shown in Fig. 5, C, work in closed circuits. The coarse material from the Dorr classifiers is picked up by a scoop feed and discharges into the tube-mill. It is proposed, however, to alter the tube-mill feeding device and to substitute a spiral screw feed for the present arrangement. The work being done by the tube-mills is shown by the following screen analyses of the tube-mill feed and the slime discharge from the Dorr classifiers which goes to the first set of Dorr thickeners.

Tube-Mill Feed

	Dec. 20.	Jan. 22.
+ 20-mesh	11.5%	9.5%
+ 30-mesh	9.0%	7.0%
+ 60-mesh	14.5%	11.5%
+ 80-mesh	33.5%	23.5%
+ 100-mesh	8.5%	12.0%
+ 140-mesh	7.5%	14.5%
+ 200-mesh	4.5%	9.5%
—200-mesh	10.0%	13.5%
	99.0%	101.0%

The Dorr classifier slime or the product of the tube-mill shows the following screen analyses:

	Dec. 20.	Jan. 22.
+ 60-mesh	0.5%	.....
+ 80-mesh	9.0%	0.5%
+ 100-mesh	5.5%	2.5%
+ 140-mesh	7.5%	7.0%
+ 20-mesh	8.5%	11.5%
—200-mesh	69.0%	78.3%
	100.0%	99.8%

From these two analyses it will be seen that the degree of fine grinding is variable but a mean between these two analyses given would be about the normal practice. At the present time the management is contemplating an increase in the tube-milling capacity by the addition of an extra mill which it is believed will materially increase the present capacity of the plant, which is about 280 tons per day, and will also improve the metallurgical results.

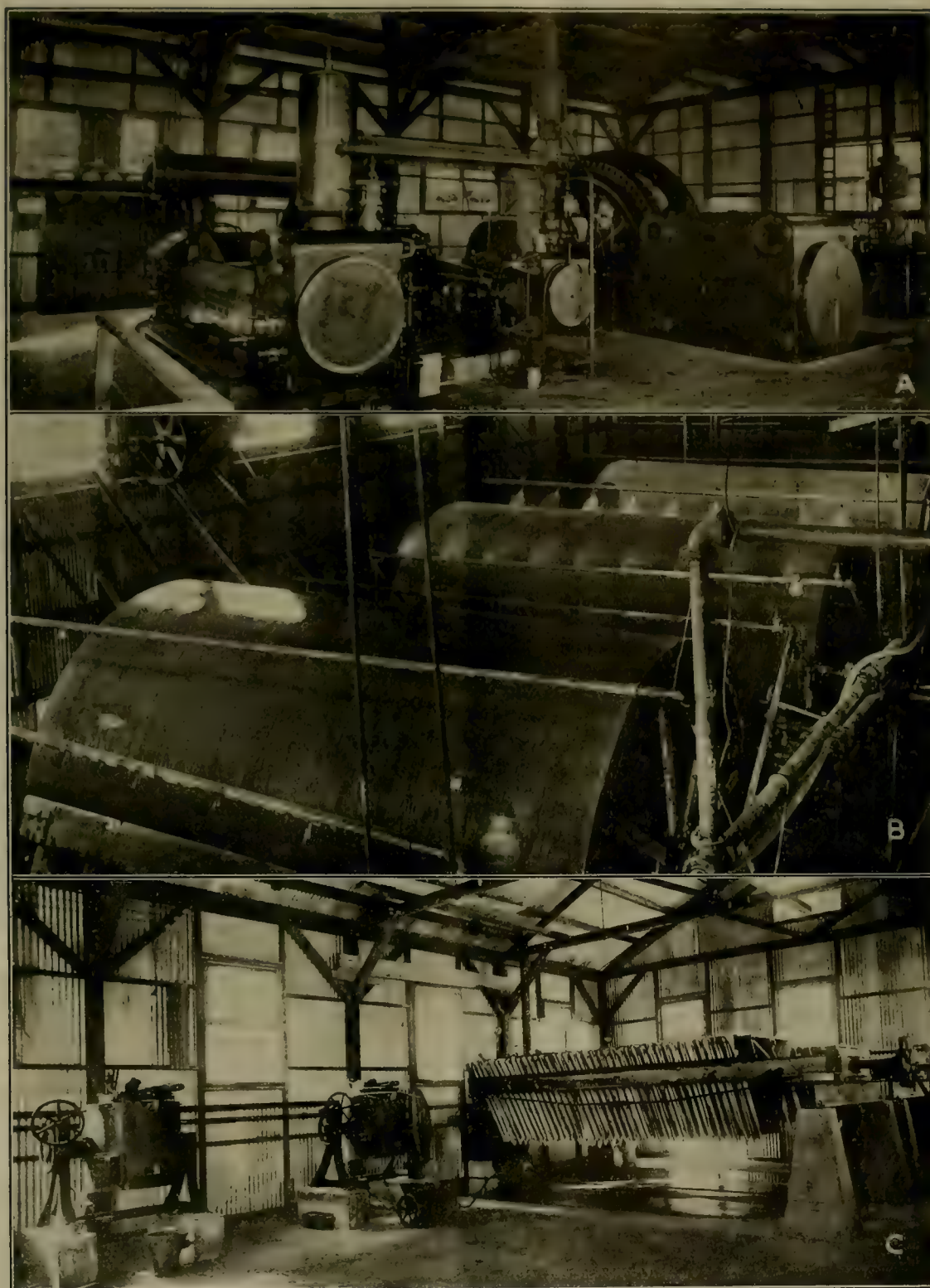


FIG. 6. A, POWER PLANT; B, OLIVER FILTERS; C, PRECIPITATION PRESSES AND SMELTING FURNACES.

Dorr Thickeners

The fine material separated by the Dorr classifiers goes to the first set of two Dorr thickeners. These vats are made of California redwood and are 38 ft. in diameter and 12 ft. high. The two thickeners are driven by one 3-hp. motor which operates at 1130 r.p.m. Lime is added in the feed launders of the Dorr thickeners at the rate of about 13 lb. per ton of ore. The NaCN consumption is about $\frac{3}{4}$ lb. per ton of ore treated.

The overflow from the Dorr thickeners is conducted to a 20 by 10 ft. mill solution return sump, while the thickened discharge is elevated by two air-lifts which are respectively 6 and 8 ft. to the Pachuea vats. The air-lifts are made of 4-in. pipe with $1\frac{1}{4}$ -in. air inlets. It is proposed to replace these air-lifts by diaphragm pumps, as they are not giving the best results. As an emergency pump a 4-in. direct driven centrifugal slime pump for a 20-ft. head driven by a 10-hp. motor at 680 r.p.m. is used. The thickened products are thus elevated to the first two of a battery of 9 Pachuea vats. Seven of these vats are 38 ft. high and 12 ft. in diameter and two are 36 ft. high and 12 ft. in diameter. Continuous circulation of the pulp is maintained through eight of these vats, the other being kept as a reserve. The air for the vats is furnished by a steam driven Ingersoll-Rand compressor with an 18 by 14-in. air cylinder and 12 and 19 by 14-in. steam cylinders. The compressor has a capacity of 1500 cu. ft. of free air per minute which is compressed to 20 lb. pressure. The exhaust steam from the compressor is circulated through coils in the first four of the series of Pachuea vats, the greater number of coils being in the first two vats. In this manner the temperature of the pulp which is being agitated is raised to approximately 85°F. In passing the pulp from one vat to another the cut is taken close to the discharge of the air lift and the launder connection with the next vat discharges at the top and close to the periphery of the following vat in the series. In the operation of these vats no sleeves are used on the air valves.

The discharge from the last of the battery of Pachueas is conducted to the first of two sets of two Dorr thickeners each. These thickeners are made of California redwood and are 42 ft. in diameter and 12 ft. in height. The rabblers are driven by a 3-hp. Allis-Chalmers motor operating at 1130 r.p.m. on a 440-volt circuit. One revolution of the rabblers is made every eight minutes. The overflow from these first two Dorr thickeners is conducted by launders to a 20 by 12-ft. overflow rich solution sump. The feed to this first set of two Dorr thickeners, which is the slime from the Pachuea vats, enters at about $2\frac{1}{2}$ parts moisture to 1 of solids and the thickened discharge from the same contains $1\frac{1}{2}$ moisture to 1 of solids. This thickened discharge is elevated by two air-lifts, these lifts being 6 and 4 ft. respectively and made of 4-in. pipe with $1\frac{1}{4}$ -in. air inlet. After being elevated it is diluted with barren solution to $2\frac{1}{2}$ parts moisture to 1 of solids,

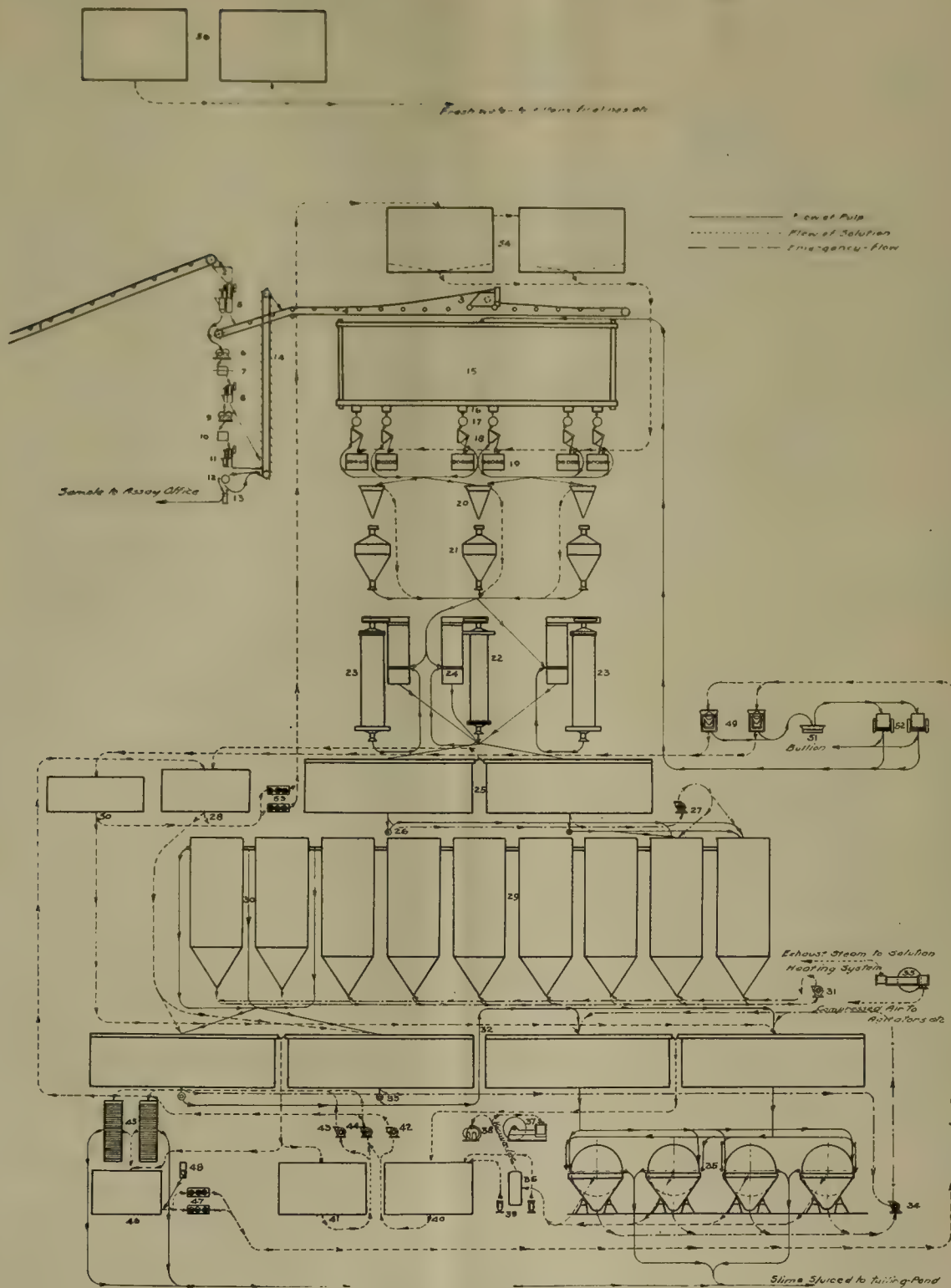
which in turn is thickened in a second set of two Dorr thickeners.

This second set of thickeners is identical in size and equipment to the first set previously described. The slime is thickened in this second set from $1\frac{1}{4}$ to $1\frac{1}{2}$ of moisture to one of solids and is discharged as such into the filter tanks of four Oliver filters, seen in Fig. 6, B. The overflow from this second set of Dorr thickeners is conducted to a 20 by 12-ft. overflow sump for poor solution. Both this and the rich-solution sump are made of California redwood. The solution from the poor-solution sump is pumped by a 4-in. direct-connected Buffalo centrifugal pump against a 60-ft. head to the mill solution return sump. This pump will handle 300 gal. per minute and is driven by a 15-hp. motor operating at 1150 r.p.m. on a 440-volt circuit. A similar pump is held in reserve for the same purpose. It is believed that with the substitution of diaphragm pumps for the air-lifts for elevating the thickened discharge from the Dorr thickeners, a more satisfactory operation of this department will be obtained.

Filtration Plant

The Oliver filters are built in units of two each. The two filters, comprising one unit, revolve in opposite directions, thus bringing the tailing discharge into one launder, which is between the two filters of each unit, through which it is sluiced to the tailing pond. These filters are 11 ft. 5 in. long by 18 ft. diameter, and make $1\frac{1}{7}$ r.p.m. The power for driving them is furnished by a 15-hp. 3-phase Allis-Chalmers motor making 1150 r.p.m. operating on a 440-volt circuit. The capacity of the individual filters is from 90 to 100 tons each. Moisture in the discharge is about 3%. The filters are of the most modern Oliver type and are fitted with the jet atomizers for washing and have both mechanical and air agitation equipment in the bottom of the V-shaped steel filter-tanks. The vacuum of the filters is furnished by a 20 by 12-in. duplex belt-driven dry vacuum pump making 125 r.p.m. The drive for this pump is a 35-hp. motor making 680 r.p.m. and operated on a 440-volt circuit. As a reserve there has also been installed a 14 by 14-in. belt-driven rotary vacuum pump. This pump makes 300 r.p.m. and by shifting the belting is driven by the same motor as the duplex vacuum pump. The filtered solution is drawn into a 36 by 96-in. receiver, from which it is pumped by a 3-in. direct-driven centrifugal pump to the poor-solution sump. This pump is driven by a 5-hp. motor making 1150 r.p.m. and operating on a 440-volt circuit. An identical pump is held in reserve for the same purpose in case of a breakdown.

The solution from the rich solution sump is pumped by a 4-in. direct-driven Buffalo centrifugal pump to two Merrill clarifying presses. These presses are made up of 36 by 36-in. frames and have a capacity of 750 gal. per day. The clarified solution from these presses flows to a 16 by 10-ft. storage tank and from thence is pumped by a Buffalo single acting triplex pump with $8\frac{1}{2}$ by 8-in. cylinders and making 45 strokes per



FLOW-SHEET OF COMMONWEALTH MILL.

minute. This pump will operate against a 120-ft. head and has a capacity of 300 gal. per minute. The pump is driven by a 15-hp. Allis-Chalmers motor making 860 r.p.m. operating on a 440-volt circuit and 19.5 amperes. An identical pump is held in reserve to be used in case of a breakdown of the one in operation.

Precipitation

Zinc dust is added to the solution at the suction end of the triplex pumps and is fed into the solution by means of an improved Merrill zinc-dust feeder fitted with a screw feed. The zinc-dust feeder is operated by a belt connected with the triplex pump, and the pump is automatically started and stopped by means of a float valve in the rich-solution sump which starts the motor when a specified amount of solution has collected in the sump.

The rich solution is thus pumped to two Merrill precipitation presses which are situated in the smelting house, an interior view of which is shown in Fig. 6, C. These presses are made of 38 by 52-in. frames and have a capacity of 750 gal. of clarified solution per 24 hours. The precipitate collected in these presses is removed twice a month and dried in a 6 by 10-ft. steam dryer which consists of a sheet iron pan with steam coils underneath and a screen top which is attached with padlocks. The precipitate, when dry, is fluxed and smelted in two Donaldson tilting crucible furnaces, No. 275, and the bullion cast in bars for shipment.

Power Plant

The power plant, which supplies power for both mine and mill, consists of a battery of 9 boilers, 5 of which are Woods safety tube boilers, manufactured by Fraser & Chalmers. The engine room, shown in Fig. 6, A, contains a 600-kw. generator which is driven directly by an 800-hp. compound Corliss engine. The mine compressor is compound condensing of the Imperial type, with a capacity of 1700 cu. ft. of free air per minute at sea-level.

The crusher house, mill building, store rooms, power plant, melting house, machine shop, and hoist house are all frame structures with concrete foundations and galvanized corrugated iron sidings and roof. Every effort has been made in the construction of the entire plant to minimize the fire risk and so avoid any possible repetition of the two previous disasters. The hillside-millsite has permitted of the utilization of gravity to a large extent in the handling of mill products, while an incline railway is maintained for the handling of mill supplies. The cost of mill construction, as itemized in a recent company report, shows the total amount to have been \$335,271.

From a mechanical standpoint the conduct of milling operations is as near automatic as modern practice has developed and local conditions permit. From a metallurgical standpoint, with increased grinding capacity and a final adjustment of the details of operation, a greater tonnage and increased efficiency is anticipated.

The accompanying flow-sheet presents graphically an outline of the treatment, the equipment, and general arrangement of the mill.

Flow-Sheet

1. Inclined conveyor.
2. Hopper.
3. Automatic self-propelling and reversing tripper.
4. Conveyor to battery-bin.
5. No. 2 Vezin sampler.
6. Crushing rolls.
7. Mixer.
8. Vezin sampler.
9. Crushing rolls.
10. Mixer.
11. Vezin sampler.
12. Quartering floor.
13. Gyrotory grinder.
14. Bucket belt elevator.
15. Battery-bin.
16. Gates.
17. Suspended Challenge feeders.
18. Shaking screens with hoppers for undersize.
19. Stamps battery.
20. Caldecott cones.
21. Hardinge mills.
22. Tube-mills, ribbed lining.
23. Tube-mills.
24. Duplex Dorr classifiers.
25. Dorr thickeners.
26. Air lifts.
27. Emergency direct-driven centrifugal slime pump.
28. Mill-solution return sump.
29. Air agitating tanks, 12 by 38 feet.
30. Air agitating tanks, 12 by 36 ft. (one used as reserve).
31. Emergency direct-driven centrifugal slime pump.
32. Dorr thickeners.
33. Air lifts.
34. Emergency direct-driven centrifugal slime pump.
35. Oliver continuous filters.
36. Receiver for filtered solution.
37. Belt-driven duplex dry vacuum pump.
38. Belt-driven rotary vacuum pump.
39. Direct-driven centrifugal pumps.
40. Overflow sump for poor solution.
41. Overflow sump for rich solution.
42. Direct-driven Buffalo centrifugal pump.
43. Direct-driven Buffalo centrifugal pump.
44. Direct-driven Buffalo centrifugal pump.
45. Merrill clarifying presses.
46. Gold tank.
47. Buffalo single-acting triplex pump.
48. Zinc-dust feeder.
49. Merrill precipitation presses.
50. Barren-solution tank.
51. Steam dryer.
52. Donaldson tilting crucible furnaces.
53. Buffalo single acting triplex pumps.
54. Battery tanks with conical bottoms.
55. Steam driven Ingersoll-Rand Compressor.
56. Water tanks.

A 95-ton steam-shovel which has been used at Panama is to be dismantled and shipped to the Brooklyn navy yard, where it will be re-erected and advertised for sale in the United States. Almost all the smaller steam-shovels retired from the canal work have already been disposed of by the Commission on the Isthmus; but it is anticipated that the larger size shovels can be sold to better advantage in the United States.

The top-slicing system has been adopted throughout for mining the Daly vein shoots, in the Daly-Judge mine, Utah, in all of which the ground is exceedingly heavy, often carrying water. All drifts and raises are run in the footwall. The method has given complete satisfaction; the mining has been clean and no ore is lost.

The Portland Canal Tunnel

By LLOYD C. WHITE

The driving of the Portland Canal tunnel was not an important operation either as to costs established or rate of progress, but, on account of its being the largest undertaking of its kind in the district, the methods and costs may be of interest. The work was carried on by the Portland Canal Tunnels, Ltd., a company with head offices at Victoria, British Columbia. The power-plant of the Portland Canal Mining Co. was leased for the work, and this expense is not included in the following costs. Also the underground equipment is entirely written off.

Purpose of the Tunnel

The portal of the tunnel is situated about $3\frac{1}{2}$ miles north of Stewart, British Columbia, and is 300 ft. above sea-level. The objects of the tunnel are to provide a working entry to the mines located in the Portland Canal fissure zone, and to provide a means of further exploring veins in this zone; also to develop water power.

The heading, $7\frac{1}{2}$ by 8 ft. in the clear, was driven a distance of 2916 ft. at an average rate of 8 ft. per day. The best weekly record was 67 ft., and the best monthly 271 ft. Two 8-hr. shifts per day were employed, consisting of four machine-men and three shovelers. After the 1000-ft. mark was passed, four shovelers were employed. Compressed air at 100 lb. pressure was supplied by a water-driven, 520-cu. ft., Rand class D-2 compressor, and delivered into the tunnel through a 4-in. pipe. Two $3\frac{1}{4}$ -in. Ingersoll-Rand E-44 drills, mounted on a 7-ft. single screw bar were used. Miners and shovelers started work together. The bar was set up above the rock pile, and from 10 to 12 holes were drilled from this position. By this time the rock was out, the bar was lowered, and three lifters were drilled. The first 1600 ft. of the tunnel is in greenstones, while the remainder is in argillites, quartz, and porphyry. With but two exceptions during the entire work, a round was drilled every shift. Five-foot rounds were drilled, but seldom 'bottomed.'

Three 20-cu. ft. cars were used, and tramming was done by the shovelers. The track, of 20-lb. rails, 18-in. gage, and $\frac{1}{2}\%$ grade, was laid on the left-hand side of the tunnel. One switch, about half way in, was used; the empty incoming car was taken off the track near the face to allow the loaded one to pass. At a point 730 ft. from the portal an 80-ft. adit was run, opening into a cañon. This not only made an excellent dumping place, but shortened the tramming distance by 750 ft. The shovelers laid and leveled the track. The floor from within 3 ft. of the face to 40 ft. back was covered with steel plates before blasting. A drain 12 in. deep was made on the right side of the tunnel, the lifter being drilled low for this purpose.

Ventilation was provided by two Schutte & Koerting blowers. The ventilating line consisted of 10-in. diameter, 24-gage, galvanized pipe. The pipe was made in 10-ft. lengths, with riveted joints, painted with tar, and wrapped with muslin. The compressor was run two hours after blasting to clear the tunnel. After the 2000-ft. mark was reached, more or less trouble was experienced with the ventilation, especially in rainy weather. Except in a few places the tunnel was dry, and after the first 140 ft. required no timbering. The writer, who had charge of the work, was the only boss. The tunnel is still being driven, but only as a 5-ft. drift and secondary to exploration on veins found in the tunnel.

Time and Cost of Operations

AVERAGE TIME OF OPERATIONS

	Hr.	Min.
Picking down—Setting up	1	00
Drilling from upper set-up	4	30
Shoveling back—Lowering bar	0	30
Drilling from lower set-up	1	15
Tearing down	0	10
Blowing out holes	0	5
Loading	0	15
Total	7	45

DETAILED SUMMARY OF COSTS

	Total cost.	Cost per foot.
Labor:		
Machine men	\$11,526.00	\$3.953
Shovelers	10,711.00	3.673
Timbering	753.17	0.258
Drainage	123.00	0.042
Ventilation	224.50	0.077
Ties and wedges	394.60	0.135
Compressed-air line	210.00	0.072
Compressor men	3,398.35	1.166
Blacksmith and helper	3,546.50	1.216
Superintendent	2,554.00	0.876
Total	\$33,441.12	\$11.468
Supplies:		
Powder	\$ 7,469.25	\$2.562
Fuse	391.50	0.134
Caps	92.00	0.032
Candles	421.90	0.145
Blacksmith coal	364.50	0.125
Machine drills and parts	1,464.77	0.503
Drill steel	343.57	0.118
Timbers	150.00	0.052
Repairs on compressor	77.40	0.027
Oils	97.00	0.031
Miscellaneous	216.00	0.073
Total	\$11,087.89	\$3.802
Equipment:		
Muck sheets	\$ 110.00	.....
Steel rails	1,290.00	.....
Ventilators	225.00	.....
Ventilating pipe	960.00	.....

Compressed-air line	1,070.00	.....
Cars	400.00	.....
Total	\$ 4,055.00	\$1,391
Length of tunnel		2916 ft.
Total cost		\$48,584.01
Cost per foot		\$16.661

All supplies were bought at Vancouver, British Columbia, and came north by steamship. The prices of some of the more important supplies at the tunnel were as follows: 40% dynamite, \$0.134 per pound; 60% dynamite, \$0.159 per pound (powder was used in about the proportion of 30% of the former to 70% of the latter); 20-lb. steel rails, \$72.24 per long ton; blacksmith coal, \$27 per ton. The scale of wages is as follows: machine men, \$4; shovelers, \$4; blacksmith, \$5; compressor men, \$5.

Lead Smelters and Refineries in the United States

By C. E. SIEBENTHAL

The following list of lead smelters and refineries was compiled in connection with the statistical work of the U. S. Geological Survey.

Arizona:

Mowry—Consolidated Mines, Smelter & Transportation Co.¹

California:

Keeler—Four Metals Mining & Smelting Co.

Needles—Needles Mining & Smelting Co.²

Selby—Selby Smelting & Lead Co.³ Refinery also.

Colorado:

Denver—Globe plant, American Smelting & Refining Co.

Durango—Durango plant, American Smelting & Refining Co.

Leadville—Arkansas Valley plant, American Smelting & Refining Co.

Pueblo—Pueblo plant, American Smelting & Refining Co.

Salida—The Ohio & Colorado Smelting & Refining Co.

Idaho:

Clayton—Red Bird Smelting Co.

Enaville—North Fork Smelting & Mining Co.

Ponderay—Idaho Smelting & Refining Co.

Sea Foam—Greyhound Mining & Milling Co.

Wardner—Bunker Hill & Sullivan Co. (Malm dry chlorination process.) Under construction.

Illinois:

Aurora—Aurora Metal Co.⁴

Chicago—Goldsmith Bros.⁵ Smelting & Refining Co.⁶

Chicago—Great Western Smelting & Refining Co.⁴

Chicago—National plant, American Smelting & Refining Co. Refinery only.

Collinsville—St. Louis Smelting & Refining Co.⁷ Refinery also.

Federal—Federal Lead Co.⁸

Granite City—Hoyt Metal Co.⁴

Indiana:

East Chicago—International Lead Refining Co.⁹ Refinery only.

East Chicago—United States Reduction Co.⁴

¹Not operated for several years.

²Subsidiary of United States Smelting, Refining & Mining Co.

³Subsidiary of American Smelters Securities Co.

⁴Smelters of secondary materials, but treating some lead ore.

⁵Subsidiary of National Lead Co.

⁶Subsidiary of International Smelting & Refining Co.

⁷Subsidiary of American Smelting & Refining Co.

Grassell—United States Metals Refining Co.² Refinery only. Betts electrolytic process.

Iowa:

Dubuque—J. W. Watters.¹

Kansas:

Galena—Galena Smelting & Manufacturing Co.

Missouri:

Desloge—Desloge Consolidated Lead Co.

Granby—Granby Mining & Smelting Co.

Herculaneum—St. Joseph Lead Co.

Joplin—Fischer Lead Co.

Valle Mines—Valle Mining Co.¹

Webb City—Webb City Smelting & Manufacturing Co.

Montana:

Cooke—New World Smelter & Mining Co.

East Helena—East Helena plant, American Smelting & Refining Co.

Nebraska:

Omaha—Omaha & Grant Smelting Co.¹ Refinery only. Betts electrolytic process.

Nevada:

Nelson—Santa Barbara Searchlight Mining Co.

Spruce—Black Forest Mines & Smelting Co.

New Jersey:

Newark—Ealbach Smelting & Refining Co. Refinery also.

Perth Amboy—Perth Amboy plant, American Smelting & Refining Co. Refinery also.

New Mexico:

Deming—National Mining & Smelting Co.¹

Pennsylvania:

Carnegie—Pennsylvania Smelting Co.

Texas:

El Paso—Kansas City Consolidated Smelting & Refining Co.¹

Utah:

Midvale—United States Smelting Co.²

Murray—Murray plant, American Smelting & Refining Co.

Silver City—Tintic Smelting Co.

Tooele—International Smelting & Refining Co.

Washington:

Keller—Keller & Indiana Consolidated Smelting Co.¹

Tacoma—Tacoma Smelting Co.²

Wisconsin:

Dodgeville—Blue Mounds Mining & Smelting Co.¹

Waukesha—Northern Smelting Co.¹

LEAD SMELTERS AND REFINERIES IN CANADA

British Columbia:

Trail—Consolidated Mining & Smelting Co. of Canada (Ltd.). Refining also. Betts electrolytic process.

Ontario:

Kingston—North American Smelting Co. (Ltd.).

Of these the following were not operated in the years 1911 to 1913, inclusive: Con. M. S. & T. Co., Four Metals, North Fork, Idaho S. & R. Co., Greyhound, Walters, Valle, New World, Santa Barbara Searchlight, Black Forest, National, Tintic, Keller & Indiana, Blue Mounds, and Northern Smelting Company.

To obtain an estimate of the value of cyanide bullion at the Lake View mill, Kalgoorlie, the specific gravity of the bars is determined by the following means: a vessel 6 in. square by 10 in. deep, with an overflow spout at the top, is filled with water till it is just overflowing. The bar is then placed carefully in the vessel and the water displaced is collected in another tin and weighed. From the calculated specific gravity, and knowing the approximate composition of the base metal present, the value of the bullion may be determined very closely.

Gold Dredging at Surinam, Dutch Guiana

By J. B. PERCIVAL

The gold gravel deposits in Surinam present many obstacles to the usual methods of mining by means of dredges or hydraulic apparatus. In general, the bucket dredge has given the best results, although lack of capital and the problem of handling the clay caused the temporary failure of three dredges which were in operation on Sara creek, the Saramacca river, and the Gross Concession. A fourth dredge arrived a few months ago, and is now being operated on the placer owned by the Guiana Gold Mining Company.

The boat on the Gross concession was in operation for several months, and produced in January and February 1910, 40 oz. of gold. It has buckets of 2 cu. ft. capacity. Sub-lessees are now at work washing the dredge tailing with 'long-toms' to make estimates of the gold recovery of the dredge. This boat is now situated in the richest part of the gravel deposit in the valley, but the gravel which will be dug later does not contain so much gold. Should this dredge prove to be successful it will afford much useful information to other dredging companies, both with respect to the methods of operation, costs, and recovery.

The dredge of the Guiana Gold Mining Co. was erected near the Colonial Railway to dredge a gravel deposit which lies between the railway and the settlement of the Guiana placer. The ground was prospected, and a map made of about 50 acres of the gold-bearing gravel area. The dredge is now close to the railway in a part of the gravel deposit that prospecting has shown to be the poorest of all the area examined. If satisfactory results cannot be obtained in this place, it will be an easy matter to transport the dredge to another part of the valley. Near the settlement the creek valley becomes narrower, the width being about 70 metres, and here the working places of the sub-lessees began. From this point upward the richness of the creek gravels seems to be assured. There is a quantity of gravel along the creek bed, not less than four kilometres in length and about 50 metres in width, which contains at least 0.1 oz. of gold per cubic metre. The height of the gravel banks is estimated to be one metre. These gold gravel deposits continue westward along the railway, but they have not yet been prospected on account of the lack of a cheap and efficient method of drilling applicable to Surinam conditions. The usual method of digging pits is not applicable here, for the ground is too sticky. The presence of large quantities of clay is a serious obstacle for prospecting and dredging in this and other districts.

In dredging it has been found that no type of bucket exists that is able to dig some varieties of the clay overburden of the Surinam gravel deposits. It is said that in Siam clay has been a serious obstacle in digging operations, but the trench experts overcame this diffi-

culty by lining the buckets with wood. This method did not prove to be very successful when applied to the removal of the clay overburden on the Guiana placer. It was then suggested that automatically discharging buckets should be used and this proved to be a simple and satisfactory remedy. The clay overburden is removed and discharged behind the dredge before the gravel is attacked. The solution of the clay problem greatly helped matters, although it took some time before a practical construction was obtained. It is not expected that the clay will be so tough everywhere, but at any rate it is now known that almost any kind of clay can be dug. In this respect the Surinam dredging industry has overcome a great difficulty, and the way seems open to profitable operations.

The problem of handling the gravel on the dredge was worked out after numerous experiments. At present a gravel-disintegrator (log-washer) and common sluices are in use. The disintegrator consists of a wooden sluice in which the gravel is broken up by means of a revolving axle with fins. In addition a small crusher was used for handling the cemented gravel. Trommels are not satisfactory because the boulders and masses of clay slip through the trommel without being washed or crushed. An experiment of this kind on another dredge proved to be an utter failure. With the machinery and methods in use at present on the Guiana placer a recovery of 1.5 grams of gold per cubic metre is obtained from gravel which in place carried 2.5 grams, according to the prospecting tests.

Dredge Requirements

From the experience obtained by dredging operations in Surinam, it has been found that it is necessary for dredges to be designed to suit the peculiar conditions. The boats must be provided with large buckets in order to remove the overburden at small expense. The overburden should not be raised very high. A low hanging ladder and tumbler is used, and the clay is transferred by a belt conveyor to a distance of 15 or 20 yards from the dredge. The material to be removed by the stacker consists of two-thirds clay and one-third gravel. Relatively small quantities of gravel are handled because the dredging must be done with so much care that the buckets are seldom filled to their capacity. As the upper tumbler is low, the gravel is discharged into a hopper, whence it is carried up to the necessary height by a bucket-elevator. The gravel is thus dug up and dumped twice before the extraction of the gold begins, thus facilitating the disintegration. A crusher must be used for the cemented gravel. To disintegrate the gravel a log-washer is necessary, under which may be placed a trommel. The lumps of clay ejected by the log-washer roll through the trommel and over the tables. The bedrock clay must be caught and subjected to a special treatment for which purpose a small washing machine may be constructed. The success of the dredging operations will largely depend upon the extraction of gold from this bedrock clay.

Bauxite Deposits of France

By AN OCCASIONAL CONTRIBUTOR

Several important companies in France are engaged in the production of aluminum in large plants in Savoy, and another plant is being built for the same purpose. The mineral bauxite (which owes its name to Baux, where it was discovered by the chemist Berthier in 1822) is found in many parts of the world. There are deposits in Hesse and Nassau, Germany; at Neustadt, in Austria, where it was exploited for some years; and the mineral has likewise been found at Carniole and in Styria, at Prichora in particular. A quantity of Dalmation bauxite is exported to Germany from the port of Almissa. The mineral has also been found at Strain, in County Antrim, Ireland, and the British Aluminum Co. works the deposits at Glenravel. Deposits have been found in Australia, New South Wales, and in the United States, where they are being actively worked, as in Alabama, Arkansas, Georgia, and North Carolina.

All the deposits outside of France, says a French authority, are of inferior quality to those of France. French deposits are found chiefly in the Department of Languedoc-Provence (Herauld, Bouches-du-Rhone, Var), where they form a band almost parallel to the shore of the Mediterranean. Bauxite has been found also in the Eastern Pyrenees, in the Ariege and in Auvergne.

Bauxite, which is hydrated aluminum oxide mixed with certain impurities such as silica, iron oxide, titanic acid, and carbonate of lime, occurs in numerous varieties even within limited areas. The two principal varieties are red bauxite and white bauxite. The red or ferruginous is compact, pisolitic, and granular. Because of its low content in silicon it is the variety chiefly used for making aluminum. The white bauxite is very silicious, is found in compact masses, and breaks easily. It is chiefly used for making alum and firebricks, for it is infusible at very high temperatures.

The aluminum content of red bauxite sufficiently pure for industrial purposes varies between 57 and 60%, with 2 to 4% of silicon. That of the white bauxites varies between 58 and 70% aluminum, 2 to 3% of iron, and 12 to 15% of silicon. Of red bauxites an excess of silicon over 3% reduces its value by about 2 francs (38c.) per ton per unit.

Bauxite in Provence and the Languedoc

In Provence and in the Languedoc the bauxite deposits are worked in open quarries and sometimes by underground mining, but it is rare that the depth is more than 50 metres from the surface. The exploitation of the Languedoc deposits was begun in 1873, but does not appear to have been carried on at first with great success. However, later, Mr. Auge discovered in the Saint-Porgoire at Villeveyrac (Herauld) a heavy bed of white production of bauxite and shortly after the Auge Company was formed for the produc-

tion of firebricks and alum. Afterward the increase in silicon content forced the Auge Company to look for fresh deposits, and thus the fine bed of the Var was discovered, where the silicon does not often exceed 3% of the total. The rapid growth of the aluminum industry is causing increased production of bauxite.

Not much need be said of the bauxite deposit in the Eastern Pyrenees. This discovery was made in the year 1906 by an engineer named Helson. He found the mineral in the Saint Antoine de Calamus chain of hills which extends parallel to the Rivesaltes-Quillain line, several kilometres distance from it. The deposits are found in the Queribus and the Calamus gorges on the southern slope of the chain. It would appear that erosion has removed the bauxite from the northern slope. These deposits are unfortunately found to be too rich in silicon to be of great industrial use. It is believed, however, that they might be utilized for the production of firebricks and perhaps also for alum, but they are not over promising at present.

The following table of analysis of French bauxites has been prepared by Francis Laur:

	Water content, %	Silica, %	Titanic acid, %	Iron oxide, %	Lime, %	Aluminum, %
VAR						
Red	12.90	1.75	21.38	3.21	...	60.70
Rose	14.70	19.13	5.11	3.52	0.52	56.96
Lilac	15.09	8.11	3.07	2.85	...	70.80
White	16.10	21.06	3.47	0.95	1.80	53.59
BOUCHES-DU-RHONE						
White	19.80	12.30	3.45	3.70	...	60.20
Red	19.80	2.20	14.00	2.50	...	61.30
HERAULT						
White	15.10	1.60	0.67	3.80	...	78.53
Red	12.50	5.25	24.21	2.28	...	55.51
Rose	15.60	5.95	5.09	2.39	...	70.82
ARIEGE						
Rose	14.79	12.02	4.71	3.32	traces	64.80

These figures are generally correct for average material. The iron oxide may sometimes make up 60% of the bauxite against only 1½% at times, and the silicon also varies in similar degree. The one or the other may disappear altogether, but they are never both absent from the ore. There is a remarkable similarity between the bauxite deposits of the Var, and certain deposits of the region of Loupian (Herauld) remarkably resemble deposits that have been observed in Algeria, at Rouma, and near Oran. It is therefore presumed that bauxite may have a similar origin to iron. Stanislas Meunier believes that bauxite is due to the action of chlorides resulting from the decomposition by heated sea water of the ferruginous clays, but this hypothesis would not apply to the laterites. Like iron, bauxite occurs at various geological horizons.

Washing Gravel at the Mineral Slide Mine

The accompanying illustration shows the method of arrangement of the feed hopper and sluice-box for washing gravel at the Mineral Slide mine near Magalia, Butte county, California. The property is a drift-gravel mine and the material as delivered at the surface through the adit is dumped in the wooden hopper shown in the half-tone, through which it is fed into the



HOPPER AND SLUICE-BOXES.

sluice, where the gold is collected in the riffles in the usual manner. At the present, the operators are washing the gravel down underground with water under pressure and subsequently running it through the sluice-boxes. The method of mining and treatment of the gravel is an experiment at this property, but appears to be promising as a cheap and efficient method for handling the material.

Shipbuilding in the principal countries of the world in 1913 was as follows:

Country.	Vessel.	Tonnage.
United Kingdom and colonies.....	737	2,203,529
Germany	201	618,783
United States	222	288,042
Holland	104	107,371
France	102	251,986
Italy	63	104,166
Denmark	35	41,682
Russia	17	30,684

With the exception of the United States, which showed a decrease of 60,000 tons, all showed an increase over 1912.

Gold output of Charters Towers, Queensland, in 1913 was \$1,470,000 from 78,911 tons of ore.

Tin From Scrap Tin-Plate

Tin is recovered from scrap tin-plate by three methods in Germany, namely, mechanical, chemical, and electrolytic.

In chemical separation, the tin-plate waste is treated at a low temperature with diluted hydrochloric acid, nitric acid, or sulphuric acid solutions and the dissolved tin drops out with the zinc. Other dissolving agencies have been experimented on with varying success. Much more important than either the mechanical or the chemical process is the electrolytic method of detinning. As a rule, hot caustic soda (liquid) is employed as electrolyte (6 to 7% Na₂O). Loosened chips of tin plate packed in wire baskets act as anodes, while the iron bath walls or iron plates suspended therein serve as cathodes. The average tension is said to be 1.5 volts. When separated, the tin is 'spongiform.'

In other processes acid electrolytes are employed. Thus in the older Siemens & Halske process, chips of tin plate, packed in wood-latticed baskets, serve as anodes, the cathodes consisting of tinned copper. The electrolyte is made up of a solution of 1 part of 60% sulphuric acid and 9 parts of water. The density of the current is about 100 amp. per square meter (10.764 sq. ft.) Recently, Siemens & Halske have also been employing an alkaline electrolyte that offers great advantages over the acid electrolytes formerly used. At any rate, it may be safely stated that the electrolytic methods utilizing acid and ferrosulphate electrolytes have not been shown to possess any practical value.

By far the greatest amount of tin-plate waste is now being detinned by the chloride method that Lambotte, of Brussels, was the first to apply on a large scale. (Imperial German letters patent No. 32517.) The principal requirements for a successful application of this method are absolute exclusion of moisture during the process of detinning, avoidance of an unduly high temperature, and proper washing of the detinned waste. The process is protected by Imperial German letters patent No. 176457, 176456, and 188018. Tin plate contains about 2.5% metallic tin.—*Daily Consular Report.*

Dredging at Iditarod, Alaska

The Yukon Gold Co. has a dredge working at this place, and in 203 days of 1913 handled 496,756 cu. yd. of gravel yielding \$1.67, at a cost of 64.33c. per cubic yard. From the beginning of operations this dredge worked under difficulties. The principal causes of the low yardage and high cost may be summarized as follows: steep grade, 6½ to 10%; large boulders; heavy granitic sand from workings above; scarcity of water for flotation, due to the unusually dry season; and the presence of strata of 'gumbo' clay. The grade and sand were the greatest obstacles. A series of dams had to be built, both before and behind the dredge, which greatly increased the expense. The dredge is now down to where the grade is less and the operation more nearly normal.

Discussion

Readers of the MINING AND SCIENTIFIC PRESS are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment. Insertion of any contribution is determined by its probable interest to the readers of this journal.

The Rand Banket

The Editor:

Sir—I observe that a misprint appeared in my communication in the April 11 number of the *Mining and Scientific Press*. Equation (3) should read:

$$r, v' = g'm, m'g.$$

J. S. HOOK.

Ithaca, New York, April 15.

Prospecting and Government Aid

The Editor:

Sir—There is so much sound sense mingled with genial constructive criticism in the letter from F. Sommer Schmidt, published under the above heading in your issue of April 4, 1914, as to deserve thoughtful consideration.

With his plea for more scouting work by the government geologists and for the maintenance of closer touch between them and current conditions in those mining districts on which reports have already been published, I am in hearty sympathy; although he perhaps does not fully appreciate the variety and broad value of certain of the other kinds of work in which the United States Geological Survey is engaged, and is apparently not aware that some progress has already been made along lines which he advocates. For example, during the past year or two a special effort has been made to cover in a reconnaissance way, and to issue brief reports on, those metal mining districts in the western states for which no geologic information was available. It is intended not only to present this information promptly, in brief reports, but to utilize it in general summary volumes on the geology and ore deposits of each state. Such a summary has been published for New Mexico, and others for Utah, Idaho, and Arizona are in various stages of preparation. The new district of Rochester, in Nevada, was visited by a geologist within a few weeks of its discovery and a brief account of the geology and of the character of the deposits was furnished to the press before the geologist returned from the field. His full report is now ready for publication.

Requests for geologic information from groups of prospectors working in undeveloped districts are receiving special consideration, and whenever possible a geologist is sent to examine and report on their district. Such a request was received from Arizona only a few weeks ago, and a geologist is already on the ground.

Old districts are being re-studied in the light of later

developments, these investigations ranging from such a complete re-study as was made of Cripple Creek some years ago, or of Leadville (now nearly ready for publication), to brief notes on new developments, such as are embodied in the Bisbee folio, now being reprinted. Some of the results of a careful re-study of the Tintic district have already been published and the complete report will soon be ready for the printer. Provisional plans for the coming field season include a detailed re-examination of the Mother Lode region, California, with special attention to the problems now confronting the miners along that belt; a visit by a geologist to Eureka and to some other old districts, together with considerable scouting among comparatively undeveloped districts.

The great difficulty, of course, which confronts the Survey in attempting to do all that is expected of it, is want of sufficient funds. The geology of metalliferous districts embraces only a part of the varied activities of the organization, and the territory to be covered is so vast that it is impossible with the present appropriations and staff for the Geological Survey to keep in close touch with all that is being done in the mining districts of the West.

In conclusion, let me heartily subscribe to Mr. Schmidt's belief that the Survey will work in closer and closer touch with the mining men as time goes on. The members of that organization would soon cease to be useful if they lost their capacity for learning any lesson that may make for increased efficiency in the service of the people. Neither they nor mining engineers should forget, however, that one great factor in such usefulness is the opportunity to carry out thorough and comprehensive scientific investigations. When that opportunity is denied and the spirit of scientific research quenched, then the type of men who can be retained in the government service will no longer be such as the Geological Survey has hitherto been able to command. The sound practical application of geology to mining must rest upon a solid substratum of scientific research, and demands such training as rigorous scientific investigation can alone supply.

F. L. RANSOME.

Washington, D. C., April 13.

[We are glad to present this letter regarding the purposes and work of the Survey in the West, from the geologist who is in direct charge of the section of metalliferous deposits.—EDITOR.]

Decline of the Rand

The Editor:

Sir—H. S. Denny's article, 'The Decline of the Rand,' which appeared in your issue of January 3, contains the following: "The Rand, since the introduction of the cyanide process in the early days, has done practically nothing to add to the glory of engineering achievements. It has rather followed a policy of sticking to the one old principle and developing the details

of that principle to the last limit. In my opinion, and I share this with a great many other engineers, the Rand might have saved itself a large amount of capital outlay if it had adopted, immediately after the war, for the treatment of its unusually simple clean ores, what has been accepted all the world over in the past ten years, namely, the one-product one-treatment method."

Mr. Denny's opinions may be shared, as he asserts, "by a great many other engineers," but I venture to say, on equally good authority, that there are many engineers and metallurgists of good repute who do not share them. Mr. Denny's is not a novel or an especially disturbing point of view. He is simply reiterating a somewhat time-worn sentiment—I use the word advisedly—which so long as the Rand continues to exist as a mining field, will make its perennial appeal to metallurgical faddists and extremists the world over, and encourage machinery men and inventors to hope for better times. Popular fallacies die hard; but none seems to exhibit a more enduring vitality than the belief that there is something radically wrong with Rand metallurgical practice. One might suppose, after reading this oracular utterance from overseas, that the metallurgists and engineers of the Rand had resolved themselves into a kind of close corporation for the exclusive purpose of nursing and perpetuating obsolete ideas, and jealously opposing the intrusion of up-to-date principles and methods. Even if this were true, it is difficult to see how Mr. Denny's remedy would have helped the industry. In his opinion, all would have been well if the Rand "had adopted, immediately after the war, for the treatment of its unusually simple clean ores, what has been accepted all the world over in the past ten years, namely, the one-product, one-treatment method." This method (by which I understand the writer to mean the reduction of ore to one product and its treatment as such) has not been adopted on the Rand for the simple reason that nothing would be gained by using it. As a pioneer in the introduction of 'all-sliming' in Nevada in 1905, and a strong advocate of its adoption in certain isolated cases where it was applicable, I came to the Rand greatly impressed by its advantages. But I was soon to be impressed in a different way: I was astonished at the effectiveness and low cost of methods which I had come to look upon as old-fashioned or obsolescent. The huge slime and sand plants spread over acres of ground, certainly did lack the neat and desirable compactness of the modern all-sliming plant. Here, at first glance, appeared a most alluring field for the ambitious innovator. It seemed a tempting opportunity to introduce the latest and newest thing with which one was familiar: in other words, to revolutionize Rand practice and become famous! But I must confess that my ardor soon evaporated in the light of incontestable facts. I could not see that anything was to be gained by 'all-sliming,' or by any other radical sweeping change in local practice. Indeed, the arguments against all-

sliming on this field at the present time are irrefutable. The total extraction being what it is—ranging from 94% in the older plants to 97% in the newer—could only be very slightly increased by fine grinding or sliming the sand, since the coarse sand is the poorest product in the plate residue, and the cost of regrounding this material, as experiments have conclusively shown, would leave an exceedingly problematical net gain. Mr. Denny's allusion to capital expenditure does not apply to the plants of more recent construction, where the amortization of initial cost is by no means the serious item he imagines. And even supposing it were, the "one-product, one-treatment method" would hardly appeal to the practical man as an effective remedy. An all-sliming plant on this field, with the huge tube-mill and filtering additions required, would be an extremely expensive installation. Without recourse to a comparative estimate, it is obviously impossible that the mere elimination of sand plant should offset the cost of the additional fine-grinding and filtering equipment required.

The survival of the old system of separate sand and slime treatment on the Rand is easily explained: it has persisted because it is so admirably adapted to the unique local conditions. At all events, nothing better has been found to take its place. Yet in spite of this safe conservatism, which critics often mistake for stagnation, the metallurgy of the Rand has in recent years made solid and distinct progress. The introduction of tube-mills, heavy stamps, vacuum-filtration, and air-lift agitation, are notable among a host of lesser innovations; but it is significant that every deliberate attempt to effect radical changes in our metallurgical system has met with disastrous failure. This is not due, as is popularly supposed, to any niggardly or obstructive policy on the part of the mining houses. Vast sums have been willingly spent on fanciful installations and processes which have lamentably failed, and it is only fair to those companies who have suffered through their amiable credulity, to state their attitude, in the face of overwhelming losses, has usually been most patient and generous. I venture to say that at the present time there is no mining field in the world where more enthusiastic interest is evinced in innovations of real value. But the Rand mining companies, after many costly experiences, have become wary; like the Missourian, they must be 'shown.'

F. L. BOSQUI.

Johannesburg, March 17.

The Strassburg hospital and university some time ago bought 200 milligrams of radium at \$76 per milligram, and has bought 100 milligrams more, which will cost at present prices \$98 per milligram, or at the rate of \$3,000,000 per ounce troy.

Gold received for coinage at the Australian mints during 1913 was as follows: Melbourne, 555,321; Perth, 1,490,933; and Sydney, 540,283 fine ounces.

Concentrates

Most of these are in reply to questions received by mail. Our readers are invited to ask questions and give information dealing with the practice of mining, milling, and smelting.

Opal mined in New South Wales in 1913 was worth £29,493.

Steam-shovel work at the Nevada Consolidated Copper mines cost 17.75c. per ton in 1913.

Mining costs in the Flat River lead district, Missouri, average 85c. per ton.

Ore mined at Broken Hill in 1913 was 1,744,177 tons, an increase of 104,518 tons over 1912.

The first run at the new Cam & Motor 500-ton mill in Rhodesia, resulted in the treatment of 10,693 tons yielding \$7.58 per ton.

Dredges in New South Wales in 1913 recovered gold and tin worth £104,177 and £239,958 respectively. Since 1900 the totals have been £3,097,977 and £1,513,026.

An unusual arrangement of shafts is at the Messina copper mine, Transvaal. For several reasons, two main shafts have been sunk within 50 ft. of one another.

Gasoline is extracted from natural gas by two stages of compression of the gas to 350-lb. pressure, the yield being from 1½ to 4 gal. per 1,000 cu. ft. of gas treated.

Ore broken in the Broken Hill South mine in the latter half of 1913 was 97.3% by contract, 0.2% by wages, and 2.5% by development work. Miners earned from \$4 to \$4.76, and trammers from \$3.20 to \$3.46 per 8-hr. shift.

Actual Recovery at the sand and slime plants of the Ooregum mine, India, in 1913 was 70 and 95% respectively. Consumption of cyanide was 0.48 and 0.78 lb.; caustic soda, 0.71 lb., and zinc, 0.08 and 0.21 lb. per ton respectively.

Analysis of crude oil refined by the Midwest Oil Co., at Casper, Wyoming, is as follows: gasoline, 18.92% at 62°B.; naphtha, 2.75% at 52°B.; kerosene, 24% at 43°B.; mineral seal, 3% at 37°B.; gas oil, 17.5% at 35°B.; wax oil, 15% at 30°B.; and tar 16 per cent.

Reverberatory furnaces at the Steptoe Valley plant, Nevada, had a capacity of 481 tons of charge per day in 1913, against 371 in 1912, and 262 in 1911. The larger furnaces have not shown a reduction in the oil ratio, but show better costs on account of a large tonnage and less labor required.

Many miners and millmen have an idea that the porphyry copper ores of the great American mines con-

tain no precious metals. In treating such large tonnages, these certainly add to the revenue. During 1913, the Nevada Consolidated treated 3,139,137 tons of ore averaging 0.013 oz. gold and 0.034 oz. silver per ton. The recovery was 12.32c. per ton for both metals, with an extraction of 43.87 and 57.83% respectively. The total revenue from gold and silver was \$557,987.

Several methods are available for the purpose of preventing bullion from adhering to the ingot mould into which it is poured. The mould may be oiled with a light oil and any excess wiped away, or the inside of the mold be chalked. Perhaps the surest and simplest way is to invert the mould and rest the extreme edges on a couple of bricks, and light a small wad of oily waste underneath. In a short time the inside of the mould will be evenly coated with lampblack, which forms an excellent protection against adhesion of metal to the mould.

Ordinary valves or cocks are unsuitable for use in connection with the regulation of the underflow of settlers or classifiers. A preferable arrangement is to follow a valve, capable of opening to the whole width and shape of the discharge pipe, with a Bunsen valve. This latter consists of a short length of rubber-canvas hose fitted with a clamp. During operation the main valve is open and the rate of flow regulated by the Bunsen valve. In reducing the flow by means of the latter contrivance the hose is restricted in cross-section, but no sharp edges are formed which would, if present, favor the accumulation of solid material and possibly result in a chokeage of the outlet. The main valve is useful at times when it is necessary to entirely close the underflow for the purpose of repairing the Bunsen valve, or for other reasons.

A transparent liquid, having a specific gravity which may be regulated, and which may be made to exceed that of quartz, is of value in the preliminary work which is incidental to the treatment of most ore. Such a liquid may be made by saturating a small amount of water with potassium iodide. Mercuric iodide is then added in small quantities at a time, and as long as it dissolves. When a point of saturation is reached with the mercuric iodide, the solution is again in a condition to take up more potassium iodide. The addition of potassium iodide and mercuric iodide is then repeated in the sequence described until the desired specific gravity is reached. A sample of the ore under examination, and ground to various degrees of fineness, may be tested in a small test-tube with the liquid described. If the solution is correctly proportioned, the quartz will float on the surface of the liquid; middling containing, say, quartz and pyrite, will remain suspended according to specific gravity; and the heavier mineral will sink to the bottom. A magnifying glass will then afford a means of rapidly arriving at a conclusion with regard to the probable effect of finer crushing, and a reliable forecast of concentration results may be made.

American Electrochemical Society Meeting

[For metallurgists interested in copper, perhaps the most significant paper read before the recent meeting of the American Electrochemical Society was the address by Mr. Smith, in which was discussed frankly and fully the negative as well as positive results of the work done in perfecting a leaching process at Chuquicamata. The mine has already been described in the *Press*. We give below, with only incidental condensation, Mr. Smith's paper discussing the metallurgy.—EDITOR.]

LEACHING AND ELECTROLYTIC PRECIPITATION OF COPPER AT CHUQUICAMATA

By E. A. CAPPELEN SMITH

The Chuquicamata copper mine is at Chuquicamata, a station on a branch of the Antofagasta and Bolivia railroad, in the province of Antofagasta, Chile, between 22 and 23° south latitude. Chuquicamata is 165 miles by railroad from Antofagasta, and 82 miles in a straight line from the coast, at an altitude of 9500 ft. above sea-level. The deposit has long been known as the atacamite deposit of Chile, and for many years past has been mined by the natives. As evidence of their operations, there are found in the old workings many stone utensils such as hammers, and even mummies.

The deposit consists of bronchantite, contained in the cleavages of granodiorite, mixed in part with chalcantite and to some extent with atacamite, and associated with a deposit of salt. A small amount of *caliche* containing nitrates is also present in the upper layers of the orebody.

The so-called *llampera* orebody extends for a distance of approximately 8000 ft., with an average width of about 500 ft. Throughout the whole length of the deposit numerous adits have been run and a very large quantity of ore has been left on the dumps from these tunnels. From the adits, raises have been made almost to the surface, leaving in places a shell over the workings 8 to 12 in. thick. A few shafts have also been sunk in the ore deposits, the deepest one to a depth of 110 metres.

ACQUISITION AND DEVELOPMENT OF THE PROPERTY

The property was acquired by Albert C. Burrage, of Boston, who, in connection with the firm of Messrs. M. Guggenheim's Sons, formed the Chile Exploration Co., which Company now owns the property. The property has been explored by churn-drilling, which has developed an orebody in excess of 200,000,000 tons. Most of the drill-holes, however, were stopped while the bottom of the hole was still in ore.

The general strike of the orebody is north and south. Lately a number of drill-holes have been sunk at a considerable distance west of the *llampera*, and after going through from 300 to 400 ft. of capping chalcocite, and chalcopyrite have been found, giving indications of a very materially increased tonnage over that reported up to date. In the *llampera* zone, of the 200,000,000 tons of ore so far developed, approximately two-thirds is bronchantite and one-third sulphides. No change in the formation has been shown, even in the deepest drill-holes, the ore still appearing to be in the cleavages of the granodiorite. The lower drill-holes show primary ore. From the amount of ore developed and indicated, it appears that the Chuquicamata mine is probably the largest copper deposit known today.

It was generally assumed that this large and well-known deposit of ore was atacamite, and as such could not be treated at a profit by any of the established methods: first, on account of the highly silicious nature of the ore and the absence of sulphides and water, and, second, on account of the volatilization of the copper chloride in smelting. It was demonstrated that the mineral was not atacamite {oxy-chlo-

ride} but bronchantite (oxy-sulphate), and that mixed with the bronchantite in the upper parts of the orebody was a deposit of salt. The bronchantite, being an oxy sulphate of copper, is insoluble in water, but very readily soluble in dilute sulphuric acid. It was therefore evident that the way to treat the bronchantite orebody would be by wet methods.

PRELIMINARY EXPERIMENTS

About 600 tons of the oxidized ore, representing, as nearly as could be judged, a fair average of the oxidized orebody, have been shipped to New York for experiment on a small scale. At first, tests were run on a very small scale, and gradually—as promising results were obtained—on a somewhat larger scale, treating about two tons of ore per day. The average content of the ore thus treated was somewhat in excess of 2% copper. The main problems which presented themselves for solution were: (1) the solubility of the copper minerals in sulphuric acid; (2) the amount of chemicals required as dissolving agents; (3) the amount of impurities which would enter the solutions; (4) the precipitation of the copper from the solutions obtained.

The principal developments in the solving of these problems may be briefly summarized as follows:

1. *Solubility of the Mineral*.—Experiments conducted on a small scale disclosed the fact that the copper-bearing mineral was very readily soluble in a cold dilute sulphuric acid solution, and that only comparatively coarse crushing would be required.

2. *Chemicals Required*.—After prolonged experiment, it was found that the ore yielded enough sulphuric acid, from the decomposition of the copper sulphate present in the bronchantite, to more than make up the losses in sulphuric acid in the operation. The losses of acid occur mainly in two stages—first, the loss due to dissolving other components besides copper from the ore; and, second, due to wasting of solutions through discarding of the tailing.

3. *Impurities Entering the Solutions*.—Experiments extending over a long period of time have shown that no deleterious amount of impurities will accumulate in the solution, other than the chlorine derived from the salt deposit mixed with the mineral in the upper parts of the orebody.

4. *Precipitation of the Copper*.—The experiments conducted in our experimental plant have shown conclusively that electrolytic copper of the highest grade can be produced from the sulphuric acid solutions obtained.

EXPERIMENTAL LEACHING

After completing a number of leaching tests on a laboratory scale, and after running a number of tests with 100 kilos of material each, experiments were made on a larger scale, and a plant was built of sufficient size to treat two tons of ore per day. In this plant there have been treated 131 charges of ore, and it has been run entirely as a self-contained unit; leaching the ore, washing it, purifying and electrolyzing the solutions obtained, and leaching the following lots of ore with the electrolyzed solution from previous charges.

In this plant were treated ores representing the general character of the oxidized orebody at Chuquicamata; some high in copper, others low in copper; some high in impurities, others low in impurities; and enough runs were made to test the method on both high and low-grade ores, and on ores containing large amounts of salt as well as smaller amounts of salt, this being the principal impurity in the orebody. The salt deposit, however, is confined to the upper 50 ft. of the orebody, and principally to the first 25 feet.

In order to make sure that the method should be tested under the most adverse conditions, the same solution was used

over and over again for the treatment of the 131 charges of ore, only setting aside enough solution to allow for the excess acid. A complete analysis of this solution was then made and showed the following contents:

	Grams per litre.
Cu	50.44
Fe	3.71
Mn	0.07
As	nil
Sb	nil
CaO	0.80
MgO	3.32
Al ₂ O ₃	1.61
Na ₂ O	21.60
K ₂ O	5.00
SO ₃	122.75
Cl	11.52
Free acid (as H ₂ SO ₄)	28.00
Total solids on ignition	189.40
Nitric acid	4.00

The results obtained when using the solution which had previously treated 131 charges of ore were just as good as the results with the solution made from sulphuric acid and water. In other words, the accumulation of impurities has been proved to have absolutely no effect whatever on the results obtained. The average extraction obtained in this 2-ton plant was 90.99 per cent.

Following the experiments in the 2-ton plant, a leaching tank was built of concrete, lined with mastic asphalt, having a cross-section of 4 by 6 ft. and 15 ft deep, holding 15 tons of ore, this allowing the use of the full height of ore column since adopted for the plant now building at Chuquicamata. [See *Mining and Scientific Press*, April 11, 1914, p. 620.] The question to be decided was whether it was feasible to leach the ore in tanks of this depth. Extensive experiments gave results confirming those obtained in the smaller tanks.

A wooden filter bottom with cocoa matting on top has been employed in the 2-ton tanks and in the 15-ton tank, although a great number of tests were made without any filter bottom, simply placing a piece of cocoa matting over the outflow pipe. All tests were made without applying any extraneous heat. The washing of the ore was by the so-called 'piston' method, with a final water wash, and the tailing discharged contained an average of about 12% moisture, and about 0.04% water-soluble copper.

EXTRACTIONS OBTAINED

The leaching results obtained up to date are as follows:

Percent.

The average extraction while treating the ore in lots of 100 kg. each was	90.62
The average of 131 charges treated in the 2-ton plant shows an extraction of	90.99
The average extraction obtained in the 15-ton tank, while treating 25 charges leached to date, has been	90.96

These results are based on the weight and sampling of the ore as charged into the tanks, and the weight and sampling of the residue discharged from the tanks.

By combining all of these results and taking the copper content based on the weight and sample of the ore treated, as against the copper produced in the electrolytic tanks in the form of cathode copper, together with the copper held in solution as copper sulphate, the extraction was 89.6%.

AMOUNT OF CHEMICALS REQUIRED

After having supplied the amount of sulphuric acid required to start the operations, it was found that not only was no further acid required, but that excess acid was produced from the sulphuric acid contained in the ore itself, to such an extent that an actual gain is shown of approximately 9 lb. of

acid (H₂SO₄) per ton of ore treated. In other words, it will be necessary to discard an amount of solution equivalent to this gain in acid in order to prevent the acid from accumulating in the process. This gain in acid was made while treating an ore averaging a great deal higher in salt than even the average of the upper layers of the orebody at Chuquicamata will show. As the greatest loss of acid is in forming sodium sulphate, I believe that a still larger gain in acid will be shown when treating the average orebody.

IMPURITIES IN SOLUTION

Of the impurities accumulating in the solution, the principal elements, outside of the chlorine present, are nitric acid, alumina, iron, and alkali salts. After more than a year's work with the same solution, discarding only enough solution to take care of the excess acid, the following impurities were present:

	Grams per litre.
Fe	3.71
Mn	0.07
As	nil
Sb	nil
CaO	0.80
MgO	3.32
Al ₂ O ₃	1.61
Na ₂ O	21.60
K ₂ O	5.00
Nitric acid	4.00

This amount of impurities is insignificant so far as their effect upon the leaching and electrolysis is concerned. The main impurity in the solution is the chlorine obtained from the salt in the upper part of the orebody. It was at first thought desirable to electrolyze direct the solution containing the chloride, and it was found perfectly feasible to do this in covered electrolytic tanks, maintaining a slight vacuum so that the chlorine gas was all drawn off through fans. However, it was also proved that only a part of the chlorine was eliminated in this manner and that an appreciable quantity was deposited with the cathode copper in the form, probably, of cuprous chloride.

Various methods of precipitating cuprous chloride were tried, and finally shot copper, placed in a revolving drum, was adopted as the most satisfactory method. The cuprous chloride, forming on metallic copper, sticks tightly to the copper shot, and it was found necessary to present continuously clean surfaces of copper in order to maintain an effective precipitation. After trying out several methods, it was decided that the best apparatus for this purpose would be revolving drums similar to tube-mills, through which the solution would be passed in contact with the shot copper contained in the drums, as in this way the copper, rubbing against itself, continuously presents a clean surface. Precipitation with cuprous oxide was also tried and worked very well except that the efficiency of the copper in this form as a precipitating agent was found to be very much lower than that of metallic copper, even allowing for the theoretical difference.

The cuprous chloride produced may be treated in several different ways. It is now intended to filter-press the settled cuprous chloride, mix the filter-press cakes with limestone and coke, and smelt the product thus obtained, producing metallic copper and calcium chloride as a slag. A number of experiments have been conducted with this mixture to establish the reaction, and it has been found that a very liquid slag of calcium chloride is produced containing a very small amount of copper, and that in this manner it is perfectly feasible to smelt the cuprous chloride without any loss by volatilization. Some small-scale experiments have also been made looking to the electrolytic treatment of the cuprous chloride, and later on it may be possible that this latter method will be adopted, if found more profitable, in preference to the smelting method.

PRECIPITATION OF THE COPPER

The solution, freed from its chlorine content, is now electrolyzed, using insoluble anodes, and ordinary copper cathode starting sheets. After a vast amount of experimenting, it was decided to employ an insoluble anode made of magnetite. Various other anodes have been tried with more or less success, but after having investigated all the possibilities, it was decided to use magnetite anodes. Experiments with these anodes have extended over about a year and a half, and no material amount of chemical wear on the anodes has been found. The magnetite anodes which have been adopted are manufactured by a secret process by the Chemische Fabrik Griesheim Elektron of Frankfurt, Germany. The nature of the material naturally gives a brittle anode. However, as it will not be necessary to handle the anodes after they are installed in the tanks, this is not a very decided drawback.

At first a number of difficulties were encountered in the efforts to secure an even current distribution and proper suspension of the anodes, but all of these obstacles have been overcome and it is believed that a very serviceable anode has been developed. The anodes themselves are hollow castings with a wall thickness of approximately $\frac{1}{4}$ in., and have a thin electroplated copper deposit on the inside. As I am not myself familiar with the methods employed in the manufacture of these anodes, I am unable to give any further information on this point. I can only state that after months of continuous operation the anodes have been found entirely satisfactory for their purpose.

The copper cathodes produced from the electrolysis are of the usual quality of cathode copper—in fact, a little better—as in this particular case no arsenic or antimony, usually the most deleterious impurities in cathode copper, is present in the solution. The solution will enter the head tank of the electrolytic system containing approximately 5% copper and $2\frac{1}{2}$ to 3% free acid, and will leave the last tank of the cascade containing about 1.5% copper and 8 to 9% free acid. Within these limits it is always possible to produce a good hard cathode, equal to or better than the usual standard. The electrolytic tanks used during the experiments were made of concrete lined with mastic asphalt.

DESIGN OF PLANT NOW BUILDING AT CHUQUICAMATA

On account of the very large orebody already developed at Chuquicamata, the first unit of the plant now building has been designed to treat about 10,000 tons of ore per day. The electrolytic refinery will have a capacity of about 335,000 lb. of copper per day. The ore will be mined by steam-shovels, practically no stripping being necessary. The ore will be transported to the mill, distant about $2\frac{1}{2}$ miles from the mine, in standard American gage railroad cars of 60 tons capacity each.

Arriving at the plant, the ore will first pass through gyratory crushers, thence through 48-in. Symons disc crushers, and finally through Garfield rolls until a product is obtained of about $\frac{1}{4}$ -in. mesh. The ore will be carried on conveying belts from the crushing plant, after sampling, to the leaching vats. Each of the leaching vats has the following dimensions: 110 ft. wide, 160 ft. long, and 16 ft. high. The leaching vats, six in number, will be placed end to end. The belt delivering the ore from the crushing plant will be discharged into the leaching vats with the aid of an electric traveling bridge, spanning, and traveling the entire length of, the leaching tanks. The leached and washed residue will be removed from the leaching tanks by a 15-ton grab bucket traveling on an unloading bridge, and, after sampling, will be delivered upon a conveying belt for disposal to the tailing dump. The tanks are being built of heavily reinforced concrete, and will be lined with mastic asphalt $1\frac{1}{2}$ in. thick. This tank lining has been developed by the Vulcanite Paving Co., of Philadelphia, and consists of a specially refined Trinidad asphalt mixture, to which is added crushed quartz or granite.

In the experimental plant, where this lining has been in use for considerably more than a year, both in the leaching and electrolytic tanks, absolutely no difficulty—not even a single leak—has developed. The material has been tested at a temperature of 50° C. without finding any signs of softening, and as this is far beyond the range at which it is intended to operate, tests at higher temperatures have not been made, although the temperature limit, so far as softening is concerned, will probably lie somewhere between 50 and 70° C. Tests have also been made to try the strength of this material from a physical standpoint, and in one case a 250-lb. cathode was elevated about five feet above the bottom of the tank and then dropped in such a way that one of the sharp corners of the cathode hit the bottom of the mastic asphalt lined tank. In this case, a piece of the lining about $\frac{1}{4}$ in. thick and 2 ft. in diameter was broken away, and as far as could be seen the tank lining was just as good as ever. The material has been tested in strong and weak acid solutions, and found to be absolutely unattacked.

From the bottom of the leaching tanks the solution will be removed through eight 6-in. openings equally distributed over the tanks. A filter bottom, consisting of two layers of 2-in. planks with a layer of cocoa matting between, will be employed. This filter bottom will be raised 4 in. above the bottom of the tank. For the main solution circuits, 9-in. and 16-in. lead lined iron pipe will be used. Open boot horizontal centrifugal pumps, made of type-metal, will be used for pumping the solutions. The pumps will have a capacity of 550 cu. ft. per minute, elevating to a height of 60 ft. In the leaching plant, the cycle of operation will require approximately six days, of which one day will be occupied in filling the tank, two days in leaching, two days in washing and draining, and one day in discharging.

The solutions will be conducted to the leaching tanks by gravity from nine solution-storage tanks placed above the leaching tanks. The dimensions of these solution storage tanks are as follows:

Two tanks, 12 by 130 by 150 ft.

Seven tanks, 12 by 70 by 150 ft.

From the strong-solution tank, the solution will flow by gravity through the dechlorinating plant, consisting of twenty-one 30 ft. long by 4 ft. inside diameter revolving steel drums lined with earthenware. These drums will be half full of shot copper. From these drums the solution, containing the cuprous chloride in suspension, will flow to seven Dorr thickeners made of concrete and lined with mastic asphalt. The clear solution overflowing will travel by gravity to the electrolytic refinery, while the thickened cuprous chloride, together with approximately 1% of the original solution, will go to filter-presses.

The electrolytic refinery will consist of 510 electrolytic tanks of the following dimensions: 19 ft. long, $3\frac{1}{2}$ ft. wide, 4 ft. 10 in. deep. They will be made of concrete, lined with mastic asphalt, and will be set through the floor, having inspection aisles underneath and a concrete working platform between the rows of tanks. The tank-house will be of concrete and steel construction. Of the 510 tanks, 30 will be used for making cathode starting sheets, and the rest, 480 tanks, will be used for electrolytic deposition of the copper from solutions. The tanks will be arranged in five electrical circuits, with 96 tanks to a circuit, and will be divided into 30 solution circuits, the solution in each circuit flowing through 16 tanks placed *en cascade*.

The anodes, made of magnetite, will be 5 in. wide, 2 in. thick, and 4 in. long, placed five to a bar. The cathodes will be 3 ft. wide by 4 ft. deep. The spent electrolyte, containing about 1.5% copper, will be pumped back to the storage tanks to be used for leaching subsequent charges of ore. The cuprous chloride from the dechlorinating plant will be smelted and cast into shot copper for use in the dechlorinating drums.

Special Correspondence

JOPLIN, MISSOURI

OPERATORS ORGANIZE TO IMPROVE SANITARY CONDITION OF MINES.

—NEW PROPERTIES OPENED BY THE ST. JOSEPH, T. COOPER, PITCHER LEAD, AND OTHER COMPANIES.

Operators have organized to prevent the spread of contagious diseases in the mines. Miners' consumption has caused many deaths throughout the district in recent years. Richard Polehmus, field manager for the American Zinc, Lead & Smelting Co., who left the Joplin district several years ago to look after the Company's holdings in Tennessee, returned for a few days in April and addressed a meeting of operators who were gathered to discuss plans for improving the sanitary condition of the mines. "Out of hundreds of men employed at the Company's mines five years ago, less than 50% remain," said Mr. Polehmus, "and new workmen have taken their places; the old boys are either gone to their reward or are invalids for life." The first important step taken as a result of the cooperation of producers will be the

Cooper & Co., who hold a lease of the Johnson land, northwest of Joplin. The operators are interested in the Joplin-Kentucky mine on the St. Louis-Joplin Lead & Zinc Co.'s property, adjoining the Johnson land on the southeast. They have tested their Johnson property lease with several drill-holes, 'pay dirt' being encountered from 140 ft. down to about 200 ft., with some lead in the upper ground, into which orebody the concern is now breaking in a new shaft which is being sunk. The lead ore carries a high grade of galena. A steam hoist is used. The shaft will be continued down to the blende formation.

The Picher Lead Co. is conducting a quiet drilling campaign on 2000 acres of land at Miami, Oklahoma. Although several dozen drill-holes have been sunk, the Company has given out very little concerning its discoveries. Operators on the ground report fairly good blende and galena. The field of activities is in a virgin part of the Miami district. Five drill rigs are at work.

A coal vein is being worked by John Newlin and associates, who hold a small lease on the American Zinc, Lead & Smelting Co.'s land at Midway Camp, northeast of Joplin. The coal is found at 28 ft. It was blocked out at several points by drilling. Zinc ore is found beneath the coal. The operators will use their own fuel in operating their hoist



GENERAL VIEW OF JOPLIN DISTRICT BETWEEN WEBB CITY AND ORONOGO.

use of sprayers in drilling hard ground. Particles of flint rock, breathed into the lungs of the workmen, have caused the majority of cases of tuberculosis. Another step will be the introduction of individual canteens to take the place of the old-style water keg, from the bung-hole of which everyone drank regardless of the nature of any particular malady from which he might be a sufferer.

Mill No. 1 of the American Zinc, Lead & Smelting Co. at Carterville, Missouri, has resumed operations after a shutdown of several months. Three of the Company's four plants at Carterville are now in operation; ore containing about 2% blende and lead is treated, the recovery from the three plants now in operation being about 600,000 lb. of blende concentrate and 180,000 lb. of lead concentrate per week. The Company ships most of its zinc output to its own smelters.

The St. Joseph Mining Co. is developing a new property on a 40-acre lease of the Connor land, northwest of Joplin. The lease adjoins the Dundas Mining Co.'s lease on the east. Three drill-holes on the St. Joseph ground showed blende and galena from 90 to 208 ft., and a shaft is now into ore at a depth of 125 ft. In the Company are David M. Sayers, of Joplin; J. W. Grounds, of Kansas City, Missouri; and J. M. Legris, of Kankakee, Illinois. A steam hoist has been installed and mining operations commenced. The formation is typical of the 'Chitwood' district, the blende and galena crystals occurring in a conglomerate mass of chert, closely cemented to flint boulders and to 'sugar rock.' Above the ore formation is a substantial cap-rock of limestone.

A most promising property is being developed by Thos.

and pumps while they sink to the lower ground for ore.

The Durston Mining Co., west of Galena, is handling surface accumulations of several decades. A mill of 250-ton daily capacity has been constructed on the McElroy land, and a number of narrow-gage tracks run in various directions from the mill to reach the many old dumps on the ground. Shallow mining on this land has been in progress for over 25 years. As hand-jig plants were used almost exclusively in the early days of that camp, a heavy percentage of blende, in the large boulders, was lost. These are being milled and the recovery is averaging more than 2%. Also the operators are skimming the entire surface of the lease for a depth of 8 to 14 in., this top part being 'made' ground resulting from the accumulation of sediment for many years. This dirt as it is now being worked yields about 2% in blende concentrate.

ISABELLA, CALIFORNIA

WORK AT THE MAMMOTH MOUNTAIN MINE, KERN COUNTY.—THE KEYS AND BIG BLUE MINES.

The erection of a complete 10-stamp mill has just been completed at the Mammoth Mountain mine, 4 miles southwest of Isabella, Kern county, and is now in operation. At present, however, only one shift can be operated, owing to the shortage of water; that available being drainage from the mine, which is only equivalent to half a miner's inch. The water is lifted from the shaft by a Dow triplex motor-driven pump and is conducted through the main adit to a

large tank above the mill, with a capacity of 22,000 gallons. A new concentrating table is on the ground, but has not yet been installed, it being thought unnecessary, owing to the low percentage and grade of the pyrite in the ore. The mine is equipped with a 50-hp motor-driven Erie No. 4 compressor and Leyner and Ingersoll machine-drills. An electric hoist is used in the shaft. Ore is being broken in the stopes above the 400-ft. level, and a crosscut is being driven from the 600-ft. level, the present shaft bottom, to the vein. The vein averages about 4 ft. in width and is quartz, sometimes intermixed with an altered granite, the wall rock being granite. Above the 400-ft. level the vein divides, about three feet of profitable ore being on the hanging wall. On the foot-wall the dip of the vein alters about 5°, and a strong body of red oxidized quartz, impregnated rather freely with arsenical pyrite, continues to the surface. This foot-wall vein is being stoped with machine-drills, the shrinkage system being employed. The vein strikes northeast and southwest approximately, the hanging wall vein dipping 85° to the southeast, the foot-wall vein dipping about 80°. The hanging wall vein has been worked profitably to the 300-ft. level, but has been temporarily abandoned, so much ore of better value being in sight. Driving ahead on the 400-ft. level is under way, and at a point 1500 ft. along the strike of the vein and 500 ft. from the shoot which is now being stoped another shoot has been cut, which will be stoped as soon as the mill is in shape to work three shifts. A. G. Kealing is in charge of the property.

At the Keys mine, nearly a mile northwest of the Mammoth, several men are developing and stoping ore. The 5-stamp mill is running steadily on a fair grade of ore. The mine is equipped with a small compressor and machine-drills, but at present all of the stoping is done by hand. The manager, Mr. Reid, has been at the property for about a month.

The Big Blue mine, near Kernville, shows signs of revival. A small crew of miners is at work repairing the drainage adit, and it is rumored that active operations will be commenced about May 1. The manager, Mr. Long, who has been absent in the East for some time, is now at the mine. This property is equipped with modern machinery, although the old 80-stamp mill on the Kern river has been dismantled.

TORONTO, CANADA

WORKMEN'S COMPENSATION ACT.—THE JUPITER MINE.—DOME RETURNS.—BUFFALO PEOPLE INTERESTED AT PORCUPINE.—CONSOLIDATION AT COBALT.—CANADIAN MINING & EXPLORATION CO.—CREIGHTON NICKEL MINE.

The new Workmen's Compensation Act for Ontario will probably be in force by next November, and in any event it would become operative on January 1, 1915. The bill is now up before the Ontario legislature and has passed its second reading. As it is not a question of party politics and has the support of both sides of the house, there should be no difficulty in having it become a law. In spite of the protests made by some of the interests affected by this bill, it is practically the same as originally drafted by Sir William Meredith. All of the interests affected by the new act are in favor of compensation itself, but they object to some of the terms and clauses of the act. They consider the amount of compensation too high, and the number of employees embraced altogether too large, for a legislation which has not yet been tried. This proposed act is more comprehensive and embraces a greater variety of employees than any similar legislation in the world, but the Canadian Manufacturers' Association and others would prefer to see this legislation tried out on a somewhat smaller scale at first. The government will include in the estimates an annual payment of \$100,000 for the administration of the Compensation Commis-

sion, but it is doubtful if this sum will cover the total cost of administration, and in that event the industries covered by the act will have to bear the balance of the cost.

The Jupiter mine in Porcupine is now under control of the McKinley Darragh company of Cobalt, and operations under the new management will be started in a few days. According to the terms of the deal which have been ratified by the McKinley Darragh shareholders, a new company, with a capitalization of \$2,000,000, will be formed to take over the assets of the Jupiter company. The present shareholders will receive one share of stock in the new company for every two shares turned in. This will leave 1,000,000 shares in the treasury, which will be taken by the McKinley-Darragh company at 12c. per share. The purchasers agree to spend \$30,000 by August 1 in developing the property, and should results be satisfactory they will then pay off the \$50,000 bond issue which is outstanding, and provide additional working capital to the amount of \$40,000. P. A. Robbins, of the Hollinger mine, made a report on the property some time ago for the Jupiter shareholders, and it is understood that he estimated the net value of the ore after deductions were made for working costs, at \$120,000. Out of this amount, however, funds would have to be provided for the building of a mill. The property is an excellent prospect, and development to date has by no means exhausted its possibilities.

The Dome report for February shows that the mill treated 12,010 tons and produced bullion worth \$69,000. The mill ran 89% of the possible time. This smaller tonnage is due to February being a short month, and also to a shut-down on account of power troubles. The drop in the grade of the ore was considerable, the average value recovered being \$5.75, as compared with approximately \$8 per ton for the preceding month. The report for March has not yet been published officially, but will show a production of about \$86,000 from 15,000 tons of ore. This is the highest monthly tonnage ever treated at the Dome.

Buffalo interests have recently made offers for several small properties in the vicinity of the Dome mine. These consist of the Porphyry Hill, which was formerly a part of the Preston East Dome holdings, the Little Pet, and the Fogg properties. All of these adjoin, and they have small rich veins of narrow width. An offer of \$40,000 has been made for an 80% interest in the Porphyry Hill and \$25,000 each for the same interest in the other two properties. These deals have not yet been officially endorsed by the owners.

At a meeting held in Toronto on April 14, a consolidation of the interests in the Cobalt Townsite, Cobalt Lake, City of Cobalt, and Cobalt Townsite Extension companies came before a general meeting of the Cobalt Lake shareholders. A poll of the shareholders of some of these companies, held a short time ago, resulted in a large majority in favor of amalgamating the properties. Some of the shareholders of the Cobalt Townsite company were, however, by no means favorably disposed to the scheme, as they thought that the new company proposed to pay too high a price for some of the other properties. The estimated value of these various properties was £1,600,000, and the net annual income is estimated at 17%. The proposed capital of the new company is \$7,500,000, and shareholders in the various properties will receive shares in the new company in return for shares in the present companies.

At the annual meeting of the Canadian Mining & Exploration Co., held recently, the report of the president, Ambrose Monell, showed that during the year 109 properties were given preliminary and final examinations. Of these, 34 were more or less developed mines, and 75 were prospects. Of the mines, 8 would have been satisfactory if the terms had been suitable and the Company would have been prepared to develop 9 of the prospects under somewhat different conditions. The hope was expressed that negotiations with regard

to some of these properties would result in their being acquired by the Company. Two properties on the Pacific Coast are being held under option, and negotiations are under way for obtaining several others. The profit and loss statement for the year showed a gross income of \$133,799, of which \$78,000 was expended, leaving a balance of \$55,500 to be carried forward.

Recent developments at the Creighton nickel mine, in the Sudbury district, have shown a much larger tonnage of ore than was expected by the management a year ago. The ore from this mine is the highest grade ore being produced in any quantity in the Sudbury district today. At the No. 3 mine, where it is stated that approximately 40,000,000 tons of ore has been developed by underground workings and diamond-drilling, extensive plans for the production of ore were under way, but on account of the higher grade ore being produced in the Creighton and the large tonnage shown by recent development, it has been decided to do only a limited amount of work at No. 3 in order to carry out certain development and provide a small tonnage to flux the Creighton ore.

NEW YORK

MERGING OF THE ANACONDA AND INTERNATIONAL SMELTING COMPANIES.—THE A. S. & R. CO. IN MEXICO.—MEXICAN COPPER.—UTAH COPPER.—ALASKA EMER GOLD MINES COMPANY.

The Mexican situation has divided interest during the week with the absorption of the International Smelting & Refining Co. by the Anaconda company. The move is not an especially startling one, for the International is already a very close relative of the Anaconda, since 47% of its stock is held by the United Metals Selling Co., which is controlled by the Amalgamated Copper Co., which owns the Anaconda. E. P. Mathewson, the manager of the Anaconda smelting plant at Anaconda, was for some time general manager of the International, and was last year succeeded in that office by W. D. Wraith, who had been smelter superintendent at Anaconda. The absorption of the New Jersey corporation by the Anaconda is to be carried out by an exchange of stock on the basis of 3.3 shares of Anaconda for 1 share of International, and a special meeting of International stockholders is called for May 26 to consider this proposal. The Anaconda stock is \$25 par and quoted at \$33, while the International is \$100 par and quoted at \$105, so that the exchange represents the present relative positions of the two shares. Only about 330,000 shares of Anaconda will be required to take over the International, and as there are 1,667,500 of Anaconda shares still in its treasury, this will not make any very great inroad on its treasury stock. The International has had an interesting history, since when it started work at Tooele it was expected that it would be a large copper smelting plant. The expected amount of copper ore never materialized and the copper furnaces have never operated at more than a fraction of their capacity. Meanwhile an unexpectedly large supply of lead ore developed, and the International has become a considerable lead producer, owning as well a large copper refinery near Chicago. Now that plans are well advanced for the new smelter at Miami, Arizona, to handle the concentrate from the Inspiration and Miami mills, the International will become an important copper producer again, and its absorption by Anaconda is the more logical.

Recent developments in Mexico are of intense interest to mining men everywhere. Perhaps the greatest interest is that centred around the operations of the American Smelting & Refining Co., which owns many mines, smelters, and railroads in Mexico. The operations of several of these have been either interfered with or completely stopped, for a good part of the time during the past year or so, but some of the plants, especially those at Chihuahua and Aguascalientes, have been kept in fairly steady operation, though at somewhat reduced

capacity. Daniel Guggenheim is quoted in a recent interview as saying that the dividends of the Company will not be seriously affected by the present situation. Ever since the trouble in Mexico developed, preference has been given to investments in this country, and work has been concentrated on the American plants. The Tacoma plant, by the way, is developing rapidly because of the recent shipments of copper ores from South America. The rates to Tacoma are somewhat more favorable from the west coast of South America than they are to the Atlantic coastboard, and as the Tacoma refinery is the only one on the west coast, it is possible to smelt there at an advantage, and produce refined copper for the western and trans-Pacific market, sending any excess to the Atlantic seaboard. It seems as though the Tacoma plant is likely, therefore, to grow considerably in importance, especially as Alaskan ores are also increasing in quantity. Another point in regard to Mexico is the possible effect it will have on the copper market, which has been decidedly dull lately. The optimists are inclined to think that the cutting off of the Mexican output will cause an increase in price, but the importance of the Mexican output may be easily overestimated. The Cananea plant has already been shut down, and its output will be off the market for a time; but it should not be overlooked that the total shut-down of Cananea only takes off the market an amount about equal to that by which the Utah Copper exceeded in March its February output. There seems little reason to believe that the decrease in copper production is likely to have anything like the effect on the market which increased buying is apt to produce. If war should actually be declared the manufacturers of ammunition would have to immediately begin to add to their present stocks, and that would mean buying more copper. On this score, it seems as though there is an excellent chance for an improved market for copper. The U. S. S. R. & M. Co. is another big organization which suffers heavily from the present situation in Mexico, as its most valuable properties are there.

The report of the Utah Copper Co. has just come out and shows a new high level of both production and earnings, even in spite of the fact that the cost of copper is given as 9.25c, as compared with 8.78c. per lb. in 1912. The average price received for the copper was also somewhat lower in 1913, being 14.98c. as compared with 15.84c. in the preceding year. The production, however, was 113,924,834, as compared with 91,400,000 lb. the preceding year, and the total net profits were \$8,513,105, as compared with \$8,450,000 for 1912. The Company made a new departure by beginning to pay off a small sum for depreciation. It will be remembered that the Utah Copper has so far deferred a certain part of its operating expenditures in order that they shall be charged off to the later operations which they would benefit. The writing off of \$507,000 is quite a small amount, but is a start in the wiping out of these capital debts, at any rate. On the basis of the present estimate, the Company has ore reserves of 332,500,000 tons, or a life of about 50 years, at the present rate of production. As the mining and milling properties and equipment are carried in last year's balance sheet at about \$18,000,000, and the deferred charges at about \$2,500,000 more, a yearly sinking fund of \$507,000 ought to take care of amortization in case the life of the mine is as long as it is hoped. For the first time in its history, the management announces that construction work is practically completed. Presumably from now on the production, which has heretofore been steadily increasing, will remain pretty steady at between 10,000,000 and 12,000,000 lb. copper per month. An interesting move is the election of W. Hinckle Smith to the Utah board. Mr. Smith has been interested in the Ely district for a long time and has been on the Nevada Consolidated board since the beginning. His election to the Utah board is another example of the tendency of all the big groups to get together, which has been so marked in the past year or two.

Some time ago I wrote concerning the internal troubles of

the company which owns the Alaska Ebner property at Juneau, which is now under option to the United States Smelting, Refining & Mining Co. On April 22 the physical assets of the Alaska Ebner Gold Mines Co. were sold at auction, under a foreclosure suit of the Guaranty Trust Co., for \$225,000, the only bid being that of the bondholders' committee. The assets include mining machinery at Juneau, mines in Madera county, California, claims and notes aggregating \$97,000, and shares of stock of the following companies: Bristol Consolidated Mines & Smelting Co., 1,700,350; Bay Bristol Consolidated Mining Co., 199,996; Ebner Gold Mining Co., 100,000, and Humboldt Mining Co., 1000 shares. Receivers were appointed for the Company two years ago, when it was stated that the liabilities were \$2,000,000.

WASHINGTON, D. C.

THE SMOOT BILL ON MINING LAWS.—ROUGH PASSAGE FOR THE RADIUM BILL.—RESCUE WORK IN MINES DISCUSSION.

It is being generally conceded in the halls of Congress that probably the only mining legislation that has any chance to be passed this session is the Smoot bill creating a commission of three to codify the mining laws of the country. This is on the Senate calendar now, which is full of other legislation, so this bill has to wait its time until the more important legislation is out of the way. Of course, codifying the mining laws is very important work, and much needed, and the legislation could be put through in a short time; but Congress is always loth to do the easy and obvious thing. Senator Smoot, of Utah, is watching the chances for his bill, and is confident that it will ultimately pass during this session, but he is satisfied that it is a matter of 'watchful waiting' only. It is well known that if the Senate once passes the bill it will be an easy matter to get the House to pass it. The movement for a commission of five members, instead of one of three, still shows life, but Senator Smoot is averse to recalling the bill from the calendar to make this change in the bill for a larger commission, and before offering the amendment in the Senate he wants to be sure that there would be no opposition to it, lest it defeat the bill. He believes that a commission of three is better than no commission at all.

The radium bill seems to be doomed. It has been before the Senate for several days, through a special order arranged for by Senator Walsh of Montana, father of the bill. When the Senate permitted this to be done, it supposed that it was allowing just one hour for the consideration of the bill on a certain day, hoping thereby to be that courteous to the measure and its friends, and then letting it lie dormant. But the Vice-President has ruled that the Senate had arranged such a status for the bill that it must be considered every day at 1 p.m., for one hour, until disposed of. The ruling has excited the Senate considerably, as it may set a bad precedent, and the Senators have been very busy debating the 'metaphysics' of the arrangement, rather than the bill, using a great deal of valuable time that way. It is a way the Senate has, and at this writing the status of the measure is still in the plight indicated. The debate, however, has shown the degree of opposition to it, and that it is sufficiently strong seemingly to defeat the bill. It is contended that the time is not ripe for such a sweeping measure, which the bill is deemed to be. Furthermore, it is declared that the bill introduces the Government into mining, and that this is a very serious precedent indeed. The bill, therefore, is engendering votes against it on that account alone. Still further, the opposition is growing on account of the feeling that radium has yet to be found a real cure for cancer, and so, why hurry? There is also not a little complaint that the bill is a preventive against prospecting for radium, and that this is to be avoided. Of course the anti-conservation people in Colorado are especially in arms against the bill, for it spells conservation, which is not popular in Colorado mining circles.

Hearings were given in the week beginning April 19 by the House Committee on Mines and Mining, on legislation planning rescue work in mines. Among others, William Greene of the International Mine Workers, will be heard. This legislation is probably something for the next session. The House Committee also expects to report soon on the results of its inquiry into the Colorado mine troubles. The report will suggest legislation. Little, as a rule, comes from these reports. Generally the report is on something that has ceased to exist, and in which there is no longer any public interest, consequently no imperative need for legislation, and especially legislation of a controversial kind.

ROCHESTER, NEVADA

DEVELOPMENTS IN THE BIG 4 LEASE.—COLD LEASE.—INCREASE IN GOLD IN ORES OF THE ROCHESTER MINES GROUP.—SUNDRY LEASE WORK.—PROPOSED RAILWAY EXTENSION.—PLACERS.

The Big 4 lessees on the Rochester Mines Co.'s property have been underground stoping the 50-ft. level, and are mining 7 ft. of good shipping ore. This ore is directly beneath the 50 stope which produced about \$100,000 last fall. In the lower levels, on the 160 ft. south, after following the shoot down along the hanging wall, a few shots were put into the foot-wall which exposed shipping ore, with the result that this has been followed upward from the bottom, and the stope shows a width in places of 14 feet.

The Codd lessees are sinking again, having installed another hoist and skip, and will connect with the main Causten level, which is 400 ft. below the apex of the main vein. The lessees are taking out good ore on the 320-ft. level north.

A notable feature of the Rochester Mines ore is the increase in the gold content with depth. At and near the surface the value in gold from the various leases, according to smelter returns, amounted to only 60 and 80c. per ton, whereas the recent shipments from the Causten lease, the lowest workings on the peak, have yielded over an ounce of gold per ton. The lower levels of the Big 4 lease also show a big increase in gold. The leases on the Rochester Weaver ground have always had a fair gold content, the first shipments from the Colligan averaging about an ounce; but these workings are all at a lower zone than those on Nenzel peak.

The No. 4 lessees in the Rochester Mines are now driving north from the main Causten level, and are down about 400 ft. The Camille Rock lessees, on the Nenzel Crown Point property, which lies to the northeast of the Rochester Mines ground, within the past few months have opened about 5 ft. of good ore which is being sorted and sacked for shipment. This lease has been hampered by surface water, which filled the shaft and workings. It is expected that a hoist and equipment will shortly be installed. The showing on this lease has greatly increased the value of this property, through which an extensive vein system runs, including the veins of the main property of the district. The Cole and Colligan lessees to the south have opened small but rich shoots of ore, and the Shea Stoker lease, also on the Rochester Weaver ground, is in very good ore from 3 to 5 ft. wide. The Boughton and the Ferri Sampson lessees on the McIntosh-Pitt ground are getting out another shipment. A lease has recently been let on the Minnehaha property, situated east of Nenzel peak, to Force and McGilvary. Lessees have been sacking and shipping float from Nenzel peak found on the ground to the west, and returns of at least \$60 per ton are expected. Recently some high-grade float, showing free gold, has been found.

It has been rumored for some time that the Nevada Short Line, running an industrial track and train service from the lower end of Limerick cañon to Nenzel, on the Southern Pacific, would extend its service to the town of Rochester, but so far nothing has been done beyond making the surveys, for which quite a camp is established.

General Mining News

ALASKA

CHISANA

All litigation connected with claims in this district has been finished at Cordova by Judge Brown. There were 16 suits from Chisana. The defendants in all these cases were the original locators of the ground. The plaintiffs were those who had made later locations, claiming the first locations to be invalid for various reasons. Twelve of the disputed locations were made by power of attorney, and it was claimed that these were invalid because the power of attorney had not been recorded prior to staking the ground. The question of citizenship was not discussed. The most important argument decided by Judge Brown was that the power of attorney need not be recorded, under the Wickersham act, prior to staking, but that the location is valid if the power of attorney be recorded and all the acts of location completed before the rights of the second locator intervene.

CIRCLE

The Circle quadrangle is described in Bulletin 538 by L. M. Prindle of the U. S. Geological Survey. The area con-



WILD GOOSE DREDGE, 23 ABOVE OPIHIR, COUNCIL DISTRICT.

tains about 17,000 square miles of well known territory, and includes the Birch Creek placer district, which is the most important.

CORDOVA

The barge *America* has arrived with 2600 tons of supplies and machinery for the Midas copper mine, which is owned by the Granby Consolidated company of British Columbia. A tramway, wharf, ore bins, and a bunkhouse will be built. Seventy-five men are to be employed, under G. E. Smith, at the beginning of operations.

FAIRBANKS

The dredge being built by the Union Construction Co. at San Francisco for the use of Clarence Berry and associates is more than half complete. It will be shipped to Circle City for use on Mastodon creek at the opening of navigation. Announcement that the contract for the boat had been let was received with surprise at Fairbanks, but has been confirmed by the *Mining and Scientific Press*, which made the first announcement.

JUNEAU

(Special Correspondence.)—The Alaska Juneau company has had 20 stamps running since early in March, and in about another month 10 or 20 more will be at work, crushing through 14-in. screens, by passing the fines, separating a waste product on Wilfley roughing tables, and regrinding the oversize

from classifiers or screens of the Bunker Hill & Sullivan type in a Chilean mill and a Hardinge mill in competition.

The main adit of the Perseverance mine, recently connected with the shaft, is now being trimmed-up to size. The United States Smelting, Refining & Mining Co. has just cut the vein in the adit. A 5-stamp sampling mill is being erected at the mouth of the adit.

Juneau, April 14.

March returns from the mines on Douglas Island are as follows: Alaska Mexican, gold worth \$46,535 from 19,698 tons of ore and 371 tons of concentrate, with a profit of \$13,743; Alaska Treadwell, gold worth \$204,463, from 83,581 tons of ore and 1572 tons of concentrate, with a profit of \$125,869; and Alaska United, gold worth \$70,702 from 37,121 tons of ore and 734 tons of concentrate, with a profit of \$9802.

The Alaska Gastineau Mining Co. will add to its power-plant equipment a 1750-kva. alternating current generator and switchboard from the General Electric Company.

ARIZONA

COCHISE COUNTY

On April 22 a fire at Bisbee destroyed 55 houses worth about \$100,000. In a short time a relief fund of \$5000 was raised for those rendered homeless.

GLA COUNTY

Additional Hardinge mills are being installed in the Miami mill. Fire destroyed buildings worth \$20,000 in Miami last week.

(Special Correspondence.)—The haulage drift on the 600-ft. level of the Inspiration mine was connected April 21, so that from now on all material and waste going to and from these lower workings will be handled through the incline instead of the Colorado shaft. The 12-compartment oil-floatation machine was started early in the week, and is now treating the material which the 8-compartment machine has been handling in the test mill.

Miami, April 22.

MARICOPA COUNTY

(Special Correspondence.)—The old Phoenix mine, 20 miles north of here, is being sampled and examined, and will probably be reopened for its low-grade gold ores. The property attracted considerable attention years ago. A 100-stamp mill was erected, but only 20 were used. Three years ago, 50 stamps were moved to the Glory Hole in Yuma county, those remaining being a monument to the work of the promoters.

Phoenix, April 23.

CALIFORNIA

Oil production of 11 fields in March averaged 286,591 bbl. per day. There were 5899 producing wells. Total shipments from the districts were 8,833,769 bbl. Stocks on March 31 were 49,847,770 barrels.

PLACER COUNTY

A representative of the Guggenheim interests, E. B. Braden, has stated that within six weeks mining will be resumed on the sulphide ore in the Dairy Farm mine, 11 miles north of Lincoln. At present 100 tons per day of gossan is being extracted, and shipments of sulphide ore to the Selby smelter will be from 200 to 300 tons per day.

SHASTA COUNTY

Fire broke out on the 1200-ft. level of the Midas mine, 53 miles southwest of Redding, on April 21, and has not yet been subdued. The mine has two shafts, 600 and 1300 ft. deep respectively. Three miners were rescued by the superintendent, H. L. Waste, and J. Moore. About 100 men will be out of employment. W. H. Roberts, of Sacramento, is manager and owner of the property.

SIERRA COUNTY

There are now six regular gold producers at Alleghany,

the Rainbow being the latest on the list. The adit at this mine is in 2500 ft., and some rich ore has been opened. A new 10-stamp mill is to be erected to replace that burned last year. L. B. Woodbury is manager.

COLORADO

OURAY COUNTY

A branch of the Colorado Metal Mining Association has been formed at Ouray with H. H. Du Prau as president and William Rathmell secretary. About 6 ft. of ore has been opened on No. 8 level, off No. 3 shaft, of the Camp Bird mine.

SUMMIT COUNTY

Lessees in the Dunkin mine, on Nigger hill, in the Breckenridge district, have extracted gold specimen ore worth \$25,000 during the first half of April. This property is owned by Leadville people, who gave a 10-year lease to O. K. Gayman, Theodore H. Knorr, W. W. Wharton, and J. A. Summer. The rich pocket was found at a depth of 500 ft. The Wellington Mines Co. shipped 18 carloads of zinc concentrate, also 65 tons of lead-silver concentrate, during the two weeks ended April 15. R. M. Henderson is manager. A busy season is expected for the Tonopah Placers, French Gulch Dredging, and other companies.

TELLER COUNTY (CRIPPLE CREEK)

From the El Oro mine, on Battle mountain, a carload daily of \$28 to \$44 ore is being shipped to the Golden Cycle mill. The April output will be about 44 cars. Additional miners are to be employed. An electric locomotive is being installed in the No. 2 working of the Portland mine. At 400 ft. in the Spicer claim, owned by the Strong company, and under the business centre of Victor, rich ore has been opened in granite. The Dante mill, on Bull hill, is producing 350 tons of ore per month. It is operated under lease by Edwin Gaylord. The Doctor-Jack Pot Mining Co. has acquired several claims of the Work Mining & Milling Co. James F. Burns, chairman of the committee in charge of the proposed extension of the Roosevelt drainage tunnel, has informed the Elkton Consolidated company's directors that \$50,000 has been raised for the work. This will do for 2600 ft. farther, the tunnel being a little smaller than the present size. Drainage would then be about 150 ft. below the present water-level in the Elkton. The work could be finished early in 1915.

James F. Burns has been elected president of the Cripple Creek Drainage & Tunnel Co. F. G. Peck, of the Portland, and John T. Milliken, of the Golden Cycle company, resigned, their places being taken by Irving Howbert and John Tait Milliken. E. M. De La Vergne, formerly of the Elkton Consolidated, also resigned. At the meeting at Colorado Springs it was decided that the tunnel should be completed to its original destination, the Vindicator main shaft. The Vindicator, Golden Cycle, and Portland companies, and other district companies, have promised increased subscriptions to the project. The credit balance is \$6000. The executive committee has been authorized to proceed with the work at once.

IDAHO

LEMHI COUNTY

The Kirtley Creek Gold Dredging Co.'s dredge, built by the Yuba Construction Co., is handling 100,000 cu. yd. of gravel per month. On an adjoining creek, the Bohannon Dredging Co. is handling about 2000 cu. yd. per day. The Bohannon Creek property consists of 3300 acres of dredging ground, which is estimated to average 25c per cubic yard. Both of these large dredges are operated by electric power supplied by the Lemhi Power Co. from Salmon.

Development at the Virginia Consolidated mine, near Baker, has proved ore worth \$250,000, in 6000 ft. of adits and other work. A larger treatment plant is to be erected, and probably a Lane mill will be installed.

SPOONSHOOT COUNTY

Net profits of the Snowstorm Mining Co. for 1913 amounted to \$137,455, against \$88,778 in 1912. Ore mined was 105,674 tons, worth \$709,577, of which mining cost \$309,161, and transport and reduction, \$297,847. The Company has started to drive an adit from its workings into Missoula ground. It will be over 8000 ft. long, and cost \$80,000. An additional 1000 ft. of depth on the Missoula orebodies will be made by this work. Owing to the low price of land, and repairs to be made to the shaft, hoist, and mill, the Morning mine, one of the Federal Mining & Smelting Co.'s properties, has been temporarily shut down. About 400 men are regularly employed. Affairs of the Stewart Mining Co. are said to be badly tangled, and further litigation is certain. Suits, injunctions, and other legal processes are being brought by William Beaudry, William A. Kerr, John W. McKinnon, and Campbell Carrington.

The Stewart Mining Co. did not pay its expected dividend on April 25, and there was a drop of 6c. per share in Spokane as a result.

MICHIGAN

Copper production of this state last year was 135,852,409 lb., worth \$21,057,278, compared with 218,138,408 lb., worth \$35,992,837, in 1912, according to the U. S. Geological Survey. Silver output was 295,173 and 528,453 oz., respectively; and ore treated, 7,016,307 and 11,411,941 tons. The reduction was due to the strike, which started in July 1913.

HOUGHTON COUNTY

During six days of the past week, the Mineral Range railway handled 73,840 tons of copper 'rock,' from the following mines: Ahmeek, 9840; Allouez, 5320; Centennial, 2280; Hancock, 2120; Kearsarge, 14,200; La Salle, 1320; Mass, 2080; Mohawk, 13,680; Osceola, 5020; Superior, 3560; and Wolverine, 10,400 tons.

MONTANA

FERGUS COUNTY

During March the Barnes-King Development Co. treated 4087 tons of ore, averaging \$10.15 per ton. The average cost for mining and milling was \$3.50 per ton. The month's profit is about \$40,000. The Company is out of debt, and has a balance of about \$125,000.

LEWIS AND CLARK COUNTY

There is quite a revival of mining activity in districts adjacent to Helena. More men will be employed at the Valley Forge, Lee Mountain, and Porphyry Dike mines in the Rimini district. At Marysville, 75 to 85 men are working at the Bald Mountain, controlled by Thomas Cruse. Development at the Piegan-Gloster, operated by the Barnes-King company, is encouraging. Six miles from Marysville is the Bald Butte, and prospecting is at an interesting stage. George Padbury is superintendent. Ore worth over \$160,000 has been opened above 300 ft. in the Franklin, in the scratch gravel district. Prospecting is under way at the Montana Copper-Silver Mining Co.'s claims nearby. The York Mining Co. is employing 48 men at Trout creek, and a mill is being erected. Probably the Spring Hill mine will be reworked if the stockholders' meeting on May 4 decides on any action.

SILVERBOW COUNTY

(Special Correspondence.)—The Anaconda Mining Co. has contracted with Minerals Separation, Ltd., for an experimental unit for flotation. The process will be tried on the slime in competition with the roasting and leaching now under way. If it proves successful, a flotation plant will be built.

Butte, April 22.

In the dispute between the W. A. Clark interests who own

the Elm Orlu, adjoining the Black Rock, and the Butte & Superior company, concerning orebodies in the west end of the Black Rock claim, a settlement is likely to be made. Messrs. Creden, Wiley, and Finch have been making examinations for the Butte & Superior, and Messrs. Weed, Winchell, Green, and Pyle for the Clark interests.

NEVADA

CHURCHILL COUNTY

During March the Nevada Hills Mining Co. produced 5080 tons of ore averaging \$9.68 per ton, yielding \$43,469, at a cost of \$39,981. The total cash resources are \$207,676. Development covered 592 ft. during the month, at a cost of 65c. per ton.

ELKO COUNTY

Oil locations aggregating 8580 acres have been made on the low mountain range immediately south of Elko in the past two weeks. The names appearing on the locations consist of 18 Ely people, 18 Elko people, and 13 whose residences are in the east and San Francisco. This country has been a favorite one for the oil prospector, and people who have lived here for the past 15 years will remember that there have been several oil booms.

At a depth of 400 ft. in the Alpha mine, at Jarbidge, 5 ft. of ore worth over \$75 per ton, and containing 80 oz. silver, has been opened. A 5-stamp mill is at work.

ESMERALDA COUNTY

During March the Goldfield Consolidated mill treated 30,349 tons of ore, yielding a net return of \$161,286, according to the assistant general manager, J. W. Hutchinson. The total costs were \$5.80 per ton. Development totaled 2789 ft. at a cost of \$8.01 per foot. Stopping operations in the hanging wall of the old 305 stope in the Red Top-Laguna mine exposed a considerable tonnage of good milling ore. In the Clermont-Jumbo the 402-Z intermediate drift, driven south on the hanging wall vein of the old 401 stope, produced 200 tons of \$50 ore. Lessees on the Jumbo No. 2 produced 85 tons of ore valued at \$1874, from which the Company received a net royalty of \$928. On account of the preliminary expense necessary for the extraction of this ore, the net profit to the Company is largely in excess of that which would have resulted from Company operations.

LANDER COUNTY

By the recent decision of Judge Farrington, of the U. S. district court, 700 ft. of ground along Copper cañon, near Battle Mountain, is open to location as a placer district. The Glasgow & Western Exploration Co., which holds claims there, will appeal from this decision.

LINCOLN COUNTY

A 'Publicity Edition' of the *Pioche Record* gives a good deal of interesting information on the mines of this district. Names of the principal producers were given in last week's issue of the *Mining and Scientific Press*.

NYE COUNTY

Two auto-trucks are to be used in transporting ores from the various mines controlled by the Commercial Mines & Milling Co. to the War Eagle mill at Manhattan. It is the intention of the operators to make a series of mill tests, making a separate test from each of the many places where ore will be mined.

The Golden Arrow Mining Co., controlled by Eastern people, has arranged to erect a 50-ton mill and cyanide plant. Over 6000 ft. of development has been done in the claims at Golden Arrow. Mr. Kieron is manager.

The Sunset Mining & Development Co. is developing the Tramp mine, which consists of 11 claims, in the Bullfrog district. The country rocks are rhyolite, basalt, and quartz-

ose and shaly beds underlain by limestone. The contact between the rhyolite and shaly limestone is the fault plane of the Original Bullfrog-Amargosa fault, which may prove of importance to ore formation in the mine. Bonanza mountain, in which is the Tramp mine, contains a large number of faults. Each of the three principal veins in the mine is in a different fault. The ore is soft and decomposed between rhyolite walls, and the veins are from 2 to 40 ft. wide. The shrinkage system of stoping can be used, and little timber is necessary. Development to date totals about 14,500 ft. The Tramp adit, or 400-ft. level, will serve as a main haulage-level for the whole mine. Ore reserves amount to about 54,000 tons in five veins, gold content varying from \$4 to \$10.60 per ton. Equipment consists of a Hendrie & Bolthoff hoist driven by a General Electric motor, an Ingersoll-Sargent air-compressor driven by a Westinghouse motor, and five Sullivan and one Waugh machine-drills, according to a report by E. T. Hager. Tests made on the ores by F. W. Lockman show that by leaching sand and filtering slime an extraction of 90% of the gold should be made with a low consumption of chemicals, while it might pay to erect an all-slimes plant. The president of the Company, E. S. Van Dyck, has proposed the erection of a mill to treat 2000 tons per month, costing about \$30,000.

A new treatment plant is being erected for the Sunset company, most of the machinery being supplied by the Colorado Iron Works Co., which hopes to have it installed early in August. The flow-sheet is as follows: One-inch grizzly, Blake crusher, Challenge feeders, ten 1050-lb. stamps, 6-mesh screens, belt and bucket elevator, 45-in. Akins classifier, slime from classifier to No. 1 set of 7 by 20-ft. Dorr thickeners, sand from classifier to a 5 by 18-ft. Colorado Iron Works tube-mill, pulp from tube-mill over copper plates, slime from No. 1 thickeners to four 12 by 15-ft. Pachuca tanks, slime from these to No. 2 thickeners, filtration by a 12 by 12-ft. Portland machine, residue on belt-conveyor to dump. An extraction of 90% is expected at a cost of \$1.75 per ton.

STOREY COUNTY

A cyanide plant for the treatment of concentrate saved in the Jacket mill, is to be erected within 90 days. It will save freight and smelter charges on this product, and increase the milling capacity of the present 200-ton plant by about 20%. Walter Techow will have control of the construction and operation.

WHITE PINE COUNTY

According to the *Ely Record*, the Newark valley, in the extreme western portion of the county, is fairly prosperous. It lies at an altitude of 6000 ft. The Ruby district has promising copper deposits.

OREGON

JOSEPHINE COUNTY

(Special Correspondence.)—The Rogue River Public Service Corporation is erecting dams and power-plants on the Rogue river near Grant's Pass, to compete with the Oregon-California company, whose plant is at Raygold above Gold Hill. The Ament dam and works have been secured for a central station, and will develop 5000 hp. G. E. Sanders is manager of the concern. A large hydraulic plant is being installed by the Althouse Mining Co. near the old town of Holland.

Grant's Pass, April 8.

LINCOLN COUNTY

(Special Correspondence.)—Gold is being recovered from the beach sands at Newport, near Yaquina bay, one of Oregon's popular summer resorts. Machines worked during the winter were reported to have saved from \$20 to \$60 per day, while single operators claimed from \$5 to \$10 per day. The gold is light and some mechanical device will be necessary to make good recoveries. The Oregon Bureau of Mines and Geology

will investigate the sands. This county is not a gold producer, and interest is being taken in the discovery.

Newport, April 6.

TEXAS

BRAZORIA COUNTY

(Special Correspondence.)—The first shipload of Texas sulphur shipped through this port from the Freeport Sulphur Co.'s mines left on April 8, on the steamer *Honduras*. It was also the first heavy tonnage of outbound cargo that has left the mouth of the Brazos river for nearly twenty years. The quantity of sulphur loaded was approximately 2100 tons, and the new conveyor handled nearly 60 tons per hour.

Freeport, April 10.

EL PASO COUNTY

Two 55-hp. direct-current back-g geared motors for operating Stillwell-Pierce converters are to be installed by the El Paso Smelting Company.

UTAH

GRAND COUNTY

Prices offered last week by a uranium ore buyer are as follows, according to the *Greenriver Dispatch*: 2%, \$2.12; 2½%, \$2.25; 3%, \$2.50; 4%, \$2.60; 5%, \$2.70; 6%, \$2.85; 10%, \$3; 15%, \$3.25; and 20%, \$3.50 per pound. Sampling charge is paid for by buyer, analysis by seller. Above prices f.o.b. car lots Greenriver. The United States claims are being developed by E. V. Grant. The Radium Co. of America has shipped 100 tons of ore to date.

SUMMIT COUNTY

The Snake Creek tunnel is being advanced 10 ft. per day. In a raise from 1200 ft. in the Daly-Judge mine, a shoot of ore assaying 30% lead, 3% copper, and 60 oz. silver has been cut.

WASHINGTON

The itinerary of Bureau of Mines rescue car No. 5 is as follows: April 20 to 25, at United Copper and Copper King mines, Chewelah; April 27 to May 9, at Republic and Knob Hill mines, Republic; and May 11 to 15, at the state college at Pullman.

FERRY COUNTY

(Special Correspondence.)—Ore shipments from Republic during February totaled 3259 tons. This went to the Granby, Greenwood, Trail, and Tacoma smelters. The Ben Hur mine is producing for the mill and smelters about 100 tons of ore per day. The Trail plant generally gets it, but the Greenwood plant requires 2000 tons. Work in the mine is being done at 300, 400, and 600 ft. The ore averages from \$8 to \$15 per ton. Fifty-seven men are employed. Two men are sampling the Republic Mines Corporation property for Robert Sterling, who has another three weeks in which to exercise his option. At 300 ft. in the San Poil mine, a 4½-ft. ore-shoot, worth from \$11 to \$18 per ton, has been opened. C. C. Arrasmith has a lease on the Morning Glory mine, which is yielding ore worth from \$35 to \$124 per ton. The San Poil Consolidated Co. has decided not to sell its mine and plant.

Republic, April 22.

STEVENS COUNTY

Besides the Copper King and United Copper mines at Chewelah, the Keystone and Joe Dandy claims are also being prospected. These have adits driven 600 and 350 ft., respectively. Spokane people are interested. The Copper Queen mine, near the Copper King and United Copper, has been optioned for \$100,000 to a Duluth-Superior syndicate.

WYOMING

CROOK COUNTY

The Bear Lodge gold mining district is described in a recent issue of *The Crook County Monitor*, from which the following is abstracted: The area is from five to eight miles north of Sundance, covering about 15 square miles, at an

altitude of between 4500 and 7000 ft. The Bear Lodge Gold Mining Co. has two groups of claims. The Last Chance has been prospected by an 400 ft. incline shaft, vertical shaft, and other work. A large silicious lode containing iron, manganese, and gold was cut. Shafts from 25 to 400 ft. have opened the Daisy group. Additional machinery is to be installed. P. J. Scott is manager. The Warren Peak Mines Co. has driven an adit 285 ft., opening 1 to 6 in. of ore, giving very high assays. Eighteen inches of telluride ore occurs in this vein, and is worth up to \$16 per ton. The adit also cut a 5 ft. formation worth \$5 to \$7 per ton. A Gates crusher, 5-stamp mill, copper plates, cyanide plant, and power plant are about completed. E. A. Rock is manager. A good deal of fair-grade ore has been developed in the Reuter Mining Co.'s claims. In 1913 about 1000 tons was treated in the plant containing a Gates crusher, Huntington mill, and cyanide plant. J. E. Reuter is manager. The Hutchins Consolidated Gold Mining Co. has spent about \$15,000 in prospecting and plant, and results are encouraging. J. D. Russel is manager. The Silver Top Mining Co. owns 200 acres near the Bear Lodge claims. Seventeen feet of ore has been cut, and recent work in another shoot is promising. Other workings give gold and silver from \$2 to \$7.20 per ton. A steam hoist, air-compressor, and two machine-drills are working. George H. Leeman is manager. A 175-ft. adit in the Pistol claims has given favorable results. The Beaver Creek Mining Co., with Tom Whitman as manager, has recently been formed. An adit is now being driven. Some copper ore was opened on the surface. Considerable work has been done by the Retriever Mining Co., and a fair tonnage of profitable ore is being opened. A steam plant is to be installed. At the Camp Bird a shaft is being sunk. Harry Williams is in charge. The Grizzly Bear Mining & Milling Co. has 23 claims. Adits are being driven to cut veins which assay 60c. to \$8.70 per ton at the outcrop. J. B. Richardson is president. Good copper ore is being opened in the Copper Prince, the oldest mine in the district. Sundance, the county seat, is well situated for a mining centre.

CANADA

BRITISH COLUMBIA

Rossland mines continue to ship heavily to the Trail smelter. The tonnage for the first two weeks during April and the total tonnage for the year to April 14 is as follows: Center Star, two weeks 7475, year 48,566; Le Roi, two weeks 2120, year 18,857; and Josie, two weeks 477, year 5146 tons. All the mines lost one day owing to the break at the West Kootenai Power Co.'s plant at Bonnington Falls. A contract, at \$13.50 per ton, has been let by L. Johnson, manager of the Union mine, 49 miles up the north fork of the Kettle river, to haul 1000 tons of ore to Grand Forks. A fair amount of work was done in the winter at this mine. One 500-ton shipment averaged \$49 per ton. The Standard Silver-Lead Mining Co., a Spokane concern, will pay an extra dividend of \$50,000 in May. On April 1 there was \$320,000 in the treasury. Up to April 21, the Granby company's Grand Forks smelter has treated 371,072 tons of ore for the current year, and shipped 6,340,550 lb. of blister copper. On May 13, a meeting of stockholders of the Company will be held in New York to discuss the proposed loan of \$3,000,000.

ONTARIO

According to A. A. Cole, in a report to the T. & N. O. commission, 16 Cobalt mills treated 664,845 tons of ore in 1913, against 455,517 in 1912, 381,871 in 1911, 305,513 in 1910, 126,421 in 1909, and 49,424 in 1908, a total of 1,984,749 tons. During the four weeks ended March 25 the Hollinger mine produced 14,820 tons of ore (541 tons from the Acme mine) averaging \$13.30 per ton. The recovery was 96.4% at a cost of \$4.33 per ton. The gross profit was \$121,641, and net surplus was \$753,447. Development continues satisfactory. On the 200-ft. level a shoot 6 ft. wide, worth \$12 per ton, was opened.

Personal

JOSEPH CLENDENIN is in Europe.
 L. D. RICKETTS is in New York.
 J. D. HUBBARD has returned to Chicago.
 R. B. MOORE was up from Trona last week.
 H. M. WILSON was in San Francisco this week.
 A. E. DRUCKER was in Paris the middle of April.
 R. E. CRANSTON is in Montana on professional business.
 J. E. FLORANCE has gone to Guatemala on professional work.
 CHARLES M. ROLKER has removed his office to 59a, London Wall, E.C., London.
 E. P. MATHEWSON was in New York last week and has returned to Anaconda.
 P. D. BURTT is in El Dorado county, California, at the Oro Fino and Crusader mines.
 W. J. PITCHFORD, who has been visiting California, has gone to Washington temporarily.
 SIDNEY J. KIDDER was married April 29 to Miss MARGARET POWELL at Marysville, California.
 H. V. WINCHELL sailed for Europe from New York on April 16 and expects to return early in July.
 F. L. HESS and J. A. HOLMES attended the dinner of the M. & M. Society in New York last week.
 W. S. NORRIS has resigned as general superintendent for the Jumbo Extension M. Co. at Goldfield, Nevada.
 D. C. JACKLING gave a dinner to a number of well known mining engineers on April 22, at the Engineers' Club, New York.
 F. H. MORLEY left this week for Santa Barbara, planning to go later to Colorado Springs for the summer. While Mr. Morley is far from being an invalid, the doctor has forbidden regular work for him for the present, and he has, therefore, given up the position on the staff of the *Mining and Scientific Press* that he had held since December. He will write for the *Press* hereafter as a special contributor.

Obituary

A. H. W. JOHNSON, who has been the president of the Pulso-meter Steam Pump Co. of New York, died on March 16. The management of the Pulsometer company will hereafter be in the hands of William J. Berow, who has been associated with it for many years.

J. D. KENDALL, one of the old time mining men of Utah, died at Salt Lake City, last week. He was best known as superintendent at the Central-Eureka mine in the days of its maximum production. He had been out of active practice for some years at the time of his death.

A. SYDNEY ADDITON, who died at Berkeley, California, Wednesday of this week, was one of the well known metallurgists of the Pacific coast. Born in Massachusetts and educated in the East, his professional career was in the West. Mr. Additon was one of the pioneers in cyanidation work. In 1898 he was connected with the Toronto & Lillooet Gold Reefs, Ltd., at Lillooet, British Columbia, coming soon after to Berkeley, which was thereafter his home, except for two years passed as superintendent of the Mayflower Consolidated at Rhyolite, Nevada. While living in Berkeley he was for a time connected with the mining machinery business. Later he practised as a consulting metallurgist and in both capacities he designed and built many mills. From his experience in this work he wrote the series of incisive and interesting articles on 'Underestimating the Cost of Milling Plants' that we printed in 1913. In earlier years he had been a frequent contributor to the *Press*, and at all times he was generous in his exchange of information with fellow engineers.

Society Meetings

MAY

Name.	Date.
American Iron and Steel Institute	22
Chemical, Metallurgical and Mining Society of South Africa, Mining Exhibition, Johannesburg.....	19-29
Geological Society of America (Cordilleran Section), Seattle	21-23
Institution of Mining and Metallurgy, London.....	21
National Fire Protection Association	5-7

JUNE

American Institute of Electrical Engineers	22 or 26
American Society for Testing Materials	23-27
American Society of Mechanical Engineers.....	end of June
Colorado Scientific Society, Denver.....	6
Franklin Institute, Philadelphia	end of June
Society for the Promotion of Engineering Education	29 to July 2

AUGUST

American Institute of Mining Engineers, Salt Lake City	10-14
Canadian Mining Institute, Rocky Mountain branch, Banff.	
Lake Superior Mining Institute, Marquette, Michigan...	17

SEPTEMBER

American Chemical Society	9-12
American Institute of Electrical Engineers.....	not fixed
Colorado Scientific Society, Denver.....	3

OCTOBER

American Institute of Electrical Engineers.....	9
American Iron and Steel Institute	23-24
Colorado Scientific Society, Denver.....	3

NOVEMBER

American Institute of Electrical Engineers	13
Colorado Scientific Society, Denver.....	7

DECEMBER

American Institute of Electrical Engineers	11
American Society of Mechanical Engineers	7-8
American Museum of Safety	11-20
Colorado Scientific Society, Denver.....	5 and 19
Geological Society of America, Philadelphia.....	29-31
Society of Gas Lighting (annual meeting).....	10
Society of Naval Architects	11-12

JUNE 1915

Sixth International Congress of Mining, Metallurgy, Applied Mechanics, and Practical Geology, London

AUGUST 1915

American Association for Advancement of Science, San Francisco	17
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SEPTEMBER 1915

American Institute of Mining Engineers, San Francisco	27-30
Engineering Congress, San Francisco.....	20-25

Schools and Societies

MCGILL UNIVERSITY, Montreal, senior students, under J. Bonsall Porter, will hold a mining school in the Kootenai and Boundary districts of British Columbia during the current month.

TWENTY-FIVE students from the mining and geological departments of the Lehigh University spent April 17 and 18 at Franklin Furnace, New Jersey. The program included a visit to the mine and mill, as well as a study of the geology and minerals of the region.

New York Metal Market Review

The exportation of copper assumed a normal basis in April; neither foreign nor domestic buying was heavy and prices declined steadily. Makers of brass and copper tubes reduced their prices 3c. per pound, in part because of foreign competition. The New York price of lead stood for weeks at the low level of 3.89c., a figure which was attractive to outside speculators and at which a big business was done. Spelter declined, without recovery up to April 23, because of the slower demand from the galvanized sheet mills. Tin lost over 2½c. in April, London declined heavily, and big business was absent. Antimony was featureless except for its low prices. Aluminum prices are practically unchanged. The feeling of most business men in the East is that should the conflict with Mexico be a thorough one, it will benefit business, at least for a time. Their choice is for a vigorous campaign, or none at all.

COPPER

April brought a cessation of the extraordinary run of copper exports which in March reached the record-breaking total of 45,793 tons. Authorities abroad have decried the suggestion that the metal arriving from America was going into so-called 'hidden stocks.' Henry R. Merton & Co., Ltd., London, for instance, says under date of April 4, after pointing out that the total visible European supply on March 31 was 26,129 tons, against 26,755 tons on March 14:

"What has hitherto been a matter of curiosity and speculation, and even suspicion in connection with these enormous supplies is gradually becoming a very clear and simple proposition, for upon the most searching investigation it must be admitted beyond doubt that practically every ton of copper recently imported into European ports has gone directly into consumers' hands, and the conjecture of hidden storings may be dismissed entirely. How much of these large quantities is required for immediate consumption and how much is used in order to fill the depleted reserves of manufacturers it is impossible to ascertain, but when it is remembered that the European stocks have now shrunk to barely 20,000 tons, it will be easily understood that the users of refined copper on this side of the Atlantic cannot any longer work with safety unless they build up a reserve supply at their own works."

It further is pointed out that European consumers would be in a dire way, should American demand suddenly awaken. Near the end of March, selling agencies were asking 14.37½c. cash, New York, for electrolytic, then quotations were advanced, first to 14.50c. cash, at which level a good business was done, and then, on April 3, to 14.62½c. cash, New York, or 14.75c., 30 days, delivered. This latter figure was the ostensible quotation of the leading sellers throughout most of the month, but resale lots were sold or offered below this level at all times. The advances were made on the strength of the huge exports in March. It developed early in April that consumers were comfortably supplied for their needs of that month and in part for May; but despite this, and the fact that consumers were inclined to await the appearance of the March statement of the Copper Producers' Association, the advance to 14.75c. was made. The statement, which appeared on March 8, showed that the marketable copper on hand April 1 was 64,609,319 lb., a decrease of 13,762,533 lb. as compared with March 1, but the figures had no radical effect on the market. Concessions in price became heavier as the month progressed, about 14.55c. cash being the market April 8, while in the following week there were several reductions, until on April 15, 14.37½c. could be done. This price held for a few days, but by April 22, the metal could be had at 14.25c. cash, and the next day as low as 14.12½c. was quoted. With the decline in buying abroad came easier prices there, but even before this there were evidences that the domestic market was top heavy which resulted in the concessions referred to. The

lots offered were small, but many, and in the aggregate more copper was to be had than demand called for. Trade in brass and copper products felt a slightly better demand in the first week of the month, but it soon diminished and the advances to 14.50c. cash and 14.62½c. cash were considered as examples of trying to boost the market too rapidly. Eastern mills rolling copper complained that the orders they were getting did not assure activity more than a few days ahead. The third week of the month was dull, with the range of quotations wide. An interesting disclosure at this time was that American makers of brass and copper tubes have been compelled to reduce their base prices 3c. per pound to meet competition, most of which came from abroad. The new quotations were 16c. for seamless brass tubes and brass tubes, iron pipe sizes, and 19½c. for copper tubes. Ordinary brands of Lake copper were quoted at 14.75 to 14.87½c. cash, in the early part of April, but prices tapered off as the month progressed, although choice brands remained nominal at around 15c. cash. Exports, up to April 24, were 23,388 tons. The Waterbury average for March was 15 cents.

LEAD

The report for March left the New York price of lead at 3.90c., but on March 30, the big interest reduced its New York quotation to 3.80c., New York, whereupon the St. Louis quotations came down to 3.67½c. The Western price varied between the latter figure and 3.70 throughout April, while the New York price was unchanged. The reduction to 3.90c. induced good buying of small lots and that to 3.80c. brought about some real heavy purchasing. With the low prices came an easier market abroad and the exportations which had been a feature theretofore were lessened. At the lower prices the market looked attractive to investors in no way regularly associated with dealing in lead, who bought to some extent for speculation. Following the starting of low prices and the big sales, there was not much doing until the latter part of the month, when there was again fair buying on a basis of 3.67½c., St. Louis, which caused the Western price to advance to 3.70c. again. Firmness prevailed toward the end of the month.

TIN

This metal lost over 2½c. per pound in April, the almost steady course of the market being downward. The price on April 1 was 37.75c., on April 8, 36.75c., on April 15, 36.15c., and on April 23, 35.12½c., for large lots, prompt delivery. London declined steadily also, and at times, in the third week of the month, there were drops of £2 to £3 in a single day. The London quotation for spot on April 22, £161, was the lowest of the year. Consumers did not come forward to any great extent at any time up to April 22, despite the fact that prices were low and sellers pressing to get business. The best of the buying was on the part of dealers. The unsatisfactory state of the American iron and steel trade was held responsible for a large part of the dullness and corresponding weakness. It was hoped that orders might accumulate over the Good Friday and Easter holidays, which were observed by the Exchange here and abroad, but more particularly on the other side, where the London Metal Exchange closed from the eve of Good Friday until the following Tuesday. But the looked for orders were wanting. Deliveries into consumption in March were good, amounting to 4450 tons. The total for three months of 1914 showed a decrease of 1750 tons as compared with the same period last year. The total visible (world's) supply on March 31 was 16,989 tons, or 5857 above that of March 31, 1913. In stock and landing April 1 was 1997 tons. The arrivals in April up to the 23rd amounted to 4326 tons and there was afloat on that day 1160 tons. On April 24 tin broke £5 5s. at London, and the New York price fell about 1c., which made the total loss of the month about 3½c. Later in the day there was a recovery which left a net loss of £4.

The Metal Markets

LOCAL METAL PRICES

San Francisco is not a primary market for the common metals except quicksilver. The prices quoted below therefore represent sales of small lots and are not such as an ore producer could expect to realize. Ore contracts usually call for settlement on the basis of Eastern prices, less freight and treatment charges. The prices quoted are in cents per pound, except in the case of quicksilver, which is quoted in dollars per flask of 75 pounds.

San Francisco, April 30.

Antimony	9	— 9½c
Electrolytic copper	15½	— 15½c
Pig lead	4.15	— 5.10
Quicksilver (flask)		\$39.00
Tin	40½	— 42c
Spelter	6½	— 6¾c
Zinc dust, 100 kg. zinc-lined cases, 7½ to 8c. per pound.		

EASTERN METAL MARKET

(By wire from New York.)

NEW YORK, April 30.—Copper had a downward tendency at the beginning of the week, but is moving up, and is now strong. European and American consumers buying. Copper shares show little change, but the demand for them is increasing. Amalgamated is firm, and A. S. & R. dropped slightly. Lead is firm. The St. Louis market is dull at 3.80c. for lead, and 4.90c. for spelter. This metal is quiet in New York. Quotations in London are copper, £64 2s.6d.; lead, £19; and spelter, £21 7s.6d. per ton. Bar silver is 27.18d. per ounce.

SILVER

Below are given the average New York quotations in cents per ounce, of fine silver.

Date.	Average week ending
Apr. 23.....	58.50
" 24.....	58.50
" 25.....	59.00
" 26 Sunday	58.45
" 27.....	59.12
" 28.....	59.25
" 29.....	59.00

Monthly averages.

	1913.	1914.		1913.	1914.
Jan.	63.01	57.58	July	58.70	.....
Feb.	61.25	57.53	Aug.	59.32	.....
Mch.	57.87	58.91	Sept.	60.53	.....
Apr.	59.26	58.52	Oct.	60.88	.....
May	60.21	.....	Nov.	58.76	.....
June	59.03	.....	Dec.	57.73	.....

China and India have both been buying, as well as the Continent. Orders from India have been mostly for shipment by the steamer which is timed to arrive in Bombay for the May settlement, according to Samuel Montagu & Co. The total silver imported into the United Kingdom up to the end of March was 22,449,046 oz., compared with 33,634,311 and 34,474,199 oz. during similar periods in 1913 and 1912. The reduction of supplies to less than two-thirds of those in the previous years, chiefly as a consequence of the difficulties in Mexico, demonstrates what a powerful factor that country is in the silver market. In gauging the present position of the market, some importance should be attached to the change of sentiment which must follow the final dispersal of the erstwhile speculative stocks. The knowledge that these existed, the uncertainty created by their size, and the possibility of their forcible realization, has, during recent years, discouraged buyers for trade purposes—who, be it remembered, are the principal consumers of the metal—from replenishing their stocks. The rise in price which attended the Indian Government purchases, failed to inspire confidence, as the market was well aware that speculative stocks had been only partly reduced. It is probable that, in these circumstances, trade consumers all over the world have been working from hand to mouth during the last three years or more. Toward the close of this period, the financial crisis of last December, in India, rendered up-country buyers unable, as well as unwilling, to send buying orders. It is, therefore, likely that a state of silver semi-starvation obtained in the country bazaars, pending an improvement in the financial situation. Buyers were well aware that 25,000,000 oz. could be obtained from the Syndicate at any reasonable price. All this tended to produce an inert and featureless market. With the exhaustion of the Syndicate's stock, the situation has changed.

COPPER

Quotations on copper as published in this column represent average wholesale transactions on the New York market and

refer to electrolytic copper. Lake copper commands normally 1-5 to 1-4c. per lb. more. Prices are in cents per pound.

Date.	Average week ending
Apr. 23.....	13.95
" 24.....	13.90
" 25.....	13.90
" 26 Sunday	13.95
" 27.....	14.05
" 28.....	14.10
" 29.....	14.10

Monthly averages.

1913.		1914.	1913.		1914.
Jan.	16.54	14.21	July	14.21	
Feb.	14.93	14.46	Aug.	15.42	
Mch.	14.72	14.11	Sept.	16.23	
Apr.	15.22	14.19	Oct.	16.31	
May	15.42		Nov.	15.08	
June	14.71		Dec.	14.25	

The copper situation in England and Europe at the end of March was as follows, according to Henry R. Merton & Co.: stocks of standard and fine metal at London, Liverpool, Swansea, Newcastle, and Birmingham, 9948; fine copper at Havre, 1791; fine at Rotterdam, Hamburg, and Bremen, 19,979; and afloat from Chile to Europe, 2350; from Australia, 3800; a total visible supply of 26,129 tons, or 58,528,960 lb. At other European ports there was estimated to be 600 tons. The respective figures at the same date of 1913 were as follows: 22,527, 3534, 38,874, 2200, 4000, 45,074, and 2500 tons.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.	Average week ending
Apr. 23.....	3.90
" 24.....	3.90
" 25.....	3.90
" 26 Sunday	3.80
" 27.....	3.90
" 28.....	3.90
" 29.....	3.90

Monthly averages.

	1913.	1914.		1913.	1914.
Jan.	4.28	4.11	July	4.35	.....
Feb.	4.33	4.02	Aug.	4.60	.....
Mch.	4.32	3.94	Sept.	4.70	.....
Apr.	4.36	3.86	Oct.	4.37	.....
May	4.34	.....	Nov.	4.16	.....
June	4.33	.....	Dec.	4.02	.....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending	Apr. 16.....	39.00
Apr. 2.....	" 23.....	39.50
" 9.....	" 30.....	29.00

Monthly averages.

Zinc is quoted as spelter, standard Western brands, St. Louis			
delivery, in cents per pound.			
Date		Average week ending	
Apr. 23	4.90	Mch. 18	5.10
" 24	4.90	" 25	5.10
" 25	4.90	Apr. 1	5.13
" 26 Sunday		" 8	5.10
" 27	4.90	" 15	5.03
" 28	4.90	" 22	4.90
" 29	4.90	" 29	4.90

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date.	Average week ending
Apr. 23.....	4.90
" 24.....	4.90
" 25.....	4.90
" 26 Sunday	4.90
" 27.....	4.90
" 28.....	4.90
" 29.....	4.90

Monthly averages.

1913.		1911.	1913.		1914.
Jan.	6.88	5.14	July	5.11	.....
Feb.	6.13	5.22	Aug.	5.51	.....
Mch.	5.94	5.12	Sept.	5.55	.....
Apr.	5.52	4.98	Oct.	5.22	.....
May	5.23	.....	Nov.	5.09	.....
June	5.00	.....	Dec.	5.07	.....

TIN.

New York prices control in the American market for tin, since the metal is almost entirely imported. San Francisco quotations average about 6c. per lb. higher. Below are given average monthly New York quotations, in cents per pound:

Monthly averages.

1913.		1914.		1913.		1914.	
Jan.	50.45	37.85	July	40.70			
Feb.	49.07	39.76	Aug.	41.75			
Mch.	46.95	38.10	Sept.	42.45			
Apr.	49.00		Oct.	40.61			
May	49.10		Nov.	39.77			
June	45.10		Dec.	37.57			

The Stock Markets

SAN FRANCISCO STOCKS AND BONDS (San Francisco Stock and Bond Exchange) April 29

BONDS					
Listed.	Bid	Ask	Unlisted.	Bid	Ask
Associated Oil Co.	8	100	Natomas Consol. Co.	—	26
Natomas Con.	31	—	Pac. Port. Cement Co.	100	—
Unlisted.	—	—	Santa Cruz Cement Co.	—	87
Ass. Oil Co.	—	85	Union Oil	86½	—
General Petroleum Co.	42	44			

STOCKS					
Listed.	Bid	Ask	Unlisted.	Bid	Ask
Amalgamated Oil	77	—	General Petroleum	—	6½
Associated Oil	38	38½	Noble Electric Steel	80c	—
Giant	—	85	Natomas Consol	50c	—
Pac. Int. Borax, com.	50	—	Pac. Port. Cement	90	94
Pacific Crude Oil	—	30c	Itserside Cement	—	63
Union Oil	74	—	Santa Cruz Cement	40	41
			Stand. Port. Cement	19	—

NEVADA STOCKS (By courtesy of San Francisco Stock Exchange.) April 30.

Atlanta	\$.21	Montana-Tonopah	\$.88
Belcher	.28	Nevada Hills	.30
Belmont	7.25	North Star	.20
Con. Virginia	.12	Ophir	.22
Florence	.51	Pittsburg Silver Peak	.30
Goldfield Con.	1.45	Round Mountain	.31
Goldfield Oro	.12	Sierra Nevada	.08
Hallfax	.75	Tonopah Extension	2.17
Jim Butler	.86	Tonopah Merger	.60
Jumbo Extension	.25	Tonopah of Nevada	6.70
MacNamara	.04	Union	.09
Mexican	1.10	Victor	.32
Midway	.30	West End	.86
Mizpah Extension	.35	Yellow Jacket	.21

COPPER SHARES—BOSTON (By courtesy of J. C. Wilson, Mills Building.) April 30.

	Bid	Ask		Bid	Ask
Allouez	40	40½	Mohawk	\$ 43½	44
Ariz. Commercial	41	41	Nevada Con.	14½	14½
Butte & Superior	33½	34½	North Butte	25½	26
Calumet & Arizona	61	64½	Old Dominion	46½	47½
Calumet & Hecla	416	420	Oscoda	71	73
Copper Range	36½	36½	Quincy	59	60
Daly West	2	2½	Shannon	5½	6
East Butte	10½	10½	Superior & Boston	1½	2
Franklin	4½	5	Tamarack	31½	35
Granby	78½	79	U. S. Smelting, com.	33½	34
Greene Cananea	32½	33	Utah Con.	10	10½
Isle-Royale	18½	19	Winona	3	3½
Mass Copper	3½	3½	Wolverine	41½	43

NEW YORK CURB QUOTATIONS (By courtesy of E. F. Hutton & Co., Kohl Building.) April 30.

	Bid.	Ask.		Bid.	Ask.
Braden Copper	77½	8	La Rose	1¾	1½
Braden 6s	158	162	Mason Valley	2¾	2¾
B. C. Copper	1½	1¾	McKinley-Dar	60c.	64c.
Con. Cop. Mines	1½	1¾	Mines Co. Am.	2¾	2½
Davis-Daly	½	5%	Nipissing	6¼	6¾
Ely Con.	2	4	Ohio Copper	¼	¾
First National	1¾	2¼	Stand. Oil of Cal.	306	308
Giroux	½	1	Tri Bullion	¼	¼
Hollinger	15¾	16¾	Tuolumne	¾	¾
Iron Blossom	1.15	1.25	United Cop. Co.	¼	¾
Kerr Lake	1¼	4¼	Yukon Gold	2½	2¾

NEW YORK STOCK EXCHANGE (By courtesy of J. C. Wilson, Mills Building.) April 30.

	Bid	Ask		Bid	Ask
Amalgamated	\$ 72½	72½	Miami	\$ 22½	22½
Anaconda	33½	33½	Nevada Con.	14½	14½
A. S. & R., com.	62	62½	Quicksilver, com.	1½	2
Calif. Pet., com.	22½	22½	Ray Con.	20½	20½
Chino	40	40½	Tenn. Copper	33½	34½
Guggenheim Ex.	52	52½	U. S. Steel, pfd.	108½	109
Inspiration	17	17½	U. S. Steel, com.	58	58½
Mexican Pet., com.	57½	57½	Utah Copper	54½	54½

LONDON QUOTATIONS (By cable, through the courtesy of Cathin & Powell Co., New York.) April 30.

	£	s.	d.		£	s.	d.
Alaska Mexican	1	7	6	Mexican Eagle, com.	1	12	0
Alaska Trendwell	8	5	0	Mexico Mines	4	10	0
Alaska United	1	2	6	Mosina	1	8	9
Arizona	1	17	6	Oroville	0	12	6
Camp Bird	0	10	0	Pacific Oilfields	0	2	6
Cobalt Townsite	2	3	9	Rio Tinto	71	10	0
Eloro	0	12	6	Santa Gertruda	0	12	6
Esperanza	0	16	9	Tanganyika	2	2	6
Granville	0	10	0	Tombay	1	1	8
Kern River Oilfields	0	8	9				

AUSTRALASIAN April 30.

	£	s.	d.		£	s.	d.
British Broken Hill	2	1	3	Mount Elliot	3	13	9
Broken Hill Prop.	1	17	6	Mount Lyell	1	7	6
Golden Horse-Shoe	2	11	3	Mount Morgan	3	2	6
Great Boulder Prop.	0	15	0	Waihi	2	6	0
Ivanhoe	2	15	0	Waihi Grand Junction	1	6	3
Kaikurua	1	17	8	Zinc Corporation, Ord.	1	0	0
Mount Boppy	0	12	6				

Current Prices for Ores and Minerals

(Corrected monthly by Atkins, Kroll & Co.)

The prices are approximate, subject to fluctuation, and to variation according to quantity, quality, and delivery required. They are quoted, except as noted, f.o.b. San Francisco. Buying prices marked *.

	Min.	Max.
Antimony ore, 50%, ½ ton	*\$18.00	\$20.00
Arsenic, white, refined, ½ lb	0.03	0.04
Arsenic, red, refined, ½ lb	0.08	0.08½
Asbestos, chrysotile	100.00	350.00
Asbestos, amphibole	5.00	10.00
Asphaltum, refined, ½ ton	11.50	20.00
Barium chloride, commercial, ½ ton	40.00	42.50
Barium sulphate (barytes), prepared, ½ ton	20.00	30.00
Bismuth ore, 15% ½ ton	*250.00	upward
Chrome ore, according to quality, ½ ton	10.00	12.50
China clay, English, levigated, ½ ton	15.00	20.00
Cobalt metal, refined, f. o. b. London, ½ lb	2.50	
Coke, foundry, ½ 2240 lb	12.00	15.00
Diamonds:		
Borls, according to size and quality, ½ carat	2.00	15.00
Carbons, according to size and quality, ½ carat	55.00	80.00
Feldspar, ½ ton	5.00	25.00
Firebrick:		
Silica, ½ M.	50.00	55.00
Snowball, ½ M.	40.00	45.00
Flint pebbles for tube-mills, Danish, ½ 2240 lb	21.50	22.50
Fluorspar, ½ ton	10.00	15.00
Fullers earth, according to quality, ½ ton	20.00	30.00
Gilsonite, ½ ton	35.00	40.00
Graphite:		
Amorphous, ½ lb	0.01½	0.02½
Crystalline, ½ lb	0.04	0.13
Gypsum, ½ ton	7.50	10.00
Infusorial earth, ½ ton	10.00	15.00
Iridium	55.00	
Magnetite, crude, ½ ton	5.00	7.50
Magnetite, dead calcined, ½ ton	20.00	25.00
Manganese ore, oxide, crude, ½ ton	10.00	15.00
Manganese, prepared, according to quality, ½ ton	30.00	70.00
Mica, according to size and quality, ½ lb	0.05	1.00
Molybdenite, 95% MoS ₂ , ½ ton	600.00	750.00
Monazite sand (5% thorium), ½ ton	150.00	200.00
Nickel metal, refined, ½ lb	0.45	0.60
Ochre, extra strength, levigated, ½ 100 lb	1.50	2.00
Osmiridium, ½ oz	25.00	
Platinum, native, crude, ½ oz	30.00	45.00
Silic lining for tube-mills ½ 2240 lb	35.00	45.00
Sulphur, crude, ½ ton	15.00	25.00
Talc, prepared, according to quality, ½ ton	20.00	50.00
Tin ore, 60%, ½ ton	450.00	500.00
Tungsten ore, 65%	425.00	450.00
Uranium ore, 10% min.	25.00	per unit
Vanadium ore, 15% V ₂ O ₅ , ½ ton	150.00	180.00
Wolframite (see tungsten ore).		
Zinc ore, 50% up, ½ ton	*15.00	20.00

During February, the output of the Rand was 1,861,442 tons of ore averaging \$6.44 per ton, at a working cost of \$4.30 per ton. The total profit was \$3,955,000.

Current Prices for Chemicals

(Corrected monthly by Braun-Knecht-Helmann Co.)

Prices quoted are for ordinary quantities in packages as specified. For round lots lower prices may be expected, while in smaller quantities advanced prices are ordinarily charged. Prices named are f.o.b. San Francisco and subject to fluctuation. Other conditions govern Mexican and foreign business.

	Min.	Max.
Acid, sulphuric, com'l, 66%, drums, $\frac{1}{2}$ 100 lb.	\$0.85	\$1.10
Acid, sulphuric, com'l, 66%, carboy, $\frac{1}{2}$ 100 lb.	1.25	1.75
Acid, sulphuric, C. P., 9-lb. bottle, bbl., $\frac{1}{2}$ lb.	0.13	0.18
Acid, sulphuric, C. P., bulk, carboy, $\frac{1}{2}$ lb.	0.09 $\frac{1}{2}$	0.12
Acid, muriatic, com'l, carboy, $\frac{1}{2}$ 100 lb.	1.85	3.00
Acid, muriatic, C. P., 6-lb. bottle, bbl., $\frac{1}{2}$ lb.	0.15	0.20
Acid, muriatic, C. P., bulk, carboy, $\frac{1}{2}$ lb.	0.10 $\frac{1}{2}$	0.15
Acid, nitric, com'l, carboy, $\frac{1}{2}$ 100 lb.	6.00	6.50
Acid, nitric, C. P., 7-lb. bottle, bbl., $\frac{1}{2}$ lb.	0.16	0.22
Acid, nitric, C. P., bulk, carboy, $\frac{1}{2}$ lb.*	0.12 $\frac{1}{2}$	0.15
Argols, ground, bbl., $\frac{1}{2}$ lb.	0.10	0.20
Borax, crystal, and conc., bags, $\frac{1}{2}$ 100 lb.	3.00	4.95
Borax, powdered, bbl., $\frac{1}{2}$ 100 lb.	3.38	4.60
Borax glass, gd. 30 mesh, cases, tin lined, $\frac{1}{2}$ 100 lb.	10.50	13.60
Bone ash, 60 to 80 mesh, bbl., $\frac{1}{2}$ 100 lb.	5.50	6.50
Bromine, 1-lb. bottle, $\frac{1}{2}$ lb.	0.55	0.65
Clay, domestic fire, sack, $\frac{1}{2}$ 100 lb.	1.50	2.00
Cyanide, 98 to 100%, 100-lb. case, $\frac{1}{2}$ lb.	0.18	0.22
Cyanide, 98 to 100%, 200-lb. case, $\frac{1}{2}$ lb.	0.18	0.22
Cyanide, 129%, 100-lb. case, $\frac{1}{2}$ lb.	0.22	0.26 $\frac{1}{2}$
Cyanide, 129%, 200-lb. case, $\frac{1}{2}$ lb.	0.22	0.25
Lead acetate, brown broken, casks, $\frac{1}{2}$ 100 lb.	9.00	10.60
Lead acetate, white broken, casks, $\frac{1}{2}$ 100 lb.	10.50	10.75
Lead, C. P., test, gran., $\frac{1}{2}$ 100 lb.	12.50	13.25
Lead, C. P., sheet, $\frac{1}{2}$ 100 lb.	13.00	15.00
Litharge, C. P., silver free, $\frac{1}{2}$ 100 lb.	15.00	18.00
Litharge, com'l, $\frac{1}{2}$ 100 lb.	11.50	13.50
Manganese ox., blk., dom. in bags, $\frac{1}{2}$ ton	8.00	9.50
Manganese ox., blk., "Australian, in casks, $\frac{1}{2}$ ton	20.00	25.00
Manganese ox., blk., "Australian, in casks, $\frac{1}{2}$ ton	39.00	50.40
(*5% MnO ₂ -1% Fe)		
Nitre, double ref'd, small cryst., bbl., $\frac{1}{2}$ 100 lb.	7.00	8.00
Nitre, double ref'd, granular, bbl., $\frac{1}{2}$ 100 lb.	7.50	7.60
Nitre, double ref'd, powdered, bbl., $\frac{1}{2}$ 100 lb.	7.25	8.00
Potassium bicarbonate, cryst., $\frac{1}{2}$ 100 lb.	12.00	15.00
Potassium carbonate, calcined, $\frac{1}{2}$ 100 lb.	7.50	9.00
Potassium permanganate, drum, $\frac{1}{2}$ lb.	0.10 $\frac{1}{2}$	0.13
Silica, powdered, bags, $\frac{1}{2}$ lb.	0.03	0.05
Soda, carbonate (ash), bbl., $\frac{1}{2}$ 100 lb.	1.50	1.75
Soda, bicarbonate, bbl., $\frac{1}{2}$ 100 lb.	2.00	2.50
Soda, caustic, ground, 98%, bbl., $\frac{1}{2}$ 100 lb.	3.00	3.25
Soda, caustic, solid, 98%, drums, $\frac{1}{2}$ 100 lb.	2.50	2.75
Zinc shavings, 80% fine, bbl., $\frac{1}{2}$ 100 lb.	12.00	13.00
Zinc sheet, No. 9-18 by 84, drum, $\frac{1}{2}$ 100 lb.	10.20	11.00

*Extra charge for packing nitric acid for shipment to conform to regulations.

Current Prices for Oils and Candles

(Corrected monthly by Standard Oil Co., California.)

All prices are f.o.b. San Francisco except where otherwise specified, and are subject to change without notice.

Granite Mining Candles.	Per set, cents.	Granite Mining Candles.	Per set, cents.
6s-12 oz.-10s	8 $\frac{1}{2}$	6s-14 oz.-20s	9 $\frac{1}{2}$
6s-12 oz.-20s	9	6s-16 oz.-40s	10
6s-14 oz.-40s	9 $\frac{1}{2}$	6s-16 oz.-20s	10 $\frac{1}{2}$

Extra hard 1c, per set higher than the above.

The following prices are for oils (Calol) in wood barrels; cases (2-5 gal.) 3c, per gallon higher.

	Per gal., cents.		Per gal., cents.
Compressor oil	40	Light gas engine oil	28
Amber gas engine oil	40	Red compressor oil	28
Castor machine oil	20	Red engine oil	17
Dynamo and motor oil	24	Turbine oil	17
Engine oil	24	Turbine oil, heavy	35
Gas engine oil	26	Diesel engine oil	40
Heavy gas engine oil	45	Cylinder oil	37
Heavy red engine oil	19	High-pressure cylinder oil	50
Heavy red Journal oil	21	Low-pressure cylinder oil	37
Ice machine oil	28	Valve oil	50

The following prices are for oils in iron barrels, cases (2-5 gal.) 7c, per gallon higher, except on kerosene, which is 8c, per gallon higher.

	Per gal., cents.		Per gal., cents.
Pearl oil	9	Red Crown gasoline	15 $\frac{1}{2}$
Headlight oil	10	Engine distillate	7 $\frac{1}{2}$
Kerosene oil	11	Aroturps	23
Star fuel oil, f.o.b. Richmond		Per bbl.	\$1.00
(Wood barrels, f.o.b. Richmond.)			
Petrolastic cement X		Per ton.	\$12.00
Petrolastic cement XX			11.00
Asphaltum			\$3.50 to 12.50

Company Reports

BRACKAN MINES COMPANY

This is one of the important Rand companies, and the report for 1913 includes the following: Work was hindered by a subsidence of some stopes and scarcity of labor, consequently development went behind, affecting the grade of ore by 70c. per ton. Ore reserves total 2,242,000 tons averaging \$6.70 per ton, a reduction of 215,000 tons. Ore mined was 695,173, and including that on the surface the total was 713,263 tons. Sorting reduced this to 611,519 tons, or 14.265%, while 613,269 tons was milled averaging \$6.83 per ton. The recovery was \$6.70 per ton, with a total value of \$4,150,000. Costs were \$4.51 per ton. The net profit was \$1,400,000, and \$1,150,000 was paid in dividends. The sum of \$290,000 was carried forward.

NEW IDRIA QUICKSILVER MINING COMPANY

This Company operates in San Benito county, California, and the report covers the past year. The general manager, W. K. Buckminster, states that development totaled 9182 ft. The upper levels have been worked extensively, and are nearly depleted to 'D space' at No. 4 level. Above No. 4 $\frac{1}{2}$ level, 'E space,' two new stopes show a fair tonnage of ore. A downward extension is expected. Above No. 6 level prospecting will be carried on extensively, and may produce a good deal of ore. Probably areas above No. 7 level will give some ore, also above No. 8 level. A small body of high-grade ore is opened at the west end of No. 9 level. The Molino adit has been in heavy ground, but is being pushed ahead to get under the San Carlos deposits. Three furnaces were in commission. No. 1 will be repaired in the spring. The price of quicksilver was low during the year. Ore produced was 76,993 tons, yielding 9700 flasks of quicksilver. The revenue was \$363,054; net earnings, \$65,013; dividends, \$40,000; and total surplus, \$144,600.

ARIZONA COMMERCIAL MINING COMPANY

This Company operates at Copperhill, near Globe, Arizona, and the report is for 1913. Development showed the following results: On No. 5 level there is 120 ft. of 2% copper ore over a width of 2 ft. There is no way of handling this grade at present. On No. 7, and between it and No. 6 level, there is 200 ft. of ore, including several lenses of high-grade ore. About 80 ft. averages 4.5% copper over 4 ft. At No. 10 there is a shoot 25 ft. wide, of smelting ore, averaging 2% copper, 40% iron, and 20% sulphur. On No. 12 the vein has been proved by driving a drift in the foot-wall and cross-cutting at intervals of 100 ft., exposing from 46 to 100 ft. of ore of various grades, including several streaks of smelting ore. Shipments from development were 494 tons averaging 3.58% copper. A watercourse was cut on No. 12 level in October, and a dam was built in the main cross-cut and work abandoned on the level. The shaft was sunk about to No. 14 level at the end of the year. A triplex pump was installed, and a change-house for 100 men erected. Generally, the work being done is thoroughly proving the property.

Decisions Relating to Mining

ANNUAL LABOR IN ALASKA—FORFEITURE FOR NON-COMPLIANCE.

Under the laws of Alaska, when a mining location has lapsed owing to the non-performance of annual labor during a given year, there can be no saving of the locator's rights by resumption of work prior to the intervention of other parties. The location is absolutely forfeited by operation of law at the expiration of the year in which no assessment work is done.

Ebner Gold Mining Co. v. Alaska-Juneau Gold Mining Co. (Alaska), 210 Federal, 599. January 5, 1914.

OIL LEASE—FORFEITURE UPHELD

Where lessees under an oil lease, in violation of the express terms of the lease, abandoned a drilled well and ceased work for a greater period than 60 days thereon, the lessors are clearly entitled to claim a forfeiture without waiting for the expiration of the term. Nor is it necessary for the lessor, in order to show compliance on his part with another provision of the lease requiring him to pay one-half the cost of drilling a second well, to make a tender of such one-half before work on the second well is begun.

Dittman v. Keller (Indiana), 104 Northeastern, 40. February 3, 1914.

OIL LEASE—EFFECT OF DUE DILIGENCE

The rule for construction of covenants in an oil lease most strongly in favor of the lessor cannot be invoked by him to dispossess a lessee who has faithfully performed all his covenants, has discovered oil in paying quantities, and paid the stipulated royalty. It will be presumed that an oil lease is made for immediate development, unless the contrary appears from its language. Upon the discovery of oil and gas in paying quantities, the lessee acquires a vested interest in the oil and gas as long as it can be produced in paying quantities, and the subsequent abandonment of several wells because the oil may be more profitably mined through a fewer number of wells does not warrant a forfeiture of the lease.

Burgen v. South Penn. Oil Co. (Pennsylvania), 89 Atlantic, 821. January 5, 1914.

MINERAL ENTRY—GROUNDS FOR CANCELLATION

Land embraced in a subsisting patent issued upon a timber and stone entry is not subject to location and entry under the mining laws, notwithstanding the land was embraced in a valid subsisting mining location at the date of the timber and stone entry and was at that date known to be chiefly valuable for mineral. Where the discovery upon which the location was based lies within the boundaries of the prior timber and stone patent it is lost to the mineral applicant and such loss invalidates his location unless, prior to application for patent or the asserting of an adverse claim to the ground under the mining laws, he makes a sufficient discovery within the remainder thereof. The verification of an application for patent by an attorney-in-fact for the claimant at a time when the claimant himself is both resident and physically within the land district, is contrary to regulations, and invalidates an entry allowed upon such application. Forfeiture of a co-owner's interest under Section 2324 Revised Statutes cannot take place where claimant has obtained possession under color of a laborer's lien, but has never foreclosed the same in accordance with the state law. He is not a co-tenant with the former owner within the meaning of said section.

F. E. Robbins (Land Department) 42 Land Decisions, 481. September 3, 1913.

Book Reviews

THE MINING WORLD INDEX. For the second half of 1913. By George E. Sisley. Volume IV. P. 190, also 28 pages of authors' index and subject index. Mining World Co., Chicago, 1914. For sale by the *Mining and Scientific Press*. Price \$2.

The regular publication of this index is creating more interest each half-year, especially when it is known that the articles from about 330 journals and society transactions throughout the world are noted. These include papers of interest to mining men, metallurgists, and engineers. References to each metal and non-metal, mills and treatment of ores, chemistry and metallurgy, are in separate chapters, themselves properly indexed, so that any subject is easily found. The addition of an authors' index makes this material even more readily available. The volume is of handy size, and is well worthy of being placed in any library.

ROCK EXCAVATING AND BLASTING. By J. J. Cosgrove. P. 179. Ill., index. The National Fire Proofing Co., Pittsburgh, 1913. For sale by the *Mining and Scientific Press*. Price \$2.50.

This work was written for the purpose of aiding the young engineer, superintendent, rockman, and miner, that he might have a more thorough knowledge of explosives, how to handle them and to get the best results in the various kinds of rock excavating. For those who are in charge of rock excavations, either open-cut, tunnel work, or shaft-sinking, this book will be found of particular interest. The work is fully illustrated, showing how to drill bore-holes to get the best results; how to charge the holes, methods of tunnel driving, shaft-sinking, quarry work, and open-cut excavating. The subject of rock-drilling tools, machinery, and explosives is also discussed.

THE MECHANICAL ENGINEER'S REFERENCE BOOK. By Henry Harrison Suplee. J. B. Lippincott Co., Philadelphia. P. 919. Index. For sale by the *Mining and Scientific Press*. Price \$5.

This is the fourth edition of Mr. Suplee's well known work, the first having been published in 1903. An appendix has been added giving data on miscellaneous matter, including the characteristics and application of aluminum; various metal alloys; a depreciation table; general data on coal; collapsing and bursting strength of pipe; heat transmission; notes on friction and lubrication; table for the determination of speed in railway trains; train resistance; mine ventilation; tables of slopes; foundation data and masonry construction; roof construction; coefficients of friction; general data on power-transmission machinery; floor construction; reinforced concrete columns, and entropy.

DESIGNING AND DETAIL OF SIMPLE STEEL STRUCTURES. By Clyde T. Morris. McGraw-Hill Book Co., New York. P. 249. Index. For sale by *Mining and Scientific Press*. Price, \$2.25.

This is the third edition of Mr. Morris' well known work, the first having been published in 1909. The entire book has been revised and several of the chapters have been partly rewritten. A new chapter on highway bridges has been added, together with a reprint of the specifications for steel highway bridges of the State Department of Ohio. The text has been prepared primarily with a view to the presentation of data applicable to simple structures and which can be taken up in the technical schools during the comparatively limited time usually allotted to the subject. General cases and specific examples are given of the application of the laws of statics to steel structures in order that details may be produced which are in accordance with the stresses to which they are subjected.

Industrial Progress

Oxy-Acetylene Welding and Cutting

One who has seen an oxy-acetylene apparatus at work cannot but be impressed with the advance which this comparatively simple apparatus marks in the field of cutting and welding. Its uses are many and it has been found an especially valuable adjunct to the mine machine-shop. Among its many uses may be mentioned the reclaiming of cracked or broken castings of cast iron, steel, brass, bronze, or aluminum; adding metal to parts subjected to friction; repair-



PORTABLE WELDING OUTFIT.

ing boilers by welding in new parts or filling in cracks edge to edge; welding split piping, which can be done usually without breaking the connections; welding flanges or pipes; cutting off rivet heads and driving out the shanks; putting extensions on shafting; restoring to original size bolt holes which have been worn by use; adding small metal parts which have been broken off or are missing; recovering teeth broken from gear wheels; cutting steel or wrought iron down to the thickness of one-eighth inch; cutting steel plates, girders, rails, and all kinds of structural steel; making metal containers without joints; removing defective parts and repairing shapes with perfect sheets of the same shape welded into position edge to edge; and many similar uses.

The accompanying halftone shows a portable outfit manufactured by the Great Western Cutting & Welding Co. of San Francisco. This is particularly suited for shops and mine use when the work is in different places, the outfit

being easily moved from place to place, and it is always ready for use. By changing the torch the apparatus may be used for either cutting or welding. The torches used are made under German patents, but have been improved under American patents. The generator, regulators, and controlling devices are based upon years of experience in both this country and Europe.

The Silver King Underground Station

In *Mine and Quarry* for April, H. E. Moon describes, as follows, the underground air-compressor and hoist station now being completed in the Silver Hill section of the property of the Silver King Coalition Mines Co., Park City, Utah.

It became advisable here to sink a shaft from 1200 to 1300 ft. deep at a point about two miles in from the mouth of the Alliance tunnel. This point is under 1600 ft. of cover and corresponds in elevation with the 500-ft. level of the main King shaft, through which the principal operations have been carried on thus far. The proposed shaft will be cut through to the quartzite contact, underlying the orebody that is now being worked, through the King shaft, a depth of 1300 ft. The Company decided to construct an underground station in the solid rock. This station is probably the largest one of the kind in this country. There are three rooms or chambers; first, a compressor room, 42 ft. long, 30 ft. wide, and 20 ft. high. The roof arch of this room is elliptical, and all the walls, as well as the roof, are of heavy reinforced concrete, designed to support the heavy top of badly broken limerock. Adjoining the compressor room is, second, the engine-room, 42 ft. long, 35 ft. wide, and rising in height from 12½ ft. at the back toward the shaft, at which it is 24 ft. high. These rooms are finished with smooth white cement plaster and are well lighted by electricity.

A first-motion, double-reel hoisting engine has been installed, driven direct by a 200-hp. motor, running at 65 r.p.m. and taking direct current at 600 volts from a motor-generator set placed in the compressor room. Air for the tunnel, shaft, and construction of the station has been supplied by three large air-compressors on the surface, which also furnish air for the King shaft and its workings. It was considered advisable to install an auxiliary compressor in the underground power station, to act as a booster on the main line, and ultimately to give regular additional capacity for sinking the shaft and developing the new workings below the tunnel-level. The machine selected for this purpose, particularly on account of its compactness and high air capacity per unit of floor space, was a Sullivan class WJ-3 angle compound compressor, with low-pressure cylinder 18 in. diameter, high-pressure cylinder 11 in. diameter, and a common stroke of 14 in. At its rated speed of 215 r.p.m., this machine has a displacement capacity of 886 cu. ft. of free air per minute.

The idea of the engineers in designing this plant was to have the compressor utilize the electric current during the intervals when the hoist was not running, thus eliminating excessive peak loads. To accomplish this, the compressor unloader is connected with the hoist, so that when current is thrown into the motor of the latter, this action automatically unloads the compressor and allows nearly the entire power of the synchronous motor set to be available for the hoist motor. When the hoisting current is thrown off, the unloader on the compressor is automatically opened, allowing the machine to work under full load again, thus providing a high load factor for the motor-generator set, as well as a nearly constant current demand. This synchronous motor-generator set furnishes direct current at 600 volts for the hoist, and the motor of the set takes current from the transmission lines on the surface at 2200 volts A.C., with a rated continuous input of 250 kva., and having 80% power factor. A motor-generator exciter set furnishes direct-current excitation for the large synchronous motor of the large set.

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EDITORIAL

CURIOS metal is the name applied to recent discoveries in El Dorado county. The characteristics of this 'curious metal' are described as "sharing the properties of both platinum and tungsten"; "so heavy that a chunk of it can scarcely be lifted in the hand"; "gives off emanations called the true electro rays which have the property of electro-plating"; and last, but not least, "will gold-plate an old tin can." While the fountain of youth has not as yet been linked with this discovery, hopes are entertained in that direction.

VALUING placer ground is a specialty, and many points that are so clear to a specialist as to seem not worth mentioning are continually confusing laymen. Early this year, both in London and New York, a great deal was made of the fact that the Pato dredge returns were over-running the reported average for the ground. We pointed out, January 24, that the fact was of little significance, and are glad to print this week a brief article by Mr. L. A. Decoto explaining exactly how such an over-run might occur in a theoretical case. Mr. Decoto's note has all the more value because he was himself in charge at Pato for some time. In fact, the Oroville officers, properly enough, began work on the richest ground, so as to recover as promptly as possible the money invested.

SPEAKING of intervention, we note with approval that it has been begun in Colorado. It is not necessary to decide the merits of the question in controversy between miners and operators to warrant one in affirming that the state has failed miserably to maintain the peace, and that is the first duty of a civilized government. Killing men, women, and children, destroying mines, using machine guns and armored trains, is war whether it be in Colorado or Mexico, and state troops that cannot or do not preserve the peace at home are of doubtful value as volunteers for foreign service. If there is doubt as to the constitutional right of the United States to intervene in Colorado, how much clearer is the right as to Mexico? California, in insisting on anti-alien legislation, was considered somewhat regardless of the light in which it placed the United States abroad, but is not the same thing to be said of Colorado, which persists in a merry little civil war all its own at the very time that United States forces are being used to restore order in a neighboring republic?

ALASKA coal from the Matanuska fields, which was mined last summer under the direction of Mr. George Evans, acting for the Bureau of Mines, was recently delivered at tide water. The coal was freighted by an expedition headed by Mr. Jack Dalton, who estimates the cost of the coal delivered at tide water at \$65,000, or about \$72 per ton. While it would seem that this was a rather expensive undertaking, it is really the cost of getting a sample, not of mining coal. The work marks an important step in the development of the Alaska fields, and a correct knowledge of this fuel will undoubtedly lead to much needed development.

DECISION of the case on appeal of Minerals Separation, Limited, *versus* James M. Hyde, was announced Monday last in this city. We present the complete text on the following pages and therefore little comment is necessary. Our readers will, we hope, pardon the necessity for offering them the matter in small type rather than our customary 10-point. This is a case where we feel that prompt publication in full is more important than form, for the decision is of the greatest importance to all concerned in metallurgy. As forecasted in our editorial of April 18, the court decided the case virtually upon the technical question whether or not "the 'agitation froth' of the Minerals Separation process is different from the oily 'magma' of the Froment or the areated oily mass of the Kirby and similar processes." Having found that as a matter of fact it was not different, the secondary question of extent of use did not come into play, as it might have done had the court been in doubt on the main point. The decision is a sweeping one, and, in brief, Minerals Separation is denied a basic process patent on the ground of no invention. It is a hard blow to that enterprising and able concern, for while, as we have been careful to point out, such a decision as has been rendered in this case is not, in the United States, absolutely final, the principle enunciated is very likely to control in any future litigation. Minerals Separation owns many patents and there is room for conflict over apparatus patents alone, but to sustain any claim to a basic process patent will be difficult. The Company has made no announcement yet of the policy it will pursue under the new conditions. To Mr. James M. Hyde and the Butte & Superior company hearty congratulations are in order. They were clear sighted enough to see, what the court has now held, that using the knowledge of the prior art and the skill of a careful metallurgist, it was possible to make a satisfactory recovery by flotation without infringing on Minerals Separation. What they can do others can do, and the process, as a process, is open to all; assuming that the principle announced be followed in any subsequent litigation. We wish it were possible to announce that there would be no more lawsuits, but apparently it is the way of the world in mining and metallurgy as well as in general industry.

Korean Gold Mines

The gold mining concessions in Korea are the subject of an article that we print this week by Mr. A. E. Drucker. His account is most interesting as a graphic portrayal of the trend of mining and milling in Korea and the scope and outlook of the industry. Since it was written, the re-grinding Taracol plant of the Oriental Consolidated Mining Company, mentioned as completed in May 1912, suspended operations, as recorded in the *Mining and Scientific Press* of March 14. This occurred on January 14 of the present year. The results were held to be not comparable with those of the old leaching plant, where work has been resumed.

Returns for 1913 at the Suan Concession now available show that the 40-stamp mill treated 71,535 tons and recovered gold to the value of \$671,536, with a profit of \$376,303. Dividends equal to 50 per cent of the capital stock were paid to the shareholders during the year. The Tul-Mi-Chung property on the Suan Concession is about to enter the producing stage, and a new 300-ton mill is soon to be erected which will be in operation within the next year. All of the machinery for the Company's new power plant at Pyeng Yang has arrived, and it is expected to have the plant in operation by September. This plant is 52 miles from the concession and consists of two 1000-kilowatt turbo-generator units. Other mines and prospects are in course of development on the Suan Concession and the outlook is most encouraging. Besides maintaining a 50 per cent dividend rate during the past three years, the ore reserves have increased from 421,300 tons valued at \$6,083,500 in 1912 to 633,340 tons valued at \$7,642,300 in 1913. The French concession has been hampered in the conduct of mining and development operations by internal friction in the conduct of the Company's affairs. That the property is of merit is beyond doubt and future exploitation is full of promise. The Chosen Gold Mines, Ltd., holding mining property at Kok Kang Kol, in south central Korea is also numbered among Korea's probable producers. A 40-ton mill has recently been put into operation with \$16 ore and a 93 per cent extraction, which the Company's engineers report after a great deal of experimental work. The future looks most encouraging. The Kapsan Mining concession is the last of the large concessions to be granted, and engineers' reports on development work to date variously estimate the reserves at from about 125,000 to 175,000 tons of ore which will average a little over 10 per cent copper.

With the decline in gold production in the older mining districts of the world, it is gratifying to note the rejuvenation of this ancient field in the Orient. While the present gold output of Korea, or Chosen, as the Japanese are wont to call the country, is not great, the mineral outlook is promising and important developments are anticipated. At a later date we shall publish a detailed account of the geology and ore deposits of one of the most interesting districts.

Decision in Flotation Litigation

The United States Circuit Court of Appeals for the Ninth Circuit, in the case of James M. Hyde, appellant, v. Minerals Separation, Limited, and Minerals Separation American Syndicate, Limited, appellees, argued at San Francisco in January, handed down the following opinion May 4.

The judges before whom the case was argued were Gilbert, Ross, and Dietrich, and the opinion was written by Mr. Justice Gilbert. The decision follows:

This is an appeal from the decree of the Court below sustaining Letters Patent No. 835,120, issued to Sulman, Picard, and Ballot, on November 6, 1906, and assigned to Minerals Separation, Ltd., and Minerals Separation American Syndicate, Ltd., adjudging the appellant herein to have infringed the same, and enjoining further infringement. The patent is for new and useful improvements in ore concentration. Its object is to separate metalliferous matter from gangue, by means of oils and fatty acids which have a preferential affinity for metalliferous matter. In the specifications reference is made to United States Letters Patent No. 777,273, granted to A. E. Cattermole. The Cattermole patent specifies that an amount of oil varying from 4% to 6% of the weight of metalliferous matter present is agitated with an ore pulp, so as to form granules which can be separated from the gangue. The specifications of the patent in suit state that the inventors have found that "if the proportion of oily substance be considerably reduced—say to a fraction of 1% on the ore—granulation ceases to take place, and after vigorous agitation there is a tendency for a part of the oil-coated metalliferous matter to rise to the surface of the pulp in the form of a froth or scum," and the specifications add: "The proportion of mineral which floats in the form of froth varies considerably with different ores, and with different oily substances, and before utilizing the facts above mentioned in the concentration of any particular ore, a simple preliminary test is necessary to determine which oily substance yields the proportion of froth or scum desired."

Patent Claims

There are 13 claims in the patent. The first is "the herein described process of concentrating ores, which consists in mixing the powdered ore with water, adding a small proportion of an oily liquid having a preferential affinity for metalliferous matter (amounting to a fraction of 1% on the ore), agitating the mixture until the oil-coated mineral matter forms into a froth, and separating the froth from the remainder by flotation. The next three claims specify the quantity of oil as amounting to "a fraction of 1% on the ore." The second claim adds to the first the use of slightly acidified water. The third adds to the second, "warming the mixture." The fourth adds to the third "and removing the oily coating from the mineral." The fifth specifies the oil as "oleic acid of a quantity of from 0.025 to 0.5% on the ore." The sixth adds to the fifth the use of water containing 1% of sulphuric acid. The seventh adds "warming the mixture to 30 to 40°C." The eighth specifies the use of oleic soap solution, to produce oleic acid, "amounting to 0.02 to 0.5%." The ninth is "the process of concentrating powdered ores which consists in separating the mineral from the gangue by coating the mineral with oil in water containing a small quantity of oil, agitating the mixture to form a froth, and separating the froth." The tenth adds to the ninth "warming the mixture," and the eleventh adds the use of acid. The twelfth adds "separating the froth from the remainder of the mixture," and the thirteenth adds a current of water to carry off the coarser minerals, and "filtering off the froth and removing the oleic acid therefrom by treatment with an alkali."

The answer of the appellant denied that Sulman, Picard, and Ballot were the first inventors of the process, or that there was any invention described in the patent, and denied infringement, and alleged that the process described in the patent was old and not patentable; that the process had been included in certain patents which were enumerated in the answer. The appellant was adjudged to have infringed claims numbered 1, 2, 3, 5, 6, 7, 9, 10, 11, and 12.

The appellees' process depends primarily upon the affinity of oil for the metalliferous portion of powdered ore when mixed with water. It is conceded that that affinity and the

fact that oil will carry the metalliferous portions to the surface of the mixture, while the rock or gangue will sink, have been known for many years. That which is presented as new in the patent, and as the pivotal discovery on which its validity depends, is the formation of a froth or scum containing the metalliferous matter produced by agitation of the pulverized ore in water, by the action of oil in a quantity less than 1% of the quantity of ore treated.

Early Patents

Turning to the patents which are adverted to as showing the prior art, we find the following: The British patent to Haynes, No. 188, issued in 1860, recommends the use of from 11 to 25% of oil by weight to the finely powdered ore, the mixture to be agitated with water, either warm or cold, until the earthy matter sinks and the metal is gathered by the oil. In that process the sunken earthy matter is removed, fresh ore is replaced, and the operation repeated with the same oil until it will take up no more metalliferous matter. The United States patent, No. 348,157, issued to Everson, in 1886, specified the use of oil in quantities varying from 5 to 18%. Miss Everson was the first to make the important discovery that the affinity of the oil for the metal was increased by the addition of an acid. In the description of her process, she states that in the operation, the mass is broken up and thoroughly stirred in water, in a vessel provided with a mechanical stirrer, and having an outlet or outlets at the bottom for the escape of the water and sand. The Schwartz United States patent No. 807,503, applied for in May 1904, and granted in December 1905, describes a process in which the dry ore is first mixed with enough oil to make a thick pasty mass, and water is thereafter added, and the mass is agitated so as to cause the metallic particles to float. The quantity of oil to be used is not further specified, but it is in the testimony that the Schwartz process has been experimentally used with cotton seed oil, the quantity used being 3.6% of ore treated. The United States patent to Kirby, No. 809,050, was applied for December 14, 1903, and granted January 16, 1906. The oil used by Kirby was kerosene oil in which 5% of bitumen was dissolved. One of the claims is as follows: "The process of separating minerals, which consists in mixing together the pulverized mineral material, a considerable quantity of water and a solution of bitumen in a distillable hydrocarbon liquid, the proportion of bitumen in solution being substantially sufficient to insure the coating and entrainment of the mineral particles; and allowing the same to settle, and removing therefrom the floating layer of said solution and the mineral particles which have been coated thereby." In his specifications he says: "These materials to be so thoroughly agitated together as to finely subdivide said solution into small globules, and bring said globules into contact with substantially all of the pulverized mineral particles, which will by preference adhere to them." And in describing the means for the agitation, he specifies a "vertically rotating shaft" in the mixing tank, which it is said is to be "rotated rapidly." No specific quantity of oil is prescribed, but it is stated in the specifications that a sufficient amount of the kerosene and bitumen in solution is to be used, "excellent results being obtained by using one-fourth to three-fourths as much by weight as ore." In the Froment Italian patent, issued May 20, 1902, and the British patent to Froment, issued June 4, 1903, the invention described is declared to consist "of a modification of what is known as the oil process of ore concentration." The modification consisted in releasing gas from the finely powdered ore, and "adding a suitable oil," resulting in a flotation of the oil and metal to the surface. Froment mentions the use of gas to aid in the flotation of sulphides reduced to powder and moistened by a fatty substance, in explanation of which the patentee says that if, for example, in a test-tube there is placed 10 gm. of sulphurated copper ore, with its gangue, a gram of limestone, the whole reduced to powder, and there is added thereto 30 gm. of water, a few drops of sulphuric acid "and a thin layer of ordinary oil," and the mixture is agitated for a second, the whole of the copper pyrite will instantly rise to the top of the liquid. The patentees of the appellees' patent purchased from Froment on November 17, 1903, the Froment patent, and Froment agreed to send all possible information, together with the plans, drawings, and model plant, to England, for the use of the purchasers. This agreement was carried out in December 1903. The instructions which Froment sent contains the following: "If the ore contains more than 5% of metallic matter, such as copper, lead, it will be neces-

say to use a little more oil. As a general rule one may assume 1% of oil for ore containing up to 5% of metals, 1½% of oil for ore containing up to 10%, and so on up to ores containing 50% of metallic lead, which it was said would require 3% of oil. In the instructions the mixing device is described as composed of a cylindrical body made of strong sheet iron riveted with bolts, in which two stirring devices work in opposite directions, making about 300 revolutions per minute. The Catermole process, which is referred to in the *Ex parte* Patent in controversy in this suit, is presented in two British patents, one No. 177,273 and one No. 777,274, both of date December 12, 1904. The amount of oil specified in the Catermole process is from 4 to 6% of the weight of metaliferous mineral matter present in the ore. This quantity would the amount of oil would be less than 1% of the mass treated. The fact that the final purpose of the Catermole process is to increase the sinking tendency of the metaliferous mineral instead of removing it upon the surface, does not render that process any less imperative as to the state of the mass, for there are two distinct steps in the treatment of the ore, the first a violent agitation to cause the oil to penetrate the metaliferous particles, as in the case of other oil flotation processes. Then follows a slow, smooth stirring of the mass, which releases the air from the froth or scum, and causes the oil and metaliferous particles to adhere together and form granules of sufficient size and weight to sink, where the mass at the bottom is drawn off and the particles of sand and gangue therein are forced upward and thus separated from the granules of metal. Here is described a process in which the quantity of oil used approximates the quantity which is called for by the *Ex parte* patent, a fraction of 1 per cent.

Comparison of Present and Past Patents

When the claims and the description of the process of the *Ex parte* patent are compared with the patents of the prior art, it will be seen that the only material difference is in the smaller quantity of oil which the *Ex parte* process uses. Comparing the *Ex parte* process with the *Ex parte* process, it will be seen that in both powdered ore is mixed with a sufficient water to form a fairly flowing pulp, that while *Ex parte* recommends the use of oil of from 1 to 5% of the ore by weight, the *Ex parte* recommends a fraction of 1% of oil, that *Ex parte* recommends the use of ordinary oil or a suitable oil, while the *Ex parte* patent mentions only heavy acids and oleaginous, that in both processes there is agitation of the mixture, that in both processes a small quantity of sulphuric acid is recommended, that in both processes the mixture of all the substances is made before the agitation, and that in both processes bubbles of air or gas are caught in the sulphides in the form of a froth which rises to the surface. So also in the Kirby patent the various steps of the process are similarly described. We find then the concentration of the ore mixing it with water to form a flowing pulp, mixing it with kerosene oil with a small percentage of bromine violently agitating the mass so as to bring the oil into contact with the mineral particles of the ore, causing the oil-coated mineral particles to rise and float on the surface of the water while the gangue sinks to the bottom, and lastly skimming the floating concentrate from the surface of the liquid. But the *Ex parte* says that the *Ex parte* patent is a patent, and that therefore it is to be discarded. A patent, if it fully describes an invention, whether it be a machine, device, or process, is just as effective to show anticipation as a patent which describes an invention which has come into extensive use, for a presumption of anticipation and of some utility attends the granting of Letters Patent. *Packard v. Lucine Seed Co.*, 70 Fed. 66; *E. L. Watson Mfg. Co. v. American Hardware Mfg. Co.*, 162 Fed. 902; *National Chemical & Fertilizer Co. v. Swift & Co.*, 104 Fed. 87, 91; *Universal Winding Co. v. Waltham Lumber Co.*, 82 Fed. 228; *Van Housen v. United Box Board & Paper Co.*, 143 Fed. 869; *Ironfield Mfg. Co. v. Derryman's Mfg. Co.*, 143 Fed. 512, 515; *Dashiell v. Grosvenor*, 162 U. S. 425, 432. In *Telephone cases*, 129 U. S. 1, 536 it was said: "The law does not require that a discoverer or inventor in order to get a patent for a process, must have succeeded in bringing his art to the highest degree of perfection. It is enough if he describes his method with sufficient clearness and precision to enable those skilled in the matter to understand what the process is and if he points out some practical way of carrying it in operation."

The fact that the *Ex parte* uses a smaller quantity of oil than was used in the prior art is not of itself, and it is not claimed by them to be sufficient to distinguish their process so as to render it new. It is true that the desired result may be accomplished with the use of a fraction of 1% of oil when formerly a much larger quantity of oil had been used, and had been deemed necessary, is not an invention or discovery

within the meaning of the patent laws. It is a difference of degree and not of kind. "A change only in form, proportions, or degree, doing substantially the same thing in the same way by substantially the same means with better results is not such invention as will sustain a patent." *Roberts v. Ryer*, 91 U. S. 150.

In *Ex parte Krupp Aktien-Gesellschaft v. Midvale Steel Co.*, 191 Fed. 588 the court said: "But more useful and economical administrative methods, however valuable, while they may, and usually are incident to invention, do not themselves constitute invention." And in *Delamar v. Delamar Min. Co. Ltd.*, 147 Fed. 210, 248, this court, referring to the use of zinc dust for the purpose of precipitating mineral in a solution said: "The right to use the dust being free to all, we think it follows necessarily that all have a right to adjust the quantity of the material to the necessities of each case, and ascertain by experiment or analysis, if need be, the quantity that may be required to produce the desired end, that such a use can not be made the subject of monopoly, there being involved in it no discovery, but only the exercise of ordinary prudence and skill." See also *Bridgely Brass Co. v. Ajax Metal Co.*, 169 Fed. 84; *Commercial Mfg. Co. v. General Electric Co.*, 149 Fed. 198; *Lachman v. Urschel White Lime Co.*, 136 Fed. 190; *Trighman v. Proctor*, 102 U. S. 797; *Gudet v. Brooklyn*, 105 U. S. 730.

But it is said that the *Ex parte* process is the only froth process, and that the processes described in the prior art are the only flotation or oil buoyancy process. We have to inquire, therefore, who is the oil buoyancy process. It is described in the *Ex parte* patents, No. 676,679, issued June 18, 1901, and No. 686,680, issued December 17, 1901, and in the testimony of Mr. Ballantine, General patent counsel of the appellates. Mr. Ballantine said that it was essential to this process, first, that the oil should be thick and viscous, for otherwise the metal would easily fall out of the oil, second, that the process be carried out in the cold, because if the oil be heated, it becomes thin and will not entrain or float the mineral, third, that the pumping of the pulp and the oil be as gentle as possible, so to avoid breaking the oil into globules. And the appellates' expert, Glendon, testified that in the oil bulk flotation, 157 parts of oil must be used to 6.7 parts of ore. With these definitions and explanations of the oil buoyancy process in view, it is very plainly to be seen that in none of the patents herein discussed, aside from the *Ex parte*, is that process used. The *Ex parte* patent uses 1% of oil to the ore, and directs that the mixture be agitated with hot, warm, or cold water. Kirby recommends thorough agitation by rigid rotation of the agitator, and he refers to the floating concentrate as a "scum". The *Ex parte* patent declares that thorough agitation of the mass or pulp, comprising water, the finely divided ore, the oil of fat and the need, is necessary, and in the *Ex parte* patent and *Mineral Journal* of November 15, 1900, there is an article describing a test agitation of that process, in which it was said that as the result thereof a thick scum of sulphides rose to the surface and was skimmed off, leaving the hitherto black ore as white as snow, in fact, "pure silica". And so in the *Ex parte* process, although its ultimate purpose was to precipitate the metal in the form of granules to the bottom of the tank, it was first required that the mixture be thoroughly agitated, and as the result thereof, a froth necessarily came to the surface.

Metal and Oil Froths

The contention is made, however, that if indeed the prior patents disclose froth processes, the scum which the *Ex parte* process causes to rise to the surface of the water, is so different from the froth or scum which arises under the prior art, that it is a new result, and is not anticipated by anything in the prior art. Say counsel for the appellates: "You produce a froth which is not our froth," and again they say that the *Ex parte* process is a "pure metal froth", while that of the other patents is an "oil froth," and that the *Ex parte* process consists of air bubbles surrounded by metal armor without any appreciable quantity of oil connected therewith. The evidence in the case, together with the illustration thereof afforded by demonstration of the various processes which were made in the aid of the argument before this court, convince us that the froth in all these processes is the same, with the exception that there is less oil in some than necessarily be in the *Ex parte* process than in the others. The froths are all similar in appearance, they all rise to the surface after the same amount of agitation, they all gather with equal efficiency the same quantity of metal, and all may be removed from the surface in the same way. It is not literally true, of course, that there is no oil in the froth which the *Ex parte* produce. If there were no oil in it, there would be no froth. The quantity of oil that has been put into the mixture must necessarily be found in the froth. It would manifestly be a physical impossibility to

create a froth consisting only of bubbles of air and the particles of mineral. This is admitted in the specifications of the appellees' patent, in which it is said that there must be agitation "until the oleic acid has been brought into efficient contact with all the mineral particles in the pulp," and that the air bubbles which make the scum floatable adhere "only to the mineral particles which are coated with the oleic acid."

It is said in the appellees' brief that one feature of the froth produced by their process is that it is unnecessary to clean the mineral of the oil, as the infinitesimal oil coating has no adhesive effect, and that the concentrates may be freely tailed or vanned, and counsel say "All you have to do is to gather that froth from these vessels, dry it out, and take it to the smelter." We find no evidence in the record that the froth which the appellees produce may be smelted without removing the oil therefrom, or that it would be a distinct advantage to do so, or that the froth produced by some of the antipatting processes may not be taken to the smelter without removing the oil. If the statement made in the brief is true, it is very clear that that feature of their froth was not known to the patentees at the time of their application for the patent, and is nowhere disclosed in the specifications or claims. The specifications deal only with the production of the scum or froth, but claim 13 includes "filtering off the froth and removing the oleic acid therefrom by treatment with an alkali," and on May 3, 1905, in a statement of their method of oil concentration which they sent to Australia, the patentees said, "The oleic acid is therefore of necessity recovered in the process and in the state in which it is required for re-use. This is not undertaken merely for the purpose of recovering the oleic acid, but as a necessary step in rendering the concentrates fit for vaning, separation into blende and galena."

Decision of the Lower Court

The decision of the court below appears to have been largely influenced by the consideration that the appellees' patent had gone into extensive and successful use. The fact that a patented device or process has gone into extensive and successful use is often of value in determining the question of invention and patentability. It is referred to for the purpose of turning the scales in cases of grave doubt. It is of no value whatever where the question of invention or patentability is free from doubt, and in any case its value depends largely upon the causes which produced it. It is often due to business ability in manufacturing, exploiting, and advertising, and to the fact that prior conditions have not stimulated development. The appellees' process, originally patented in Great Britain, has been installed in Australia, Sweden, Finland, Chile, and Wales, and it is in the process of installation in Cuba. It is not improbable that in those countries the prior art may have been substantially unknown, and it is possible that the appellees' success there is referable to the fact alleged in the bill, "that the complainants have been to great trouble and expense in the introduction into use of the process, and have invested large sums of money in its introduction into commercial use in different parts of the world, and in the effort to introduce it into commercial use in the United States." It is in evidence that in making the process known to the public in the United States, the appellees have expended \$60,187. Notwithstanding these efforts and expenditures, their process has not yet been installed in the United States. In *Olin v. Timken*, 155 U. S. 141, 155, it was said: "While the patented article may have been popular and met with large sales, that fact is not important when the invention is without patentable novelty." In *McClain v. Ortmyer*, 141 U. S. 419-428, the court said that "the extent to which a patented device has gone into use is an unsafe criterion even of its actual utility, is evident from the fact that the general introduction of manufactured articles is as often effected by extensive and advantageous advertising, activity in putting the goods upon the market, and large commissions to dealers, as by the intrinsic merit of the articles themselves."

It would serve no useful purpose to review all the numerous decisions in patent cases that are cited by the appellees. But we will refer to two of them which seem to be especially relied upon—*Naylor et al. v. Alsop Process Co.*, 168 Fed. 911, and *United States Mitis Co. v. Midvale Steel Co.*, 135 Fed. 103. In the first of these cases, the court held that an expert cannot take a process patent which has never been applied industrially and work the process in his laboratory, and discover therefrom something which is not disclosed on the face of the patent and then transfer that experience back to the time of the patent, and make it a part of the prior art for the purpose of defeating a subsequent patent for a meritorious invention. There is nothing in the present case to which that ruling applies, and it is to be observed that the court sustained the patent in that case expressly upon the ground that the com-

plainant therein was the first to discover a successful process for bleaching flour. The court said: "His act was not a selection of known agents in the art of bleaching flour, but was the discovery of the only agent that has yet been found to accomplish that result successfully in the milline industry." The second case is said by counsel for the appellees to be "conclusive." The invention there under consideration was a process for making steel castings homogeneous so as to prevent blowholes, and it consisted in adding to the molten steel when it is about to be poured into the mould, a minute quantity of metallic aluminum. But the distinction between that case and the case at bar is plainly to be seen in the fact that there the inventor made a distinct addition to the known art. He added something which has not been used by others, and which was effective in producing the result which was sought. In the present case nothing has been added.

The Decision

We hold that to sustain the appellees' patent would be to give to the owners thereof a monopoly of that which others had discovered. What they claim to be the new and useful feature of their invention, as stated by their counsel, is "agitating the mixture to cause the oily coated mineral to form a froth." As we have seen, that feature was clearly anticipated by the prior art, and when the elements of the appellees' claims are read one by one, it will be found that each step in their process is fully described in more than one of the patents of the prior art, with the single exception of the reduced quantity of oil which they use. The patentees of the appellees' patent made a valuable contribution to the art in discovering the smallest quantity of oil which would produce the desired result. In doing so, they pursued the course which all skillful metallurgists would be expected to pursue. They made a series of experiments to determine how small a quantity of oil could be used successfully. They found, as all must find who apply the oil flotation process, that certain oils are adapted to use with certain ores, and that a larger quantity of oil is necessary for one kind of an ore than for another. The appellees admit that for some ores they use four times as much oil as for others. Their discovery that a small fraction of 1% of oil is sufficient to produce flotation of the metalliferous matter cannot, as we have seen, be made by itself or in combination the subject of a patent. The appellees cannot take from others the right to use oil economically. This was evidently the ruling of the Patent Office on their application for a patent. One of their claims in the original application was "the process of concentrating powdered ore, which consists in separating minerals from gangue by coating the minerals with oil in water containing a fraction of 1% of oil in the ore, and recovering the oil coated minerals." This was rejected in view of the *Cattermole* patent "as expressing merely a difference of degree thereover as to the proportion of oily matter employed." Counsel for appellees admit that the claim was properly rejected for the reason that it leaves out the agitation and froth, and say "our invention is something else than the mere reduction of oil."

The decree is reversed, and the cause is remanded with instructions to dismiss the bill.

Rhodesia is much the same size as Mexico and has an area of about three-quarters of a million square miles. The government of the country is in the hands of the British South Africa Co., which administers by virtue of the Royal Charter granted them in 1889. The charter must be renewed during the present year, and practically all of the residents of Rhodesia are much in favor of such a renewal rather than the absorption of the territory as a part of the Union of South Africa. Rhodesia is less Dutch than other parts of British South Africa, and herein lies the main reason for a desire for a continuance of independence on the part of Rhodesians.

Owing to the increase of magnetite in the Great Cobar ore, New South Wales, an abnormal loss of copper has occurred in the slags, and to minimize this a reverberatory settler has been installed, which is expected to materially improve the recovery.



THE SUAN MILL.

Gold Mining Concessions in Korea

By A. E. DRUCKER

Three gold-mining concessions in Korea granted to foreigners are now on a dividend-paying basis: the Oriental Consolidated, Suan Concession, and French Concession.

Oriental Consolidated

This concession, which consists of some 600 square miles in the northwestern part of Korea, is the pioneer in the successful working of low-grade mines in the Far East. During the fiscal year 1913 this Company milled 313,701 tons of ore (\$6.39 per ton of 2000 lb.) having an assay value of \$2,005,462. The net total bullion yield was \$1,629,323, indicating an extraction of 81.3%. Bullion secured by amalgamation was \$988,714, or 49.3%. By cyaniding concentrate, \$640,609, or 32.0% was recovered. The total operating expenses were:

	Total.	Per ton.
Mining	\$ 610,212.19	\$1.95
Milling	168,657.32	0.54
Cyaniding concentrate	107,391.98	0.34
Ore transport	3,601.59	0.01
General expense	126,915.12	0.41
Total	\$1,016,778.20	\$3.25

The total operating profit was \$644,698. The ore produced by this Company from the granting of the concession to June 30, 1913, makes a total of 3,236,216 tons, at \$6.14, equal to \$19,858,339. Dividends paid on shares to June 30, 1913, equal 115% or \$4,932,910.

At the present time dividends amount to 10% per year. The Company is capitalized for \$5,000,000 in 500,000 shares at \$10, of which the issued capital amounts to \$4,293,900. On July 1, 1913, there were estimated ore reserves to the amount of 805,900 tons containing \$1,488,800.

The re-grinding cyanide plant at Taracol was completed about the middle of May 1912, but did not operate steadily until the following month. This all-sliming and cyanide-agitation plant was erected to take the place of the old 18-day leaching process, treating concentrate only.

The months of June, July, August, November, December 1912, January and February 1913, a total of seven months, were under my direct supervision, the results being as follows:

New plant:

Tons treated	14,899
Assay-value per ton	\$25.08
Total value	\$373,687.90
Bullion secured	338,622.25
Actual extraction, per cent.....	90.6
Indicated extraction, per cent.....	88.2
Assay-value of tailing	\$2.95
Increased extraction over old 18-day process:	

Actual	6.6% = \$1.66 per ton
Indicated	7.2% = \$1.80 per ton
Operating expense per ton, \$3.05.	

During the last four years of the old leaching plant

the average actual extraction was 84% on an average heading of \$25.12. The average assay value of the tailing in 1910-1912 was \$5.06, and the indicated extraction 81%. If the old 18-day process had been in use during the past fiscal year, 1913, the expense per ton would have been more than in the previous years (in 1912 it was \$1.47, since labor and supplies have increased in price). The Kuk San Dong old leaching-plant during the past fiscal year shows an increased operating expense of 30 to 40c. per ton over former years on a similar tonnage. Therefore, in comparing operating costs between the former and present method of treating concentrate at Taracol, it is reasonable to add at least 20c. to the former cost of \$1.47 per ton, making a total of \$1.67. The old process at the present time could not operate for less than that amount.

During seven months the all-sliming process treated 14,899 tons, with the following results:

Increased bullion extraction	\$1.66 per ton
Increased operating expense	1.38 per ton
(3.05 — 1.67 = 1.38)	
Net profit	\$0.28 per ton

The last Company report, June 30, 1913, states that the operating expenses for this plant will be reduced by the use of electric power instead of steam during the coming year.

One interesting metallurgical problem has been

solved in the re-treatment of the old sulphide concentrate tailing dump at Kuk San Dong. This is the residue from the old cyanide leaching-plant, and represents the sulphide product originally caught on Union vanners. During the past fiscal year, this dump material averaged \$5.80 per ton, and 16,963 tons valued at \$98,371 was re-treated, yielding bullion to the value of \$68,508 (70% extraction). The total operating expense was \$2.39 per ton.

The manager in his report for the year ended June 30, 1913, states: "The plant ran successfully and made a profit of \$27,822.63, which has been credited to the cost of the plant, because the expenses of this construction were charged against the dump. There still remains \$10,749.03 to be earned before the plant has entirely paid for itself. During the coming year the plant is expected to yield a nice net profit."

This dump re-treatment process was originally proposed to the management during 1908 by myself, after concluding a long set of tests at the Taracol experimental plant. The above described plant at Kuk San Dong was designed and erected by me and began operating during May 1911. Original investment and cost of plant was \$39,336.

The figures on the next page are taken from the Company's annual reports and show dump material remaining from which a profit is expected.



VIEWS OF THE FRENCH CONCESSION, SHOWING THE NEW MILL, AN OLD KOREAN STAMP-MILL, A STAMP-MILL AND CYANIDE PLANT, AND NATIVES WASHING GOLD.

	Tons.	Assay-value.
Old dump remaining June 30, 1912.....	27,790	\$223,964.33
Added dump during year 1912.....	4,826	34,401.09
Total	32,616	\$258,365.42
Less year 1913 dump re-treated.....	16,963	\$ 98,371.31
Lump remaining June 30, 1913.....	15,653	\$159,994.11

The following is an estimate of a possible net profit to be derived from the Company's figures, assuming that the extraction and operating cost per ton will remain as above:

70% on \$159,994.11.....	\$111,995.87
\$2.40 per ton cost on 15,653 tons.....	37,567.20

Gross profit	\$ 74,428.67
Remaining amount to be paid on plant	10,749.03

Net profit	\$ 63,679.64
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I am very glad to hear at the present time that the cost of this plant has been entirely paid out of the monthly operating profits, and that the original money invested (\$39,336) has been re-gained. The results of 1914 should be good, and up to expectations. Credit is due the manager, superintendent, and foreman in charge for their efforts. I have already described the results and operations of some recent plants constructed by the Oriental Consolidated in the *Mining and Scientific Press* of November 23, 1912.

Suan Concession

This concession, operated by the Seoul Mining Co., is situated about 50 miles due east from Pyeng Yang, the second city in population in Korea. At the present time the Suan is the only producing mine on the concession; however, the Tul-Mi-Chung mine has been sufficiently developed to supply a 20-stamp mill for a considerable time, and will become productive as soon as a plant is installed. I understand that a plant is being designed, and work on it will begin shortly.

The authorized capitalization of this Company is \$500,000 (5000 shares at \$100 each), and the issued capital amounts to \$400,000. Dividends to the amount of \$400,000 had been paid up to November 1912, or 100% to the holders of the issued shares. The actual operating costs, revenue, and gross profits at the Suan mine during 1912 were:

OPERATING EXPENSES (PER TON MILLED)

Ore milled, tons (2000 lb.), 74,432.	
Mining and development	\$1.68
Milling and ore transport	0.78
Concentrate expense	0.31
Shipment of smelting ore	0.02
General expenses	0.75
Total	\$3.54

REVENUE (PER TON MILLED)

Bullion by amalgamation	\$6.34
Concentrate shipped	1.89
Smelting ore shipped	0.08
Bank interest	0.02

Total	\$8.33
Operating profit, \$4.79.	

Gold, copper, and bismuth are the valuable metals contained in the Suan ore. Copper occurs mainly as chalcopyrite; some tetrahedrite and bornite also are to be found. Gold is alloyed with a small quantity of silver, and is rarely found in a coarse condition.

The metallurgical method employed is amalgamation and concentration, the concentrate being shipped to England for treatment. The ore passes through stamps, Pierce amalgamators, over plates, through a second set of Pierce's, tube-mill and Pierce's, and thence to concentrating tables and a canvas plant. The tailing is allowed to flow to waste. The sources of gold recovery by amalgamation are approximately as follows:

	%
Mortars	5.0
Upper Pierce amalgamators	79.0
Copper plates	1.0
Lower Pierce amalgamators	4.4
Tube-mill and Pierces	6.0
Miscellaneous	4.6
	100.0

The concentrate obtained from the concentrator plant amounts to about 1% of the ore milled. It contains gold, silver, copper, and bismuth (2.24%). The sum obtained from the smelter on bismuth alone amounted to \$19,025 during 1912.

For 1912 (1913 figures not being available) the following results were obtained:

Ore milled, tons	74,432
Assays:	
Gold	\$8.53
Copper, per cent	0.89
Tailing:	
Gold	\$1.30
Copper, per cent	0.65
Extraction:	
Gold, per cent	86.2
Copper, per cent	20.34

Owing to the presence of copper and bismuth in considerable quantities, thus preventing the successful application of the cyanide process, the treatment of the ore is necessarily complex. The sulphide has a tendency to slime readily, making concentration difficult. It is mainly a problem of efficient classification and slime concentration. The Company realizes that the net recovery by the present methods of reduction is not entirely satisfactory; consequently it has engaged Walter G. Perkins & Co., metallurgical engineers, to advise and carry out alterations in the plant.

The ore reserves of the Suan mine are sufficient to supply the present 40-stamp mill for 3½ years. This Company has been well organized and managed. It is paying a regular yearly dividend of 50% on an issued capital of \$400,000.

French Concession

This was granted to P. M. Saltarel, of Paris, during 1901 by the Korean government. The mineral, timber, and water rights are to extend over a period of 25 years from that date. Practically nothing was done with it up to 1911 by the owner. Prior to that date

several engineers had made examinations, but all reports were unfavorable. I believe that it was during the latter part of 1910 and the first part of 1911 that the Koreans made discoveries of rich gold ore at what is now called Small Nurup and Nurup mine. Koreans flocked to this new gold discovery in large numbers and constructed primitive wooden stamp-mills and cyanide plants. A considerable quantity of gold was recovered by these crude methods, but a great deal was lost.

During the latter end of 1911, L. Rondon & Co., of Seoul, Korea, secured a lease from the owner to extend

is at the present time being worked by many Koreans on the concession by primitive methods.

This concession has been poorly managed through pure ignorance of the mining business. Under good management there is no reason why it should not be one of the most productive in Korea.

Costs and Recovery at Wasp No. 2 Mine and Mill

This mine is situated in South Dakota, and during 1913 the mill treated 127,680 tons of ore yielding \$1.718 per ton in a dry-crushing cyanide-leaching mill of 15,000 tons monthly capacity. The ore is mined in open-cuts, the body lying nearly horizontal, in a bed 20 ft. thick, covered by as much as 14 to 18 ft. of soil, sandstone, and shale. This overburden is handled largely by steam-shovel. Costs were as follows:

COST PER TON

Mining:	Superintendence ...	0.0196
Labor	Expense	0.0087
Stripping	Coal	0.0087
Supplies	Cyanide	0.0782
Power	Zinc	0.0332
Explosives	Lime	0.0077
Stable	Assaying	0.0106
Repairs machinery..		
Superintendence ...	Total milling.....	\$0.6305
Expense	General:	
Coal	Repairs buildings...\$	0.0006
	Bullion expense ...	0.0074
Total mining.....	Insurance	0.0207
Milling:	Taxes	0.0140
Labor	Interest and exch'ge.	0.0003
Supplies	Surveying	0.0012
Power		
Repairs buildings...	Total general....	\$0.0442
Repairs machinery..	Total expense....	\$1.3110

The theoretical and actual recoveries of gold and silver were as follows:

	— Gold —		— Silver —	
	Fine oz.	Value.	Fine oz.	Value.
Called for by assay of heads..	12,543	\$259,267	79,799	\$47,280*
Called for by assay of tailing	3,124	64,580	53,178	31,507*
Appar. extract., difference.	9,410	\$194,687	26,621	\$15,773*
Apparent extraction, %.....		75.09		33.36
Actual recovery, mill ore....	9,595	\$198,401	29,633	\$17,523
Actual recovery, slag.....	113	2,264	1,877	1,145
Total recovery	9,708	\$200,665	31,510	\$18,668
Actual extraction, %.....		77.39		39.48

*Calculated at 59.25c. per fine ounce.



KUK SAN DONG DUMP PLANT AND ORIENTAL CONSOLIDATED MILL.

over the remaining years for which the concession was granted. This Company is now operating a 20-stamp mill and cyanide plant, the operating profit being from \$15,000 to \$20,000 per month. From January 1 to April 1, 1913, a 5-stamp mill and cyanide plant produced \$39,887 in gold bullion, from April 1 to August 1, \$77,873 with 10 stamps, and from that time an additional 10 stamps have been operating. The cyanide plant has been increased to twelve 30-ft. leaching-vats.

The slime product from the mill that has been collected in ponds for a future treatment will assay from \$12 to \$18 per ton. A great deal of valuable material is being stored here awaiting the completion of a slime-treatment plant, which will add materially (20%) to the monthly bullion production. Prior to May 1913 a considerable quantity of this rich slime was allowed to flow into the river. It is also expected to add another 10 stamps to treat rich tribute ore, that which

Labor troubles are still of frequent occurrence in Australia. Official figures for 1913 show that there were 208 disputes of all kinds, involving employees over 10 in any establishment, and totaling 50,283 people. The men-working days lost were 622,535, who lost about \$1,400,000 in wages. The wages paid in manufacturing industries is 20% of the value of the output, so the loss in products was about \$6,800,000. The disputes were characterized as stupid and unreasonable demands.

Leaching of Copper Tailing

By RUDOLF GAHL

*The electrometallurgy of copper is mainly hydrometallurgy, inasmuch as the electric current is used principally for the deposition of copper from its solutions. Up to the present time the application of the current has been confined to the precipitation of copper from solutions originating from metallic copper, in other words to the electrolytic refining of copper, but the application of electricity to copper solutions resulting from ores is being constantly advocated, and as a matter of fact, is being tried in several places on a small scale. The necessary basis for electrolytic precipitation of copper extracted in leaching operations is naturally a successful application of leaching methods, and from this standpoint a presentation of experimental results in this line may be justified for an electrochemical meeting, although the electric current was not used in these tests for the precipitation of copper.

Leaching Carbonate Ores

The leaching of carbonate ores of copper has been attempted repeatedly, but has not been a commercial success, except in some isolated cases, as for instance in the case of the Arizona Copper Co., at Clifton, where such leaching operations have been carried on for a great number of years. The frequent failure of such attempts may have been the cause for the general distrust of leaching operations that prevailed among engineers up to a few years ago. Recently this sentiment has changed considerably and leaching plants of large size are being planned. I might mention in this connection the projected Chuquicamata plant in Chile and the Ajo project of the Calumet and Arizona, where it is intended to leach oxidized ores by sulphuric acid.

Engineers are no longer afraid of giving their attention to the hydrometallurgical treatment of sulphide ores, as for instance the porphyry copper ores. Here the milling of these ores has been undertaken on an enormous scale, the gravity concentration process by which they are treated has been the subject of extensive study at the plants. While this research work has shown ways for essential improvements which, for instance, make the concentration of ores possible that nobody would have thought of milling some years ago, it has, on the other hand, clearly defined its limitations.

The concentration process has been developed to such a state of perfection that on clean sulphide ores recoveries of 85% of the copper can be obtained. Unfortunately the ores that generally are called porphyry copper ores are not of this character, as they contain a considerable percentage of their copper in the oxidized state. This is undoubtedly partly due to the fact, that

the limits between sulphide and oxidized ores are not very sharp or are not followed exactly when the ore is mined. On the other hand most of the orebodies that are mined at present are to some extent altered by oxidation.

The water concentration process is, up to the present time, not able to extract copper in oxide combination with an efficiency, approximating the extraction of the sulphide copper. I believe that 30% is an average round figure for the extraction effected on the oxidized portion of the copper in sulphide ores. It follows, that where ores are largely contaminated with such material, no satisfactory saving can be obtained by ordinary concentration methods. A great many of the mines in Arizona and New Mexico suffer from this disadvantage.

The natural consequence has been, that the copper mines have been looking lately toward a hydrometallurgical method to improve the copper extraction. It is being advocated by some to discard the time-honored concentration method and to supplant it by an altogether different treatment. They suggest to roast the ore, to leach the calcines and to precipitate the copper from the resulting solution. Electrolytic precipitation is favored by many, although it is maintained by others that the precipitation of copper from so low-grade solutions as would naturally result from leaching very low-grade ores is a problem which so far has not been solved by electrochemistry. Although replacing the concentration process by a process of the kind indicated at one of the prominent Western mines would mean a radical departure, it must be kept in mind, that similar processes have been in constant use for a long time both in Europe and in the East of the United States. The Pennsylvania Salt Mfg. Co. has produced copper in such a way for years.

Leaching Concentrates

The class of copper metallurgists which may be called the conservative party have confined themselves to supplementing the concentration process by hydrometallurgical methods. This can be done by leaching the concentrate, which I understand is being tried at the Braden Copper Co., and by leaching the tailing. The latter is the more important, inasmuch as it adds to the extraction effected by the concentrator. To this class belongs the system of leaching worked out by Laist at the Anaconda, the tests with the Bradley process also at Anaconda, and tests undertaken at some of the Arizona mines.

One test I made at Morenci, Arizona, in connection with the concentrating plant of the Detroit Copper Co. The ore has the characteristics of the porphyry copper ores, being perhaps oxidized and kaolinized to a

*Abstract from a paper presented at the twenty-fifth general meeting of the American Electrochemical Society, in New York City, April 16-18, 1914.

higher degree than other ores of the class. The principal copper mineral is chalcocite. Some chalcocite and some pyrite accompanies it. In concentrating, ores of this character behave in a typical way. The resulting sand tailing is always low in copper or can be reduced to a low figure by ordinary milling methods, that is, regrinding and reconcentration. The slime tailing, however, is high in copper content, and no standard method of milling is available to reduce it materially. This is attributed to the accumulation of oxidized material in the slime. The oxidized portion of the ore has evidently a greater tendency to form slime than the sulphide portion, and as the recovery in oxide copper is very low, it is a common thing to find more oxide than sulphide copper in the slime tailing. It was attempted in the experiments to recover the oxide copper in an economical way by leaching with dilute sulphuric acid. It is due to the confidence which C. E. Mills had in the outcome, that a suitable testing plant was built in which this experiment could be made.

Filtration and Decantation

Successful leaching not only depends on getting the copper into solution, it depends just as well on the separation of liquids from solids and on the precipitation of copper from the resulting solutions. In this case the second step seemed especially difficult, as the slime in question is very colloidal in character and behaves almost like clay. Filtering costs with this slime would probably have been prohibitive, not even considering the extra costs which the acidity of the solution would have imposed.

For this reason I looked toward a decantation method which would suit this particular purpose. Such method, in addition to eliminating the difficulty in question, would also offer an advantage over filtering.

It was found in preliminary copper leaching experiments, that it is more economical to leach in steps, that is, to leach fresh ore first with a solution high in copper and low in free acid, to replace this solution by another one lower in copper and higher in acid, to finish the leaching with a solution still lower in copper and higher in free acid. This reduces the consumption of chemicals and raises the extraction. It has also another advantage when the precipitation of the copper is effected by iron, as was the case in these experiments. By bringing nearly exhausted solution in contact with fresh ore, as described, the ferric salts are transformed into ferrous salts, and the consumption of metallic iron is reduced nearly to the theoretical limit. The loss of iron resulting from the entrance of ferric salts into the precipitating plant is thereby very materially reduced. Filtering methods do not lend themselves to a repeated change of solutions.

In cyanide plants there is no objection to using solutions resulting from the leaching operations in the milling department, as the cyanide has no detrimental effect on milling machinery. Crushing in cyanide solution is in fact frequently preferred. For this reason

it is possible to add the fresh water (which is required to make up for the water going to waste with the tailing) in the cyanide department and to send an equivalent amount of cyanide solution to the milling department. In the cyanide department the fresh water can be used for washing the tailing resulting from the leaching operations, which is the ordinary practice.

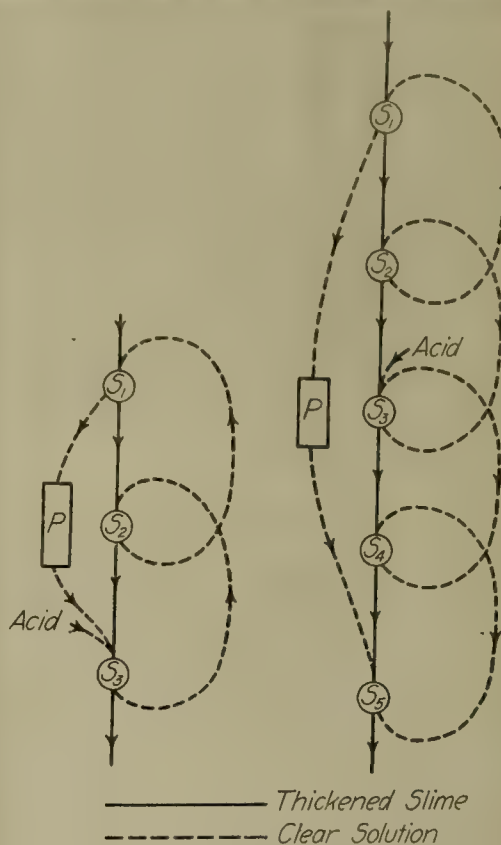


FIG. 1 AND 2.

It is not possible, however, to do this, when leaching is conducted with sulphuric acid. The resulting solutions, being unfit for use in the mill, have to be retained in the leaching department. As new quantities of water enter the leaching department all the time, solutions would accumulate, if the attempt were made to use fresh water for washing. For this reason the barren solutions coming from the precipitation plant are essentially the only ones that are available for washing the settled pulp.

Keeping in mind, that no fresh water can be used in leaching copper tailings, it follows, that the leaching plant has to be independent of the mill and that no circulation of solutions must take place between the two. The flow-sheet of the leaching plant has to be essentially a closed circuit. The only thing to do then with solutions, as they would result from counter-current leaching would be to send them to a precipitation plant and from there, having added fresh acid, to the last tank, as shown in Fig. 1.

This flow-sheet can be changed in such a way, that the objections raised against the system are obviated. Fig. 2 shows the resulting modification. Two more tanks, the number, of course, is not essential, are added to the system and serve for washing purposes. The solution discharging from the precipitating plant is sent to the last tank of the series and passes through the series of tanks in counter movement to the pulp. Comparing Fig. 1 with Fig. 2 it is evident that there is no difference in the flow sheets except regarding the condition of the pulp at various points of the system.

I might call attention to the possibility of applying heat to a system like this, although no use has been made of artificial heat in the experiments made with this plant. If heat in the form of steam or otherwise is applied at the same point or near the point, where the acid is added, as marked in Fig. 2, the temperature, after equilibrium is reached, will drop toward the end of the system, as will easily be seen by tracing the way in which the heat distributes itself. Accordingly only part of the heat introduced escapes with the tailing pulp, while the rest serves to pre-heat the inflowing pulp.

The Addition of Acid

I have been emphasizing the importance of adding acid in the most suitable place of the system. To anyone who has used similar methods in cyaniding gold and silver ores, it may seem as if this point would not deserve so much consideration. But there is a radical difference between copper leaching and cyaniding in regard to this point. In cyaniding there is always a large excess of the leaching agent over the quantity which is required to combine with the metal which is contained in the ore treated. The cyanide solution charged with gold and silver will pass through the precipitating plant and emerge from it as a solution which is available as leaching liquor again. The loss in cyanide is so small, that it can be made up in almost any part of the circuit without causing much difference in the extraction. Conditions are different in copper leaching. The solution leaving the precipitating plant is useless for leaching purposes. This means, that sufficient acid has to be added to make it a solvent for copper minerals, and it is, of course, of utmost importance to add this acid where it will accomplish most good.

I will not describe in detail the plant which was constructed along the lines indicated in the flow-sheet. It may suffice to state, that it consisted of a series of ordinary settling and small agitating tanks of the simplest kind. The pulp was transferred by gravity, the solution was circulated by air-lift. A launder filled with scrap-iron served as a precipitating plant. The plant treated between 7 and 10 tons daily for a period of 50 days continuously. It was closed down only for very short intervals and only when owing to shut-downs of the concentrator the feed for the leach-

ing plant gave out. One unskilled laborer per shift was sufficient to operate the plant; in fact, would be for a large plant, except when it was necessary to remove the cement copper and to add iron in the precipitating plant.

The conditions of the tests were varied, as far as quantity of acid and tonnage are concerned. No heat was applied. Under the best conditions a recovery of 60% of the copper contained in the slime tailing was obtained from material containing 1.24% Cu. The 60% of the copper extracted represents the copper existing in the oxidized state. A higher extraction could have been obtained by using ferric sulphate in connection with sulphuric acid. Methods for cheap production of this salt were worked out in the laboratory, but have not been tried on a larger scale.

Operating Costs

The probable operating costs of a leaching plant for slime tailing were calculated on the basis of the experiments, with a certain margin for safety. They are represented in Table 1. The slime tailing being ordinarily a waste-product was considered not to cost anything.

TABLE I.

Probable Cost of Leaching Tailing Slime per Pound of Copper Delivered at New York.

3.50 lb. acid @ \$10.00 per ton H_2SO_4	1.75c.
1.50 lb. of scrap iron @ \$19.00 per ton.....	1.43c.
Power	0.25c.
Labor and repairs	1.00c.
Smelting, refining, transportation of Cu. including losses in smelting, etc.	2.00c.
Interest and depreciation of plant	1.00c.
Total	7.43c.

The figures are based on conditions prevailing at Morenci, Arizona, where the tests were made. Owing to the situation of this mining camp freight rates are rather high.

The acid consumption is taken at 3.5 lb. H_2SO_4 , instead of 3.16, the figure obtained in the tests. The rate of \$10 per ton of H_2SO_4 is based on the assumption, that it would be possible to obtain the acid from a near-by smelting centre, where large quantities of ores high in sulphur are roasted.

The iron consumption was assumed to be $1\frac{1}{2}$ lb. of scrap iron instead of 1.25 lb. pure iron. The price of the scrap iron is so high because it has to be hauled from eastern Texas.

Owing to the relatively small scale on which the experiments were carried out, it was impossible to ascertain directly the power consumption for large-scale operations. It was estimated from figures about power consumption of air-lifts and agitation found in textbooks, etc. Power cost was assumed to be 36c. per hp. day.

Labor for leaching was found to be, and repairs were expected to be equally negligible for a well-constructed plant. Labor and repairs in connection with

the precipitation were based on what it was thought could be accomplished in a copper precipitation plant, the operating cost figures from which were available.

Smelting, refining, transportation of copper, etc., is based on the assumption that the smelting of the precipitate would be done in converters and includes the losses to be expected by this treatment. Interest and depreciation of plant is hard to approximate without making definite plans. The figure assumed may serve as an upper limit, however, and may be ample enough also to include taxes and a proportionate share of general office expenses.

As mentioned above only 60% of the copper contained in the slime tailing was extracted by leaching with dilute sulphuric acid, as the rest of the copper existed in the form of sulphide which is not acted upon by dilute sulphuric acid. Since making these tests the flotation process has been applied to ores of similar character and it has been found that it effects a very much higher extraction on the sulphide portion, an almost negligible one on the oxide portion of the copper. It follows, that tailing from flotation plants are lower in sulphide and higher in oxide copper. The fact has also been established that the oil used in the flotation treatment of ores does not interfere with a subsequent leaching of the tailing, it evidently does not attach itself to particles of oxidized copper minerals.

It seems that the conclusion may be drawn with safety that for certain classes of copper ores a combination of a flotation and a leaching process constitutes a metallurgical treatment which it will be difficult to surpass by other metallurgical processes in efficiency and cheapness.

Costs and Ore Treatment at the Broken Hill South Mine

During the second half of 1913, this mine produced 170,080 tons of ore, of which 168,957 tons was treated. The cost of mining was \$2.93; filling stopes, 25c.; development, 85c.; and concentrating, 98c.; a total of \$5.01 per ton. The mill products were as follows:

Product.	Weight, tons.	Metal content		Silver, oz.
		Lead, %	Zinc, %	
Concentrate	27,594	68.1	6.6	24.4
Zinc tailing	107,279	3.5	17.6	3.6
Quartz tailing	12,409	1.3	5.3	1.4
Slime	21,675	9.6	14.8	7.5

The metal content of the concentrate was 18,782 tons of lead, 673,465 oz. silver, and 1814 tons of zinc. The recovery by concentration was 75.8% lead, 54.2% silver, and 7.4% zinc. The zinc tailing delivered to the De Bavay and Zinc Corporation flotation plants was 122,635 and 29,405 tons respectively. With the recovery from the 107,279 tons of zinc tailing produced and sold, the total extraction was 91% lead, 85.6% silver, and 84.2% of the zinc. A selective flotation plant to treat the current and accumulated slime is being erected. The first unit will be of 500-ton weekly

capacity. The ultimate capacity will be 1000 tons of current and 1000 tons of accumulated slime per week. A sulphuric acid plant of 70 ton weekly capacity is also to be erected.

Costs at the Montana-Tonopah Mine

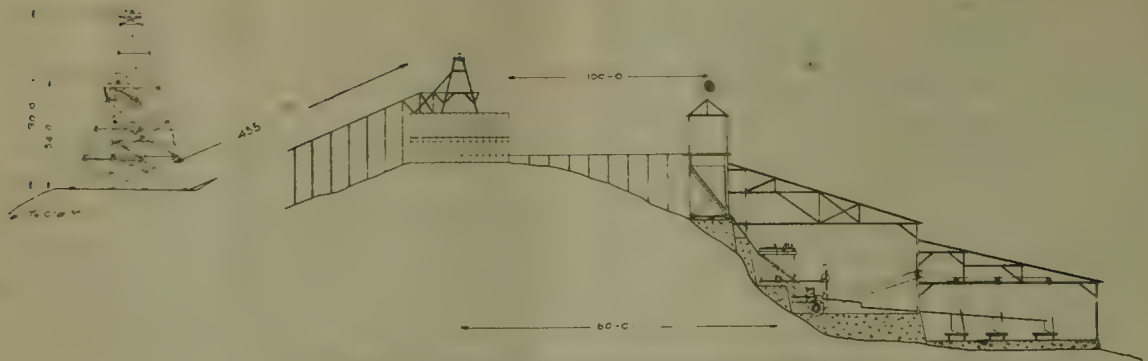
During the year ended August 31, 1913, development totaled 10,243 ft. at a cost of \$1364 per ton. Mining 52,362 tons of ore cost 72.3c. per ton for breaking, 36c. for hoisting and dumping, 79.4c. for tramming and shoveling, 45c. for timber and labor in handling it, and 29.3c. for supervision, machines, tool sharpening, surveying, assaying, etc., a total of \$2.62 per ton. This is 35.5c. lower than the previous year. At the mill 52,402 tons was treated during 348.5 days. The extraction of 91.2% is 1.2% over the last term. Costs were as follows:

	Per ton.
Crushing and conveying	\$0.118
Stamping	0.309
Elevating and separating	0.066
Tube milling	0.214
Concentrating	0.041
Settling	0.107
Agitating	1.144
Filtering and discharging	0.225
Precipitating	0.157
Refining	0.081
Water pumping	0.047
Steam heating	0.275
Mechanical department	0.029
Water	0.217
Storekeeper	0.016
Assaying	0.024
Superintendence	0.051
Total	\$3.121

The cost of milling as compared with that of last year shows an increase of 16.1c. per ton, and the cost of cyanide shows 29.9c. per ton increase on account of the greater consumption. During the year no vanner concentrate was produced, as it was found that a considerable saving in cost could be made without reducing the extraction. Although the increase in the cost of milling and the greater consumption of cyanide is due to this change, on the other hand the cost of marketing bullion and concentrate has been reduced 31.5c. per ton of ore treated, and the extraction increased 1.2 per cent. A recent improvement in connection with the Butters filter-plant is expected to materially reduce the consumption of cyanide, and to increase the extraction. Other recent changes in different parts of the plant should result in increased efficiency and lower operating costs according to Arthur H. Lawry's annual report.

Scotch mineral oil companies produced about 75,000,000 gal. of oil of all kinds in 1913, and 20 collieries in the vicinity of Edinburgh had a yield of 4,000,000 long tons of coal.

All cars at the Daly-Judge mine, Utah, were fitted with manganese steel wheels in 1913.



PROPOSED PLANT OF THE ARGONAUT MINING CO., AT JACKSON.

Disposal of Residue From Amador County Mills, California

By M. W. VON BERNEWITZ

Everywhere millmen have been troubled with the disposal of residue, and even when the problem seems to have been satisfactorily solved, and some scheme or other is working well for years, somebody suddenly makes objection to residue covering land, or to dumps making too much dust. The problem is akin to that of dredging, hydraulicking, and neutralization of smelter smoke. The people of a suburb of Kalgoorlie, Australia once appealed to the mining magistrate to stop a large company from dumping residue near it. He, without hesitation, said that the mining industry in this instance was of paramount importance and the residents must put up with the encroaching dump. There are many places where mining is of first importance, though it is not always so held.

In the Mother Lode district of Amador county, where a number of large mines have been discharging their stamp-mill tailing into certain creeks for many years, until recently no objection has been made. The farmers in the lower part of the country have now, how-

ever, complained that their land is being destroyed. They have sought the aid of the courts, and the mining companies were given until December 1914 to devise schemes to abate the nuisance. As a result, considerable work is being done to stop tailing from flowing down Jackson, Sutter, and other creeks to the farming lands below. At or near Amador City are the Original Amador, Bunker Hill, and Fremont mills containing a total of 100 stamps, crushing nearly 500 tons of ore per day. This pulp has been flowing down various creeks, but is soon to be stored in ponds, allowing only clear water to get away. Between Sutter Creek and Jackson are the South Eureka and Oneida mills of 100 stamps, crushing 490 tons per day. The former Company has diverted its residue through a long flume and pipe to a dam, nearly three-quarters of a mile distant, and has storage room for a considerable time. At the Oneida the tailing is stacked near the mill, and fairly clear water runs down the creek to Jackson.

The Argonaut 40-stamp mill, crushing 200 tons per

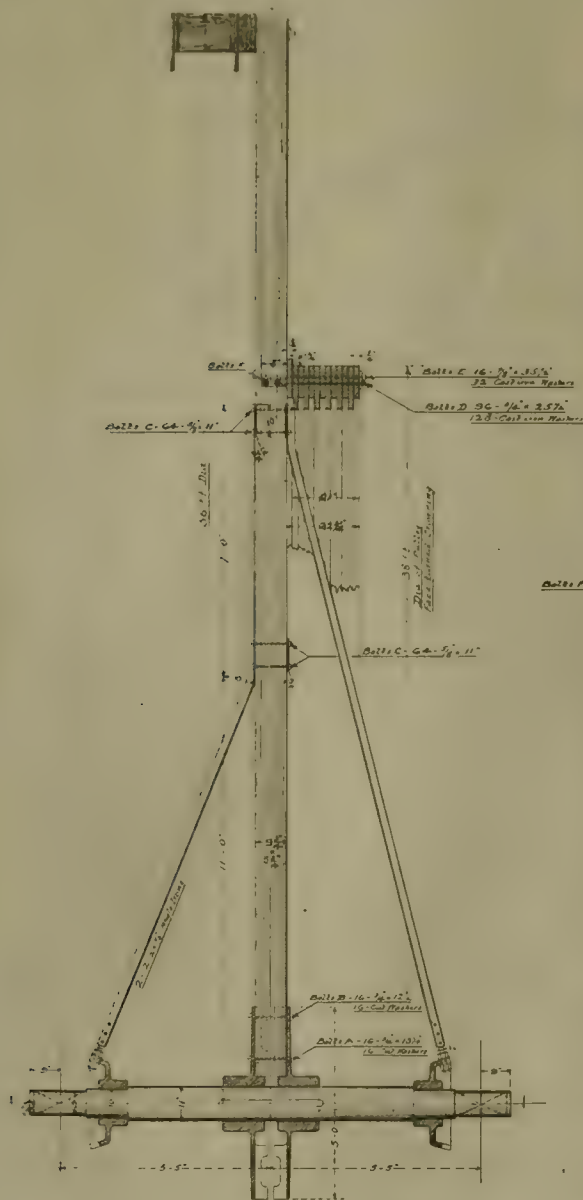


GENERAL VIEW OF THE KENNEDY SURFACE PLANT, AND CONTOUR OF THE COUNTRY NEAR JACKSON. BEYOND THE 100-STAMP MILL ARE THE FOUR TAILING-WHEEL HOUSES AS DESCRIBED. MILL RESIDUE USED TO FLOW DOWN THE CREEK ON THE RIGHT.

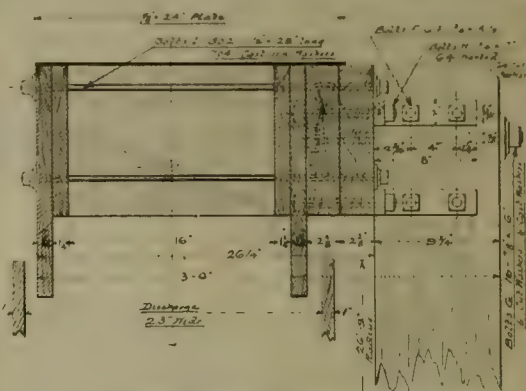
day is situated on a hillside below the main shaft, and the problem involved elevating the residue by some method. It has been decided to erect a 50-stamp mill on top of a hill 455 ft. above the shaft. The ore hoisted by the new 90-ft. head-frame, the present one being 54 ft. high, and stored in a 250-ton bin, is to be taken to a 1,350-ton storage bin above the new mill by a gravity tramway using 2-ton skips in balance, aided by an electric hoist near the main shaft. The process contemplated is stamping, amalgamation, concentration, regrinding and amalgamating the 25% product over 60 or 80-mesh screens. Three Frue vanners will be used instead of two for each battery. The residue from this plant will flow by gravity to a site, which is ample for

about 25 years' storage without stacking.

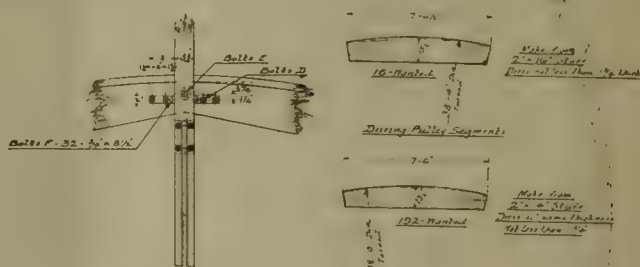
Opposite the Argonaut is the Kennedy plant of 100 stamps, crushing about 450 tons per day. This Company has a large dumping ground some distance from the mill, and the plant for disposal of residue may be described as follows: Across a creek from the plant has been built a wooden flume, 900 ft. long and 8 by 18 in. section, which is to convey the pulp to a tailing wheel 56 ft. diameter. This lifts it 36 ft. to a short flume, about 50 ft. long, and another similar wheel also elevating 36 ft. From this to a third wheel is a flume 800 ft. in length, and from this to the fourth and last wheel is another short flume, the pulp finally flowing down a valley and there stored. In short, the system



FRONT SECTION OF ONE-HALF OF A WHEEL.



DETAILS OF BUCKET AND END OF WHEEL ARM.



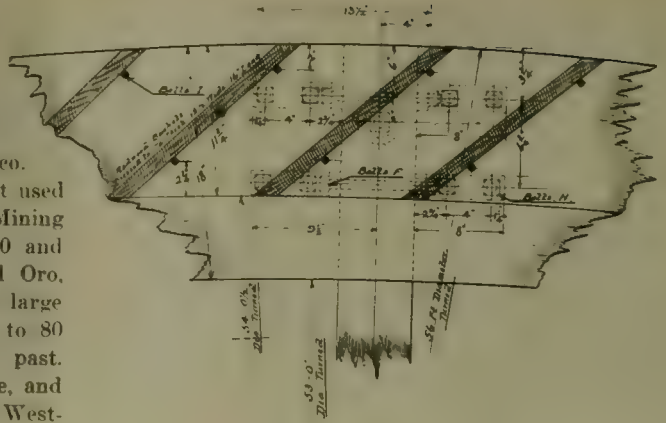
DETAILS OF WHEEL AND PULLEY.

includes a series of four wheels elevating mill tailing a total height of 144 ft., and its transportation a distance of 1800 ft. in all, including the flume from the mill to the first wheel. The grade of all flumes is 2.5%. The wheels are all identical in size and construction, being 56 ft. diameter and containing 176 buckets; each 16 in. long, with 11.99 in. pitch and holding two gallons of pulp. The axle or shaft is 11 in. diameter, and with the flanges weighs five tons. The wheel arms are braced by angle-iron to the flanges; and built up of segments on the arms carrying the buckets, is a 38-ft. driving wheel. Each wheel is driven by a 15-hp. motor, belted to countershaft and clutch gear, which drives the wheel by a 20-in. belt, and the wheel turns at 3.25 r.p.m. The construction work has been well done, and the scheme will cost about \$35,000. The

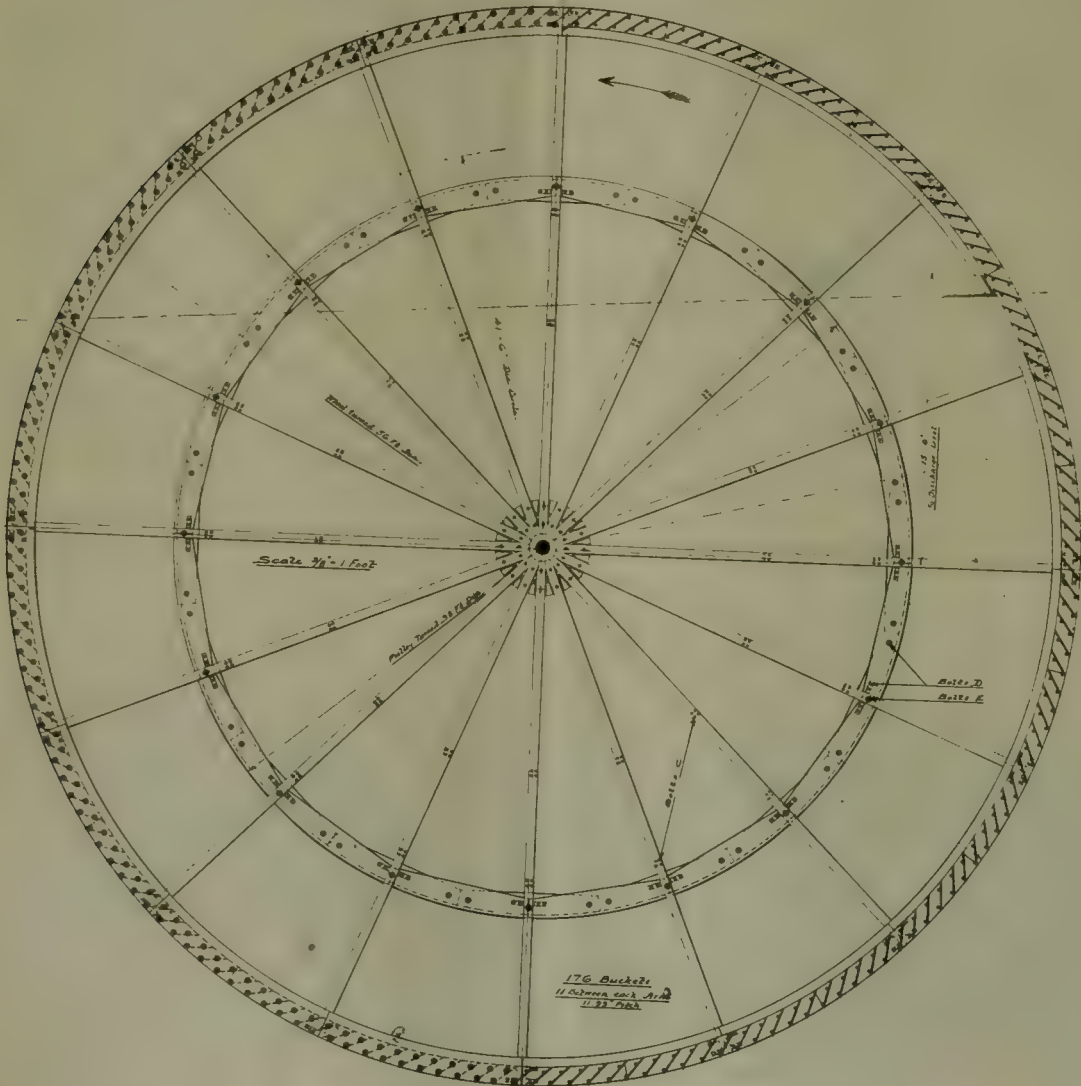
clear water from the settling pond may be used for irrigation work, or pumped back to the mill.

The accompany halftone and line-cuts show the complete plant and contour of the country, and some details of wheel construction which were designed by James Spiers of San Francisco.

Wheels for elevating pulp of any kind are not used much in the United States. At the Tonopah Mining Co.'s plant at Millers, Nevada, there is one 30 and one 45-ft. wheel working at low cost. At El Oro, Mexico, the El Oro Mining & Railway Co. has a large wheel in operation. On the Rand, wheels up to 80 ft. diameter have been greatly favored in the past. Although the first cost is high, they are reliable, and maintenance is low. Also in New Zealand and Western Australia this method has found great favor.



SIDE VIEW OF BUCKETS.



A COMPLETE WHEEL, GIVING DIMENSIONS OF PARTS.

Valuing of Dredging Ground

By L. A. Decora

From time to time, and recently more than ever before, there has seemed to be a lack of the proper understanding of the valuing of a dredging area, and especially of the relation of the actual recovery from a small portion of the area as compared to the distribution of the gold throughout the entire area. With the aid of the accompanying theoretical plot and the resultant tables, I will endeavor to explain the point in question.

I will first consider the area, as a whole, on which 18 drill-holes have been bored. For convenience these holes have been numbered consecutively, the value or the gold content of each, in cents per cubic yard, placed above, and the depth of each, in feet, below the horizontal line and to the right of its number.

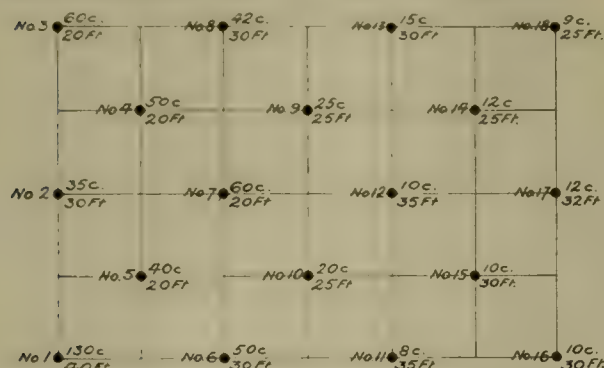


DIAGRAM SHOWING POSITION OF DRILL-HOLES.

Obviously, to obtain the average value or gold content per cubic yard for the entire area, it would be necessary to multiply the gold content of each hole by the depth of the hole, add the total of these products, and divide this sum by the total of depths of the holes. The resultant figure, in this theoretical case 37.69c., would be the average gold content per cubic yard, which would be the figure the examining engineer would report upon unless he used a safety factor to cover any possible loss in recovery by the dredge.

During certain periods in actual operation, the dredge will likely make a recovery above the average gold content per cubic yard, while for other periods the recovery may not reach the average gold content per cubic yard as reported by the examining engineer. These special cases are neither periods for undue rejoicing, on the one hand, nor for gloom on the other, but merely the expected sequence of events.

To further illustrate, cut the entire area, as per plot, into two parts, namely, one bounded by the test holes No. 1, 3, 8, and 6, calling it area A, and the other bounded by No. 9, 10, 16, and 18, calling it area B. Now determine the average gold content of the area A, by the process above described, and it will be found to be 72.42c. per cubic yard, and, likewise, the average

gold content of the area B is found to 12.72c. per cubic yard. It will readily be seen that neither the average gold content of the area A nor that of the area B, nor likewise a small portion of either, when considered by itself, can be taken as a standard by which to judge the average gold content of the entire area as reported by the examining engineer.

Area A			Area B		
1.....	130 × 40 =	5,200	9.....	25 × 25 =	625
2.....	35 × 30 =	1,050	10.....	20 × 25 =	500
3.....	60 × 20 =	1,200	11.....	8 × 35 =	280
4.....	50 × 20 =	1,000	12.....	10 × 35 =	350
5.....	40 × 20 =	800	13.....	15 × 30 =	450
6.....	50 × 30 =	1,500	14.....	12 × 25 =	300
7.....	160 × 20 =	3,200	15.....	10 × 30 =	300
8.....	42 × 30 =	1,260	16.....	10 × 30 =	300
	210	15,210	17.....	12 × 32 =	384
			18.....	9 × 25 =	225
				292	3714

Dividing 15,210 by 210 gives an average value of 72.42c. for area A, while for area B the division of 3714 by 292 gives 12.72c. If, however, the area as a whole is considered, the result is as below:

A	210	15,210
B	292	3,714

$$502 \text{ into } 18,924 = 37.69$$

That is, an average value for the whole of 37.69c. per cubic yard.

This question of the relation of the actual recovery from a small area to that of the average gold content of the entire area is one that should be thoroughly understood, not only by the examining engineers and the directors of a company handling dredging properties, but also by the investing public in general and by those who may be connected with any sort of an alluvial mine, for the question is the same whether applied to dredging, hydraulic mining, or elevating.

Tin Production in Cornwall

During February, yields from the principal mines were as follows:

Mine.	Ore treated, tons.	Tin concentrate, tons.	Value.
Basset	3,437	39	\$18,500
Carn Brea	4,423	41	20,000
Dolcoath	9,033	114	54,000
East Pool	6,324	58	27,000
South Crofty	5,407	59	32,000
St. Ives	*7,897	77	33,000
Wheal Kitty	1,214	17	.....

*Sixteen weeks run.

Cardiff, Wales, is the world's leading coal-shipping port. The coal output of Wales in 1913 was about 54,000,000 tons of which 26,340,012 tons of coal was shipped from Cardiff. Welsh coal is expensive to mine, the average being 220 to 230 tons per man per year. The average selling price last year was \$5 per ton.

Choice of Drum for Steam or Electrical Drive

By C. ANTONY ABLETT and H. M. LYONS

The conditions governing the selection of the type of drum differ very considerably, according to whether the winder is to be driven electrically or by a steam engine, and it is, therefore, very desirable to discuss this question in a paper on electrical driving.

It is characteristic of the steam engine that its overload capacity is not very great and that the turning moment varies according to the position of the cranks.

which it will give, and, consequently, the motor for winding engines is usually selected with reference to the equivalent continuous load, and it is very rarely indeed that the starting moment or acceleration peak needs to be considered.

The first type of drum to be employed for winding engines was the cylindrical drum, but later the conical drum was introduced. In some cases the latter gives

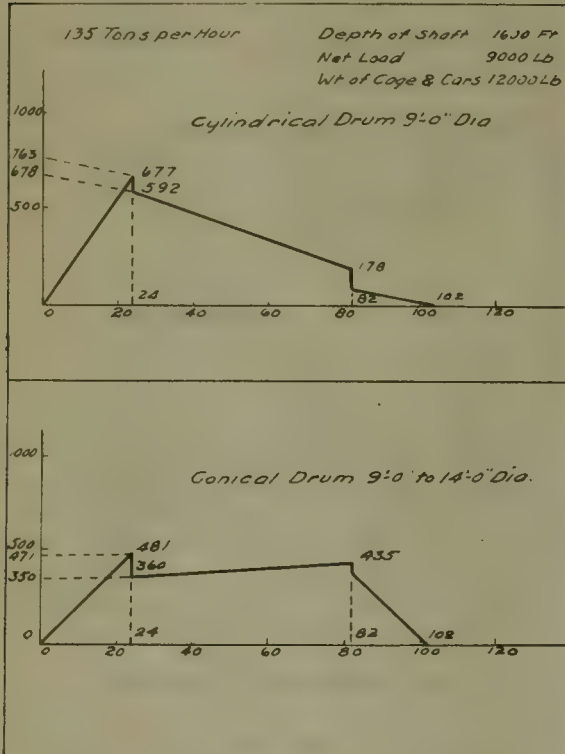


FIG. 1 AND 2.

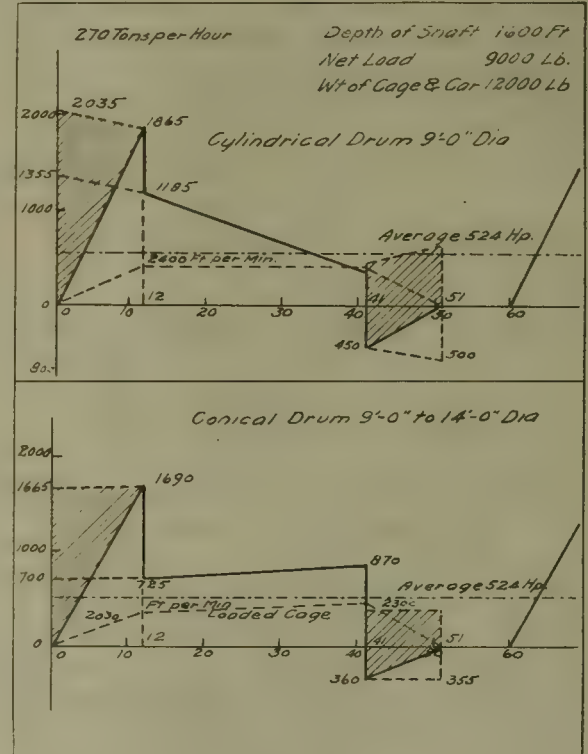


FIG. 3 AND 4.

For a two-cylinder engine with cranks at right angles, such as is usually used for a steam winder, the minimum turning moment is 0.785 of the mean turning moment, and the maximum turning moment is 1.112. The engine naturally must be able to start the hoist with the cranks in any position, so that the minimum turning moment must be at least sufficient to overcome the static load and friction.

Cylindrical and Conical Drums

An electric motor, on the contrary, has a very large overload capacity in proportion to the mean power

easier starting conditions and is beneficial to the steam engine, because the rope supporting the cage at the bank top is wound off the greatest diameter, while the rope attached to the loaded cage at the pit bottom is wound on to the least diameter, so that the empty cage partly balances the rope and the loaded cage at the start of the wind.

To illustrate the relative advantages of the cylindrical and the conical drum for the electrical or the steam drive at various speeds, Fig. 1 to 6, inclusive, have been worked out, while Fig. 7 is worked out for a scroll drum, and Fig. 8 for a Koepe pulley, under the same conditions as are illustrated in Fig. 3 and 4. These diagrams are worked out for the conditions listed following.

*From a paper on 'Electrical Driving of Winding Engines and Rolling Mills,' read before the Canadian Society of Civil Engineers and the Canadian Mining Institute.

Net load	1,000 lb.
Weight of empty cage and cats	12,000 lb.
Depth	600 ft.
Diameter of rope	1.8 in.
Diameter of rope sheaves	16 ft.
Lead	250 ft. approximately.
Cylindrical drum	5 ft. diameter.
Conical drum	9 ft. to 14 ft. diameter.
With cylindrical drum and empty cage	
at the bank, unbalanced load	16,800 lb.
With conical drum and empty cage at	
the bank, unbalanced load	10,000 lb.

Fig. 1 and 2 are drawn for an output of 135 tons per hour. Fig. 1 represents the cylindrical drum where the maximum winding speed is 20 ft. per second. Fig. 2 represents the conical drum with an equivalent winding speed.

If the cylindrical drum in Fig. 1 is driven by a steam engine the horse-power equivalent to the starting torque would be 678, and this starting torque has to be developed in the worst position of the cranks. The horse-power equivalent to the corresponding average turning moment would be 865, which gives an ample turning moment for acceleration, and the maximum speed of the engine would be 42 r.p.m. In the case of the conical drum the horse-power equivalent to the starting turning moment would be 350, and to the average turning moment 445. This horse-power, however, is not sufficient to provide for the acceleration turning moment, so that an engine having a maximum horse-power of 481 would be required, running at a maximum speed of 33 r.p.m. Thus, for the cylindrical drum, an 865-hp. engine running at 42 r.p.m. is required, and for the conical drum a 481-hp. engine at 33 r.p.m. is required, so that for the cylindrical drum an engine giving 20.6 brake horse-power per revolution is necessary, and for the conical drum, an engine giving 14.6. The use of the conical drum, therefore, demands a much smaller steam engine.

Motor Requirements

If the winder is driven electrically, a 378-hp. motor at 42 r.p.m. would be required with the cylindrical drum, and a 290-hp. motor at 33 r.p.m. for the conical drum. If the horse-power per revolution be worked out, it will be seen that these motors are of approximately the same size. In this case, therefore, it would be of advantage to employ a conical drum for a steam winder, but for the electrical winder, so far as capital cost is concerned, it would be distinctly disadvantageous, because there is no saving effected with the electrical plant and the winding engine with conical drums is considerably more expensive than that with cylindrical. The maximum power, however, taken from the supply system, is reduced nearly 30%. It should be remarked, however, that these two diagrams were worked out to show the advantages of the conical drum with a steam engine in this particular case, but for the electrical drive a diagram can be worked out with a cylindrical drum, to give the same output and to take a considerably smaller motor.

The diameter of the drum is usually fixed at not less than 60 times the diameter of the rope, so that, given the depth of the wind, the length of the drum, either cylindrical or conical, necessary to carry the rope is at once fixed. Where cylindrical drums are employed the travel of the two ropes on the drum can overlap (except in cases where the head sheaves are far apart, and the drum cannot be placed sufficiently far back), so that the cylindrical drum for two ropes is not very much longer than that required by the travel of one rope.

Conical Drums

Where conical drums are employed the minimum diameter cannot safely be reduced, and consequently the drum must be made with a larger average diameter, and although the length of drum occupied by each rope is actually less than with a cylindrical drum, yet the turns of the rope cannot be close together, and a space of at least $\frac{1}{4}$ in. between each turn must be allowed. In addition, the cone paths for the two ropes must be quite distinct, as with conical drums the travel of the two ropes cannot overlap, and therefore the conical drum is much longer than the equivalent cylindrical drum. As, therefore, both the diameter and the length of a conical drum are greater than those of the equivalent cylindrical drum, its moment of inertia is much greater. In the case illustrated in Fig. 1 and 2, the moment of inertia of the conical drum is more than four times as great as that of the cylindrical drum, and as considerably more power is required to accelerate the conical drum, it may easily happen that all the advantage of the conical drum is lost for this reason.

Fig. 3 and 4 are worked out for an output of 270 tons per hour. Fig. 3 shows the case of the cylindrical drum where the maximum speed of winding is 40 ft. per second, and Fig. 4, that of the conical drum with an equivalent speed. An inspection will show that in these cases the size of the steam engine is determined by the turning moment corresponding to the acceleration peak. For the cylindrical drum a steam engine capable of giving 2035 hp. at 84 revolutions will be required, and for the conical drum a steam engine capable of giving 1690 hp. at 66 revolutions will be required, that is, a slightly larger steam engine will be required for the conical drum. It should be noted, however, that in the case of the cylindrical drum if constant acceleration is not assumed it would be possible to reduce the maximum horse-power of the steam engine from 2035 to 1950. Should the electrical drive be adopted, a 1090-hp. motor at 84 revolutions would be required for the cylindrical drum, and a 965-hp. motor at 66 revolutions for the conical drum, so that a larger motor is required for the conical drum.

In this particular case, if the Ward Leonard system is to be employed, the effect of using a conical drum would be to increase the size of the winding motor by 12%, but to decrease the size of the motor generator

set by 11½%, the net result of this being that the cost of the electrical equipment would be the same, and the cost of the winding engine would be greatly increased. The adoption of the conical drum would diminish the maximum acceleration peak by about 10%. If the Ilgner system is to be employed it will be found that the use of the conical drum enables a very slight reduction in the capacity of the flywheel to be made, but this reduction is so slight that there is no advantage in employing this drum, as it will only increase the capital cost of the winding engine.

If, however, the winding engine is to be driven by a three-phase motor the use of a conical drum would increase the motor in size by 12%. Consequently, the total cost of the winder is considerably increased, but, on the other hand, the average power wasted in the starter is reduced from 325 to 260 hp., which means that a saving of 65 hp. minutes per wind is effected.

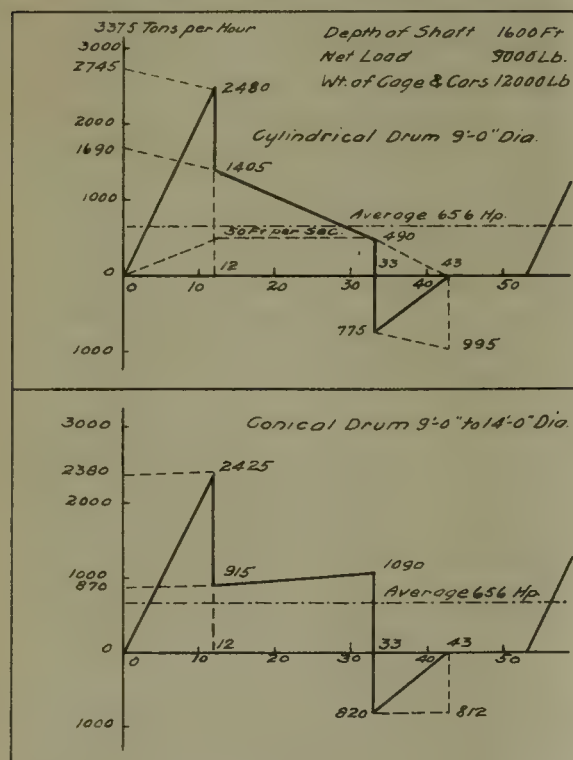


FIG. 5 AND 6.

Taking the cost of power at 1c. per kilowatt hour, this represents a saving of 65c. per hour, or about \$2000 per year.

Fig. 5 and 6 are worked out for an output of 337.5 tons per hour. Fig. 5 shows the case of a cylindrical drum where the maximum winding speed is 50 ft. per second, while Fig. 6 shows the case of a conical drum with an equivalent winding speed. It is easily seen that if a steam engine is used to drive this winder, a larger engine will be required for the conical drum than for the cylindrical. In the case of the electrical

drive a 1490 hp. motor at a maximum speed of 105 revolutions would be required with the cylindrical drum, and 1390-hp. motor at a maximum speed of 83 revolutions for the conical drum. It will thus be seen that if the Ward Leonard system is used the effect of the conical drum will be to increase the size of the winding motor by 18%, and to reduce the size of the converted set by about 7%, so that with the Ward Leonard system or the Ilgner system it is a distinct disadvantage to use a conical drum for this high-speed winder. If a three-phase motor were used to drive this winder the provision of a conical drum would increase the size of the motor 18%, but would reduce the average power lost in the starter from 620 to 566 horsepower.

Cylindro-Conical or Scroll Drum

The cylindro-conical drum is a drum which has a cylindrical portion of large diameter at the middle of its length. At each end of this large cylinder there is a short cone reducing the diameter of the drum, and the remainder of the drum at each end consists of a short cylindrical portion of small diameter. In commencing a wind the rope hoisting the loaded cage from the bottom of the pit is wound upon one of the small cylindrical portions, while the rope lowering the empty cage is wound off the large cylindrical portion. Such winders are usually proportioned so that the drum reaches full speed while the rope from the loaded cage is still being wound on the smallest diameter, but at this point the loaded cage has not reached full speed, although the empty cage has, and the loaded cage does not reach full speed until the rope has reached the top of the cone. The greater portion of the run is made with the ropes on the large diameter. Toward the end of the run the rope lowering the empty cage runs down the cone at the other end of the drum, decelerating the cage, and when this rope has reached the small diameter cylinder, the drum is then decelerated.

It will be seen that on the large diameter cylindrical portion of the drum the travel of the two ropes can overlap, and they are always designed to do so, unless the head sheaves are too far apart to permit of this.

The possibility of overlapping the travel of the ropes with a scroll drum enables a scroll drum to be constructed of shorter length than the corresponding conical drum, and it may easily be even shorter than the corresponding cylindrical drum. It will be found also that the moment of inertia of a scroll drum is less than that of the corresponding conical drum, but greater than that of the cylindrical drum, and in the case illustrated in Fig. 7 the stored energy of the scroll drum is about two-thirds that of the conical drum illustrated in Fig. 4, which produces a marked reduction in the acceleration peak.

Fig. 7 is a power diagram for a winder provided with a cylindro-conical drum worked under the same conditions as those assumed in working out Fig. 3 and 4. In the case illustrated, the small cylindrical portions at each end of the scroll drum are 9 ft. in diameter

and each carry six turns of the rope. The conical or scroll portions increase in diameter from 9 ft. to 13 ft., and each carry five turns of rope. The large cylindrical portion is 13 ft. in diameter and carries 31 turns of rope.

In Fig. 7, line AB represents the constant acceleration of the drum, the descending cage and rope to full speed, and the part acceleration of the ascending cage and rope, while this latter rope is being wound upon one small cylindrical portion of the drum. The line BC shows the drop in power corresponding to the completion of the acceleration of the drum and the descending cage. The line CD shows the continuation of the acceleration of the ascending cage and rope as this rope is being wound on one of the scroll portions of the drum. The line DE shows the fall in power at the completion of the acceleration of the ascending cage and rope. The line EF shows the power taken by the full speed run of both cages, and this power gradually decreases as the descending rope lengthens and the ascending rope shortens, so that the descending rope gradually balances a greater portion of the ascending load. The line FG shows the decrease in power, corresponding to the deceleration of the empty cage, as its rope commences to run down the scroll. The line GH shows the gradual increase in power as the rope to the empty cage runs down the scroll, and therefore balances the ascending load to a less extent. The line HI shows the fall in power at the commencement of the deceleration of the drum, the ascending cage and the rope and the line IJ shows the gradual fall in power during the deceleration period.

In this case it will be noticed that power is taken by the winding motor during the deceleration period, and this is not a case where electrical braking is necessary. If a steam engine were used to drive this scroll drum winder, an engine capable of giving 1465 hp. at a maximum speed of 62.7 revolutions will be required, and this is a smaller engine than would be required for the conical drum of Fig. 4, and slightly smaller than that required for the cylindrical drum in Fig. 3. If this winder is driven electrically, a 780-hp. motor at 62.7 revolutions would be required, and this is a smaller motor than would be required for the conical drum winder of Fig. 4, or the cylindrical drum winder of Fig. 3, the latter being about 4% smaller than that required for the cylindrical drum winder. If this winder is driven on the Ward Leonard system, the size of the motor generator set can be reduced by 30%, and if it is driven on the Ilgner system, the same reduction can be made in the motor generator set, and the weight of the flywheel can be reduced about 13 per cent.

The capital cost of the mechanical parts of the scroll drum winder is, of course, more than the cost of that for a cylindrical winder, but it is not so great as that of the mechanical parts of a conical drum winder, and if this winder is to be driven on either the Ward Leonard or the Ilgner system, it is probable that the

scroll drum winder represents one of the cheapest combinations in capital cost that can be put in to do the work. Should this winder be driven on the Ward Leonard system, it should be pointed out that the maximum peak in power which it requires is 25% less than that required with the cylindrical drum winder. If a three-phase motor is used for driving this winder, the size of the motor is slightly less than that which would be required for the cylindrical drum winder, but the waste of power is very much less, the average waste being 170 hp. continuously as compared with 260 hp. for the conical drum winder, and 325 hp. for the cylindrical drum winder.

Koepe Pulley Winder

This type of winder is used to a considerable extent in Europe, particularly in Germany. It differs from any other type, as the rope is not wound upon and off drums, but is carried over the pulley and makes contact with it for less than a single turn. Thus the rope

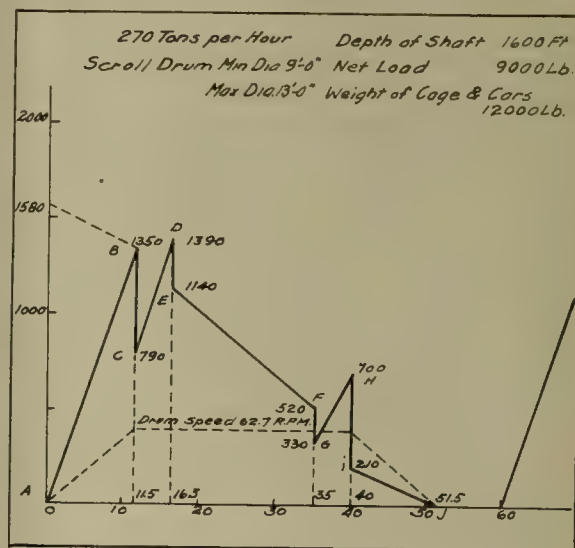


FIG. 7.

from the ascending cage comes up the shaft over the driving pulley of the winder, and then down to the descending cage, being suitably guided by head sheaves. It will thus be seen that the winding rope is driven by friction alone, and, consequently, there must be a very definite limit between the pull in the ascending rope and the pull of the descending rope, otherwise the rope will slip on the pulley, and, to keep the difference in pull of the two sides of the rope as small as possible, a balance rope is always necessary. It should be noted that such a winder cannot work with a very high acceleration, otherwise slipping of the rope will take place. As the rope is bound to creep on the pulley to a certain extent, the depth indicator must frequently be reset to insure its accuracy.

As with a Koepe pulley winder the axial length of the pulley is very short indeed compared with that of

a drum on which the rope has to be wound, and as the weight of the winding drum is not increased by the rope which it is carrying, the moment of inertia of the revolving parts of a Koepe pulley winder is small, and this, together with the use of the balance rope, keeps the maximum acceleration peak comparatively small compared with that of other types of winder.

For purposes of comparison, Fig. 8 has been drawn for an output of 270 tons per hour, and may be compared with Fig. 3 showing a cylindrical drum, Fig. 4 showing a conical drum, and Fig. 7 showing a scroll drum. In this case, however, the time of acceleration has had to be increased from 12 to 22 seconds, so that the acceleration should not be so great as to cause the rope to slip on the drum, and to enable the output to be obtained with this slower acceleration the maximum speed has had to be increased from 40 to 46 ft. per second. In European practice the diameter of a Koepe pulley is usually taken as 100 times that of the rope, but for purposes of comparison with the other cases, a 9-ft. pulley has been considered, which is 66 times the diameter of the rope.

A 935-hp. motor running at maximum speed of 97

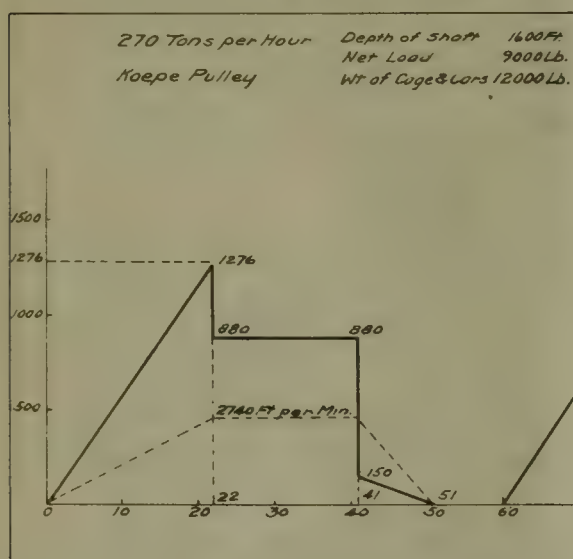


FIG. 8.

revolutions will be suitable for driving this winder, and comparing this with the motor required for the cylindrical drum in Fig. 3, it will be seen that the Koepe pulley winder can be driven with a 25% smaller motor. If it should be driven by the Ward Leonard system, the motor generator set would be 14% smaller, and if it should be driven on the Ilgner system, the motor generator set will be similarly reduced, and the weight of the flywheel can be reduced about 12 per cent.

As the cost of the mechanical parts of the Koepe pulley winder is not great, this will be the cheapest form of winder for doing the work, and as the maximum power required at the end of the acceleration period is

1276 hp., or over 30% less than the maximum horsepower in the case of a cylindrical drum winder, it will, if driven on the Ward Leonard system, have the least severe demand on the source of electrical supply. If the winder should be driven by a three-phase motor, it will be seen that while the small moment of inertia of the moving parts keeps down the acceleration peak and so tends to decrease the waste of power in the controlling resistances, the fact that a long time of acceleration has to be allowed may increase these losses. In the present case, losses in the controlling resistance correspond to a continuous loss of 241 hp., as compared with 325 in the case of a three-phase motor driving a cylindrical drum winder, and 170 in the case of a three-phase motor driving the scroll winder.

Generally speaking, the Koepe pulley winder shows to the greatest advantage with deep shafts, as it avoids the use of excessively long drums, and, from the electrical point of view, where the winding speed is not very high and where the acceleration period is short compared with the total time of winding. It has the disadvantage that if the rope breaks, both cages are detached from the winder.

General Conclusions Concerning Winding

Generally speaking, we are of opinion that the Ward Leonard or Ilgner system of electric winding is the most suitable for vertical shafts, and for all cases where large outputs are required and short and frequent winds are made.

The three-phase winder always has the disadvantage that it cannot be so completely protected against careless handling as either the Ward Leonard or the Ilgner, but it may prove more economical for long slopes where the full speed run is a long one and the periods of acceleration are comparatively infrequent.

Regarding the choice of drums for the winding engine, we are of opinion that in many cases where electrical drive is adopted, the cylindrical drum winder will prove the most suitable, but that in cases of deep shafts where the winding speed is high the scroll drum winder may prove better than the cylindrical drum winder, but that the field of application of the conical drum winder to electric winding is very small.

TABLE SHOWING THE INFLUENCE OF THE DIFFERENT TYPES OF DRUMS ON THE ELECTRICALLY DRIVEN WINDING ENGINE

Depth, 1600 ft.	Output, 270 tons per hr.			
	Cylindrical drum.	Conical drum.	Scroll drum.	Koepe pulley.
Power of motor.....	1,090	965	780	935
Speed of motor.....	84	66	62.7	97
Horse-power per revolution	13	14.6	12.4	9.6
Maximum peak with Ward Leonard system	1,865	1,690	1,390	1,276
Average loss of power with three-phase system hp....	325	260	170	241

Silver produced by the Nipissing mine to the first of the year totals 32,585,418 oz. or 1117 short tons. Ore reserves are estimated to contain 9,510,000 ounces.

Salt Lake Meeting of the American Institute of Mining Engineers

The 108th meeting of the Institute will be held at Salt Lake City, Utah, on August 10 to 14, inclusive. Although the Institute has visited Salt Lake City at various times en route to other meetings, this is the first time in its history that a meeting has been devoted exclusively to Utah. In July 1887 the members convened at Salt Lake City and then adjourned to Butte, Montana, but the technical and social attractions of Salt Lake City and vicinity more than warrant the holding of a meeting exclusively in this place.

Local committees have been formed under the chairmanship of R. C. Gemmell, and are already actively engaged in preparing for the entertainment and convenience of visiting members. Charles W. Goodale, chairman of the committee on precious and base metals, is in close touch with the local committees, both by mail and personal conference, and the progress already made by the committee on precious and base metals assures an interesting technical program.

Twenty-five papers are already in the hands of the secretary and have been accepted for this meeting by the committee on papers and publications. The attention of authors, members of committees, and members of the Institute is called to the necessity of having all papers in the hands of the secretary of the Institute before May 31.

The social features of the Salt Lake meeting will include many visits to neighboring mines and metallurgical works, and it is expected that invitations will be general. Among the several points of interest which might be mentioned are: Bingham cañon, where is situated the open-pit mine of the Utah Copper company, at which some of the most interesting mining operations of the world are carried on; also the methods of underground mining at the Ohio Copper Co. and other well known mines, such as the Highland Boy, Utah Apex, Bingham & New Haven, and others. An interesting aerial tramway is in operation from the Utah Consolidated Copper Co. to the Tooele smelter. This lead and copper smelter is the latest one built, and, since it embodies many novel features, it will doubtless be exceedingly interesting to all. Garfield is the site of the Arthur and Magna mills of the Utah Copper Co.; the copper smelter of the American Smelting & Refining Co., and an industrial town owned by the Utah and Garfield companies. At Lark is situated the mill of the Ohio Copper Co.; and at Murray is the lead smelter of the American Smelting & Refining Co. Midvale is the site of the United States Smelting, Refining & Mining Co., where may be seen the Sprague process for collecting fume, a plant for arsenical recovery, and the Huff electrostatic process, which will be novel to many of the members. Park City is a famous old camp of Utah, where are the mines of the Silver King Coalition, Silver King Consolidated, Ontario, Daly-Judge, Daly West, and others.

The Huff process for the hydro-metallurgical treatment of low-grade ores is an interesting innovation. Tintic contains several mines producing siliceous ores, showing a little copper and a good deal of silver, such as the Centennial Eureka, the old Eureka Hill, Gemini, Eagle & Blue Bell, Grand Central, Mammoth, and others. Many other interesting points, at a slightly greater distance from Salt Lake City than those mentioned, will doubtless attract several members, and it is certain that the technical features will be more than sufficient to attract many members to this meeting.

Metal Production of Central States in 1913

Silver, copper, lead, and zinc produced in the central states, according to the final figures of J. P. Dunlop, of the U. S. Geological Survey, were valued at \$58,045,927. Of this, Missouri and Michigan contributed by far the largest amount, the Missouri production being valued at \$29,604,890, and that of Michigan at \$21,235,561. These figures show a marked decrease compared to 1912, the total for the central states in that year being \$79,675,814.

Silver, lead, and zinc produced at mines in Oklahoma were valued at \$1,855,217, compared with \$1,101,042 in 1912. The increased yield of lead and zinc in 1913 was due entirely to operations in the Miami field. Drilling operations were conducted over a wide area and resulted in finding some extensive bodies of mineralized ground, the sinking of new shafts, and the erection of concentrating plants.

Silver, lead, and zinc produced at mines in Illinois were valued at \$336,963. This is less than half the value of the production for 1912, which was \$679,259. Development work was, however, more active than in previous years, so that the outlook is stated to be better for 1914.

The value of the mine output of lead and zinc in Wisconsin was \$3,570,464. These figures show a decrease of \$1,222,726 compared with 1912, when the value was \$4,793,190.

Petroleum Production in 1913

According to C. du Poizat, in *Echo des Mines*, the principal countries of the world yielded the following tonnage of oil:

	1913.	1912.
United States	32,000,000	29,500,000
Russia	9,000,000	9,500,000
Mexico	2,000,000	2,300,000
Rumania	1,800,000	1,800,000
British and Dutch Indies.....	1,700,000	1,700,000
Galicia	1,000,000	1,700,000

Slime scraped from the Standard Consolidated company's ponds, at Bodie, California, in 1913, totaled 10,151 tons worth \$5.43 per ton. The cost of collecting was 58.1c. per ton.

Discussion

Readers of the MINING AND SCIENTIFIC PRESS are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment. Insertion of any contribution is determined by its probable interest to the readers of this journal.

Drilling at Pato

The Editor:

Sir—Articles of much interest concerning the work of the Pato Mines, Ltd., in Colombia, have appeared in your paper from time to time, and in some of these articles the discrepancy between the drilling results and the dredge returns have been mentioned. In some of your news items it has been stated that the Pato company has been drilling their San Francisco property with Empire drills, all of which is true. However, a number of people have coupled up these statements and assumed that the earlier drilling of the Pato ground was done with Empire drills, whereas the truth of the matter is that it was done with steam drills. I have had many inquiries of late about this so-called drilling inaccuracy, wherein the parties have wrongly blamed the Empire drill for this discrepancy.

In justice to my Company, the New York Engineering Co., and the Empire drill, which is manufactured by it, I would be glad to have you publish the following fact: The original drilling of the Pato property was done by A. P. Rogers and C. H. Munro, with steam drills, some six or seven years ago, and before the Empire drill was known. It is in this work that the results have been criticised and not the subsequent drilling done with Empire drills.

A. C. LUDLUM.

New York City, April 4.

The Radium Bill

The Editor:

Sir—In your editorial of April 11 concerning the proposed radium bill you state your inability to see why the mining men of Colorado should object to it, or why its provisions should work hardship to those concerned. If you will permit, I should like to explain the reasons that seem to me, and to many others with whom I have talked, sufficient for opposing it. The fact that the Government retains a perpetual option on the ores extracted will effectually discourage prospecting, investing in prospects and developing them, and working out new processes for the reduction of the ores. In other words, it will nip in the bud what bids fair to become a flourishing branch of the none too flourishing metal-mining industry of this state. Several of the contributors to your recent symposium on prospecting mentioned the discouraging effects of governmental restrictions on the location of claims. If those now in force are discouraging—and no one familiar with the prospec-

tor can doubt it—this new one will be practically prohibitive. The owner of a radium claim cannot enter into a contract with anyone except the Government to sell his ore. Without a contract covering a reasonably long period, he is at the mercy of the fluctuations of the market and cannot tell whether or not he is conducting his mining operations at a profit at any given time. The metallurgist will have no incentive to invent or improve reduction processes, because, even if he owns a producing mine, he has no means of assuring himself of a steady supply of ore.

Without pernicious government interference it is not unlikely that, in the course of the next few years, new discoveries of deposits and processes would make radium comparatively cheap and plentiful, as has been the case with other rare metals. This is greatly to be desired, but the proposed bill will certainly retard, if it does not entirely prevent this. It will tend to throw the entire burden of prospecting, development, mining, and treatment on the Government. While the government bureaus do careful and thorough scientific work, they are notoriously slow in accomplishing practical results and there is no reason to believe that they would speed up in the present case. On the contrary, it is almost certain to take them longer and to cost the people of the United States more to produce a given quantity of radium than if they bought it in the open market and allowed everyone a free hand in its production. If Congress and the interested government officials are sincere in their desire to obtain the greatest possible amount of radium in the shortest possible time, and are not merely anxious to create a few more jobs and to strengthen their bureaus, why do they not accept Mr. Flannery's offer to deliver them 200 grams of radium in the course of the next five years at a maximum price of \$80,000 per gram? They certainly cannot get it any more quickly and probably cannot produce it more cheaply than that. In closing, I wish to state, that I have no personal interest in the radium mining or reduction business.

HORACE F. LUNT.

Colorado Springs, Colo., April 15.

What Is the Matter With Prospecting?

The Editor:

Sir—There are many causes that have had their influence in the restriction of the development of prospects. There is no question but that many of the more prominent exposed croppings have been discovered. The action of the Land Office during several past administrations (the present appears to approve a more liberal policy) has discouraged the man with capital; Pinchot's conservation views, the course pursued by many eastern magazines and papers in continually advising the public that all mining investments are extra hazardous; the fact that the majority of the miners today are foreigners who work and send their money to the old country, together with the world-wide un-

favorable financial conditions, have operated to make it impossible for the promotor of a mining property, doing a legitimate business, to sell stock. But the average mining engineer is more to blame than all others for keeping capital from the development of prospects. For years he has been writing and talking of 'ore blocked out, ore in sight' until you can interest very few. Nor will they even listen to anything that has not ore blocked on three to six sides.

The engineer, from his training, experience, and observation has been concerned with developed properties. He has not had experience with prospects, and when sent to examine one, he invariably turns it down. He figures this is safer, but really from lack of experience and knowledge, he rarely is qualified to pass on its merits.

In twenty-five years experience, from Alaska to old Mexico, I have known but two mining engineers whose judgment on a prospect was worth consideration. I have known several fortunes lost, to the original owners, by mining engineers turning down prospects that later proved good properties. Not but what the technical education is all right, and makes the better man, provided he will get into the harness and acquire by experience the necessary practical knowledge; but the facts are that nine times out of ten the technical course spoils the man for manual labor.

Many have been driven into other lines of business, possibly where they belong, at least until such a time as they learn that all mines were once prospects, and can give any old mine, prospect, mule, or man a square deal. That's all that is needed, a square deal, in order to rejuvenate mining.

G. L. SHELDON.

Ely, Nevada, April 2.

The Rand Banket

The Editor:

Sir—I have pleasure in responding to your invitation to contribute to the discussion of C. B. Horwood's paper on 'The Rand Banket.' As, however, my detailed mapping of the Witwatersrand in connection with the Geological Survey is approaching completion, it will be necessary for me before long to deal with the whole subject fully, and it is therefore not my intention to discuss Mr. Horwood's paper at any length. Lest, however, absence of comment should appear to indicate that Mr. Horwood's views on several points are accepted by others acquainted with the area of which he writes, it is perhaps desirable to briefly refer to one or two of them at the present time.

On the question of the origin of the Witwatersrand gold, Mr. Horwood, having taken up the position of a strong advocate of the infiltration theory, naturally passes over much of the evidence for the opposing views. The arguments for the placer origin of the gold have been most recently stated by J. W. Gregory and should be carefully considered by anyone wishing

to arrive at independent conclusions on the question. Although commencing my survey of the district with inclinations, if anything, in favor of the infiltration theory, my four years' study of the Rand, including repeated investigations of the 'reef' at numerous points over the greater portion of its extent, have not furnished any evidence in favor of that view. On the contrary, I have met with much evidence in favor of a placer origin, in addition to that already brought forward by the advocates of that view.

Those who compare the evidence in favor of the two will doubtless note that while the arguments in favor of the placer theory are for the most part of a very simple and direct character, based upon direct observation of and comparison with other similar deposits about whose origin there can be no doubt, those in favor of the infiltration theory are very frequently highly speculative or theoretical, as will be apparent from the references quoted by Mr. Horwood.

That there has been considerable local re-distribution of the gold content of the reefs, no one well acquainted with them will be inclined to doubt, and in many cases this re-distribution has naturally produced effects which although purely secondary are suggestive of an infiltration origin for the whole deposit. The local character of some of these effects is, however, strikingly shown in many instances.

With regard to the influence of dikes—against the few examples of such intrusions being associated with specially rich portions of the gold-bearing beds cited by Mr. Horwood, must be set the dozens of examples in which either entirely opposite conditions are found or where nothing unusual is to be noticed. Although it is a point to which I have paid special attention on visiting a large number of mines, I have not yet met with any instance in which the presence of richer 'reef' was clearly dependent on the intrusion of a dike except as a purely secondary and extremely local result. I have, however, met with several instances where the accidental disposition of a dike with regard to a rich patch of reef has at first sight suggested a causal relationship. Further examination, however, has never confirmed this view.

Students of Rand geology will be grateful to Mr. Horwood for the many excellent photographs of Rand specimens which have been reproduced, and also for the publication of the detailed analyses he has had made in connection with the occurrence of carbon and of iridosmine in the banket, although in the case of both these latter the deductions drawn by many readers from the results may be opposed to the interpretation placed upon them in the paper.

E. T. MELLOR.

Johannesburg, Transvaal, March 25.

The Anaconda Copper Co. reports that the year ended December 21 shows a total revenue of \$61,258,755, which is a decrease of \$6,003,285. The balance for dividends was \$11,323,500, a decrease of \$4,532,835.

Concentrates

Most of these are in reply to questions received by mail. Our readers are invited to ask questions and give information dealing with the practice of mining, milling, and smelting.

Sulphuric acid manufactured by the Wallaroo and Moonta company, South Australia, in 1913, amounted to 5602 tons, at a cost of \$4.58 per ton.

Residue from the high-grade mill of the Nipissing Mining Co., at Cobalt, contained last year 20 to 40 oz. silver per ton, 8 to 10% cobalt, 4 to 6% nickel, and 30 to 40% arsenic. This is sold to manufacturers of cobalt products, and 1659 tons were sold netting \$62,484. This mill treated 1200 tons of Nipissing ore averaging 2501 oz., and 632 tons of custom ore assaying 2854 oz. silver per ton.

Beri-beri is a disease contracted in the tropics, mainly through eating polished rice. It is characterized by symptoms referable to the gastro-intestinal, cardiac, and nervous systems. Dropsy, heart weakness, or paralysis, or a combination of all these symptoms, may be present, and if not fatal it disables its victims, and renders them unfit for work. The Bureau of Science, at Manila, Philippine Islands, has been investigating this ailment, and in *Press Bulletin* No. 24 are given details of the work being done.

Mine accounting varies greatly on different properties, and in many parts of the world. According to A. E. Jacobs, in the February Monthly *Journal* of the Chamber of Mines of Western Australia, a consideration of this important branch of the mining business leads to the conclusion, that it largely resolves itself into the question of being able to record with accuracy and reasonable despatch, the cost of the various operations arising out of the daily working of a mine. The paper by this writer, 'The Accounts of a Mine,' is 16 pages long, and with the discussion on account books, cost segregation tables, and other data, is worth filing.

Consumption of supplies at the Nipissing low-grade mill in 1913, when 77,240 tons of ore averaging 27.18 oz. silver per ton was treated, with 91.85% extraction, was as follows:

	Pounds.	Pounds per ton.	Cost per pound.	Total cost per ton ore.
Cyanide	400,722	5.190	\$0.1500	\$0.7785
Caustic soda	246,880	3.200	0.0214	0.0684
Lime	512,595	6.640	0.0040	0.0266
Aluminum dust	43,911	0.568	0.3373	0.1917
Aluminum plates	20,731	0.268	0.2438	0.0654
Aluminum ingots	74,483	0.964	0.2207	0.2128
Flint pebbles	505,170	6.540	0.0098	0.0646
Ore pebbles	239,500	3.100	.....	.....
Coal for heating	2,329,250	30.160	0.0029	0.0881
Power, kilowatt-hours	3,982,000	51.570	0.0115	0.5923
Total				\$2.0894

Costs of mining and treatment at the Perseverance mine, Kalgoorlie, during 1913, were as follows:

Mining:	Cost per ton.
Wages and contracts	\$0.86
Explosives	0.16
Timber	0.02
Drill parts and air lines	0.03
Candles	0.02
Steel and tool sharpening	0.03
Stores, etc.	0.02
Air for drilling	0.10
Power for hoisting	0.25
Assaying, surveying, sampling	0.04
General maintenance	0.10
Supervision	0.02
Net debit charges on development	0.02

Total mining\$1.67

Milling:	
Jaw crusher	\$0.10
Ball-mills	0.49
Roasting furnaces	0.68
Grinding pans .....	.....
Mechanical agitators	0.51
Filter-presses	0.41
Precipitation, etc.	0.10
Disposal of residue	0.11

Total milling\$2.40

The accompanying halftone shows the Marysville Buttes of Sutter county, California. The Marysville folio of the U. S. Geological Survey covers portions of Butte, Yuba, Sutter and Colusa counties. In the main, this area consists of broad alluvial plains, suited for agriculture. The Feather and Yuba rivers contain



MARYSVILLE BUTTES, CALIFORNIA.

profitable gravel for dredging. In pronounced contrast to the monotonous plains and low rolling hills, there rise, in the centre of the area, between the two principal rivers, the Marysville Buttes. The central peaks attain an elevation of 2000 ft. They are a circular group of mountains, 10 miles in diameter. Oaks, pine, and brush grow on them. Snow hardly ever falls, the temperature ranging between 18 and 115°. The rainfall is 18 in. per year. In general, it may be said that the Buttes are an extinct volcano of Neocene age, the internal structure laid bare to some extent by erosion. There are three divisions to the Buttes, topographically and geologically distinct, namely (1) the peripheral tuff ring; (2) the interior ring of up-turned sedimentaries; and (3) the central core of igneous rocks. The latter are massive volcanic rocks, mixed with breccias of the same material. The Marysville Buttes attract a great deal of attention to mining men traveling north through California.

Special Correspondence

JUNEAU, ALASKA

FUTURE OF THIS LOW-GRADE DISTRICT—THE TREADWELL GROUP,
ALASKA GASTINEAU, ALASKA JUNEAU, AND EBNER MINES.
HYDRO-ELECTRIC POWER

Within the next five years, it is safe to say that the district around Juneau, along the Gastineau channel, will be the centre of some of the largest low-grade gold producers in the world. Developments point to that end. As is well known, the group of mines on Douglas island, opposite Juneau, have been highly profitable for many years, and are treating an aggregate of 1,566,000 tons of ore averaging \$2.50 per ton, and paying \$1,594,460 (\$1 per ton) in dividends per year. The Perseverance and Sheep Creek mines, on the mainland, operated by the Alaska Gastineau Mining Co., which is controlled by the Alaska Gold Mines Co., has developed an immense tonnage of \$1.50 ore. Records of the work done have been published in this journal from time to time, the preparatory work being described by Grant H. Tod in the issue of August 2, 1913. A mill with an ultimate capacity of 20,000 tons per day is being constructed. The accompanying halftone shows a panorama of the property of the Alaska Juneau Gold Mining Co., and the present stage of work is seen at a glance. The plans of the Company were described by F. W. Bradley in the *Mining and Scientific Press* of December 6, 1913. Eventually an output of 12,000 tons of \$1.45 ore per day is to be treated. The total cost will be about 80c. per ton. The ores from both of these large mines at Juneau is to be handled through long adits, which makes lower haulage charges. The system of mining will be somewhat different from that in the mines on Douglas island, and it is estimated will be 48c. per ton lower than the latter. There is an abundance of timber for all purposes, and water for electric power generation sufficient for present purposes. In the future, as a larger output of electricity is required, it will be necessary to bring power in from outside. Projects for the 'Long Lake Power Development' were described by E. P. Kennedy; and the 'Speel River Electro-chemical Project,' by W. P. Lass, in the issues of January 24 and 31, 1914, respectively.

The third of the great properties now being developed at Juneau is the Ebner, adjoining the Alaska Juneau mine to the north. It is now announced that the United States Smelting, Refining & Mining Co. paid \$225,000 for the Ebner property at auction, in addition to private purchase of bonds, making the total investment more than \$500,000. The Company also has options on about six miles of adjoining properties, and on water-power privileges now controlled by the Dora Construction Co. and in which the Company can secure a 51% interest by paying the \$300,000 said to have been expended on development. A deep-level adit to cross-cut the orebody is now in progress.

The annual report of the Alaska Gold Mines Co., mentioned above, for 1913, has just been made public. Of the Alaska Gastineau Mining Co.'s bond issue of \$3,500,000, and stock of \$12,000,000, it owns \$3,267,500 and \$11,299,845, par value, respectively. No. 1 shaft was sunk to a depth of 1544 ft. Development on the vein, in preparation for mining, was continued on most of the proposed levels above No. 10 level, this having been extended a total length along the vein of nearly 5000 ft. The height of the vein, measured on its dip above the Sheep Creek adit, and for the length of the zone developed on No. 10 level, is nearly 2000 ft. Ore in this area would be over 50,000,000 tons. A new \$1.60 orebody is being opened north of the main Perseverance vein. By January 1, 1915, the first unit of the 6000-ton mill should be in operation.



PANORAMA OF THE ALASKA JUNEAU GOLD MINING CO.'S PROPERTY ON GASTINEAU CHANNEL, JUNEAU, ALASKA. DOUGLAS ISLAND ON THE RIGHT

WASHINGTON, D. C.

RADIUM BILL. SIDETRACKED.—NEW BILL FOR EXPLORATION OF PHOSPHATES, ETC.—MINING LAW BILL.—WATER-POWER BILL. LEASING WITHDRAWN MINERAL LANDS.

On May 1, Senator Walsh tried to have his Radium bill made the unfinished business of the Senate, after it had acted on the Grain Inspection bill, but it was easily sidetracked for the Panama Canal Tolls repeal bill. Congress has ceased to take any great interest in the Radium bill.

The bill of great indirect interest to the mining world, authorizing exploration for and the disposition of coal, phosphate, oil, gas, potash, or soda has been agreed upon in the full committee on public lands of the House, and it will be reported next week with a favorable recommendation. The bill is fathered by Congressman Ferris, of Oklahoma, chairman of the committee, and there were only two negative votes against it in the committee. These were by Congressmen Taylor of Colorado and Johnson of Utah. It is a leasing bill, and its character is well illustrated by the section relating to phosphates, which states that the Secretary of the Interior is authorized to lease deposits of phosphates or phosphate rock, belonging to the United States, under conditions specified in the law and through advertisement and competitive bidding. In the general provisions it is declared that no person, association, or corporation, except as otherwise provided, shall hold more than one lease, directly or indirectly, and that no person, association, or corporation holding a lease under the provision of this act shall hold more than a tenth interest, direct or indirect, in any agency, corporate or otherwise, engaged in the resale of coal, phosphate, oil, gas, potassium, or sodium purchased from such lessee; and any violation of the provisions of this section or of the anti-trust laws of the United States shall be ground for the forfeiture of the lease or interest so held. No lease can be sublet except by consent of the Secretary of the Interior, or assigned.

The mines committee of the House has made arrangements to report favorably, next week, the bill for the establishment of experimental mining stations in the metalliferous states. No action has so far taken place in any way on the bill creating a commission to codify the mining laws of the United States. It is still waiting for its opportunity.

A bill of interest to mining men is the Ferris bill, now with the House Committee on Public Lands, respecting the control of water power on the public domain. Hearings are largely attended. It provides for the development of water power and the use of the public lands in relation to electric power. Among those heard this week was W. L. Fisher, formerly Secretary of the Interior, who favored the bill, saying that state rights would be adequately conserved in the bill, but that the final control and ultimate supervision of power must rest in the Federal Government, and not in some state which could not take a broad and disinterested view.

Senator Walsh of Montana has introduced a new bill for the leasing of oil and gas lands withdrawn from entry. The bill is a short one and is interesting as another sample of desired legislation. It provides that, within six months from the passage of the act, any locator or his successors to any claim to unpatented oil and gas lands included in an order for withdrawal, upon which oil or gas has been discovered, or was being produced or operated on by drilling on January 1, 1914, and the claim of which was initiated prior to July 3, 1910, may have leased to him by the Secretary of the Interior the lands so relinquished. These must not exceed a maximum of 2560 acres. The leases to be conditioned upon payment by the lessee of a royalty of not exceeding one-eighth of the oil or gas extracted, each lease to be for 20 years, with the preferential right for a renewal

for 10 years upon such terms as the Secretary of the Interior may lay down.

NEW YORK

UNITED STATES STEEL CORPORATION'S REPORT AND BUSINESS CONDITIONS.—LEACHING AND FLOTATION OF COPPER ORES.—UTAH COPPER DIRECTORS.—MINING IN MEXICO.

The quarterly report of the United States Steel Corporation is of great interest as an index of general business, and the one which has just been published is decidedly discouraging. After the first of the new year everyone had hoped that business was going to improve, and the money market indeed, for a time, seemed to reflect better business conditions. In so far as the Steel Corporation can be taken as representative of industrial conditions over the country as a whole, it is decidedly pessimistic. The earnings for the quarter ended April 1 were less than \$18,000,000, or about \$5,000,000 less than the preceding quarter, and not much more than half of the earnings for the same period a year ago. This leaves only about \$65,000, after the dividend on the preferred stock is paid, to meet the \$6,350,000 required for the 11 1/2% dividend on the common. This makes a total deficit of something like \$7,300,000 for the past six months. It has been the hope all along that business would pick up materially by the beginning of summer at least, but the outlook now seems discouraging. The Democratic administration, according to some of the statements given out last year, seems to think that business men may conspire to depress business in order to put the administration in a hole. Supposing such an idea were possible, the conspiracy seems to be a pretty general one. So much has been said about the bad situation of the railroads that everyone is familiar with it. The domestic copper market has been dull, and were it not that sales to Europe have continued large, the copper market here would be quite depressed. The lead market is quiet, evidently reflecting the unsatisfactory conditions of general business among the consumers of lead. There does not seem to be any immediate sign of a marked revival of business, though that is what everyone is hoping for.

Among the items classed as important is the statement that the Utah Copper Co. is about to build a 10,000-ton leaching plant, and that work on a 2000-ton unit will be started within a few months. It will consist of coarse crushing, leaching with sulphuric acid, and precipitation of copper on iron. The flotation process will be used only on low-grade concentrate from the mills now working. Most of the copper companies, however, are now pursuing rather a policy of 'watchful waiting,' since such important large-scale experiments are being carried on by the Anaconda Copper Co., and the work of others will be greatly facilitated when the results of the work there become known. The Phelps-Dodge organization is pushing its work with a great deal of vigor, and has recently secured the services of Lawrence Addicks, formerly superintendent of the United States Metals Co.'s copper refinery at Perth Amboy, to take charge of its experimental work in the field. C. R. Van Arsdale, who has been in charge of the testing plant at Douglas, is now in charge of this work at the New York office. A great deal of careful investigation is being done for the Calumet & Arizona company, but results are not ready for publication. The directors of the Tamarack have voted to expend \$250,000 in the construction of a regrinding and leaching plant to handle the tailing which has accumulated in Torch lake. The attention of everybody has turned strongly toward hydrometallurgical processes in order to recover the large amounts of copper which are now being lost in the tailing or remain unutilized in low-grade oxidized ores that are rebellious to present methods of treatment.

At the annual meeting of the Utah Copper Co. William Leach Jr. and W. Hinkle Smith were elected directors to succeed T. W. Lamont and Daniel Guggenheim. The advent of Mr. Smith on the board of the Utah Copper is interesting as another example of the way in which the big copper companies are getting together by the aid of interlocking directors. The Consolidated Copper Mines is the best example of the gathering of all the principal copper operators on the board of one company. Mr. Smith has been on the board of the Nevada Consolidated for some time.

Action in regard to its dividend was postponed by the Greene Cananea board at its last meeting, the intention being to await the outcome of the Mexican troubles in order to learn whether operations are likely to be curtailed in the immediate future. The American staff of the mine and smelter went back on May 1, it being evident that there was no immediate danger of hostilities directed toward Americans. The American staff at Nacozari went back to work the day before. A good deal of discussion seems to have been started in regard to the concentrate from the Real del Monte plant of the United States Smelting, Refining & Mining Co. at Pachuca, arising out of the fact that a while ago, when the Aguascalientes plant of the A. S. & R. Co. was in difficulties, that Company notified the Real del Monte that it would have to send its concentrate either to Monterey or Perth Amboy for the time being. As the freight to these places is greater, the concentrate was stored, in the expectation that the Aguascalientes plant would soon be able to take it again. As this has not been the case, some shipments have recently been sent to Europe to see what rates and returns can there be obtained. The total value of the concentrate does not cut a very big figure in the gross earnings of the Company.

ST. LOUIS, MISSOURI

ST. JOSEPH LEAD CO. ANNUAL MEETING.—OPPOSITION TICKET.

Interest here in the annual meeting of the St. Joseph Lead Co., to be held May 13, is keen. Under the amended by-laws, thirteen directors annually are to be elected and this makes possible a clean sweep at any time. Robert Holmes continues in opposition and has circularized the stockholders against the management. At the last annual meeting 895,272 shares were voted. Of these, Mr. Holmes mustered 218,495, and 320,000 shares were held by the Jones-Camp interests. The Doe Run-St. Joe consolidation has been effected; about 95% of the Doe Run stock having been exchanged. Clinton H. Crane, who succeeded Dwight E. Jones as president on the death of the latter, has made many of the changes recommended by J. R. Finlay and Mr. Kendrick, the experts employed, by agreement, to examine the mines and railway, respectively, but not all of them. O. M. Bilharz is now in charge of all the mills and C. J. Adami of the mines. Their work is highly commended on all sides, and it is known that they are reducing the already low costs materially. Holmes and his friends object to the continuance of Roscoe Parsons as 'resident manager' and to other hold-over appointments. They protest that the recommendations of Mr. Finlay, who is no longer with the Company, have been disregarded in important particulars; and also that certain bankers have been favored by the methods of financing adopted, whereas the indebtedness should have been wiped out by appropriations from earnings. Holmes has proposed an independent ticket which includes, aside from representatives of the Jones, Camp, and Parsons families, such well known technical men as Arthur Thacher, O. M. Bilharz, Gus Setz, and others personally familiar with the property. The St. Joseph Lead Co. is a rich and powerful concern, and one in which St. Louis people are heavy owners. It is hoped that a satisfactory solution of the Company's troubles will soon be found.

BIRMINGHAM, ALABAMA

CONDITIONS IN THE SOUTHERN STATES. CHEAP MINING.—BIRMINGHAM'S GROWTH.—MINING IRON ORE.—GOLD MINING.—NEGRO LABOR ABOUT MINES.

A recent extensive trip to a number of mining districts in the southern states may be summarized as follows. In contrast to general conditions in some other parts of the country, business seemed to be on the increase, in spite of the supposed dull condition of 'things southern.' Activity in mining is due partly to a better appreciation of the natural resources in that part. Several factors contribute to the economical working of the ore deposits. Prominent among these is the presence of important coalfields in Alabama and West Virginia, and this is a particularly favorable factor for the extensive but low-grade iron ore beds of the South. The ore is mined cheaply, mostly by negro labor, and in the Birmingham district is turned into pig iron and steel within a short walk of the mines. Furthermore, it is not generally appreciated that Birmingham, the distributing point, is practically as far west as Chicago, and can compete with advantage in the southwestern trade as well as enjoy a monopoly in the southeastern states.

Birmingham is rivaling some of the Pacific Coast cities in rapidity of growth, having increased from 38,000 in 1900, to 180,000 today, and is styled by its boosters as 'the city with a payroll of a million a week.'

Another factor making for economical production is cheap negro labor. Undesirable as the negro is as a neighbor, and



ONE OF THE 'RED ORE' MINES OF THE TENNESSEE COAL, IRON & RAILWAY CO., ON RED MOUNTAIN, NEAR BIRMINGHAM.

in some states he outnumbers the white man, still, since he is there, he makes a better workman than is commonly supposed, especially on work at which a white man would get impatient. In some districts the negro miners are paid \$1.25 per day. It was 75c. per day a few years ago. In other places he receives more, especially where the mining is on contract at, say, 30 to 50c. per ton on the train cars. For a long time the prevalence of this cheap labor kept modern mining machinery out of the mining districts; but now a number of steam-shovels, locomotives, tramways, belt-conveyors, etc., are replacing the colored man and his mule. Incidentally, the mule is still an important asset in the smaller mines and pits, and in outlying districts.

It happens that the comparatively recent character of many of the geological formations tends toward flat-lying strata, and ore deposits close to the surface, or dipping at low angles. Thus, open-cut mines and pits are common. This applies to the brown iron ore deposits which are mined by steam-shovels, similar to the Mesabi range in Minnesota, and to the bauxite, phosphate, kaolin, and other deposits. The red iron ore, and coal, are mostly mined underground, through a slope, in place of a shaft with tipples taking the place of head-frames.

Gold mining is receiving quite an impetus by the success of one or two of the old mines of North Carolina, now worked on modern methods. One mine and mill there is making good profits from a 2-ft. vein yielding between \$10 and \$15

per ton. The vein is quartz, with slate walls. Heavy stamps, 1750 lb. each, dropping 105 to 110 times per minute, are used. Other plants consist of Parral tanks, filter-presses, and general all-sliming equipment. A controversy recently arose over one mine taking ore from across the boundary line of its neighbor, and as there was no state law against this, the manager of the offended company had a law passed in the legislature providing appropriate fines. Negro labor does not seem to be so well liked in the gold district as in some other parts of the country. To a manager or foreman used to capable white miners and skilled millmen, they are provoking, to say the least. They require a boss who understands their qualifications and failings. There has been more or less 'tinkering' with gold prospects in Georgia, and some talk of looking into the old mines in Virginia and Maryland. Gold in the Appalachians was quite important at one time.

BOSTON

BOSTON & MONTANA DEVELOPMENT CO.'S PROPERTIES.—EXCELSIOR CONSOLIDATED GOLD MINES.—STOCK EXCHANGE FAILURE.—BOSTON'S VIEWS ON MEXICO.—HALL LITIGATION.

Freeman I. Davison left Boston for London on May 4, to join Sir Robert William Perks, of MacArthur Brothers & Perks, Ltd., which interests have assumed the financing and construction of the Southern Montana railway south of Butte. This starts at Silverbow station on the Butte, Anaconda & Pacific line, and runs south through Deer Lodge and Beaverhead counties, branching off at Dewey's, up the Wise river, to Elkhorn and at Ralston, up the valley to French Gulch. At these two points the Boston & Montana Development Co. has mining properties. It is estimated that at least \$2,500,000 will be expended, beginning about July 1, building this road, which will be about 110 miles long. When the road is extended to Butte it will have a length of about 130 miles. The MacArthur-Perks interests sent their engineer to inspect the ground and check up conditions, and he has reported the situation much better than it had been represented to him. The Elkhorn mining property has large ore deposits. Governor Allen, president of the Company, estimates that there is 72,000,000 tons of commercial ore down to a depth of 1200 ft. The stock of the Company has been quite active on the New York Curb, being listed last December, selling at \$5 and since moving up to \$9 per share. It is expected that English investment interests in the Company, which owns the railroad to be built, will eventually become considerable.

A number of Worcester capitalists have subscribed the necessary money for settling the lawsuit of the Excelsior Consolidated Gold Mines, of the Meadow Lake district, Nevada county, California, and a corporation has been formed under Arizona laws, with 3,000,000 shares, \$1 par value. It is expected that the mines will be reopened about June 1. The Pacific Gas & Electric interests have built a good road from Cisco, 7 miles, to the mine. The plans of the new management are ambitious, consisting of blocking out 200,000 tons of ore per year. The ore is said to average \$10 per ton. The Excelsior was discovered about 50 years ago and has been worked intermittently, a good deal of the time being in the courts. About 10 years ago there was continuous work going on there, and it is said that the ore left is of good value. The Company has a small stamp-mill roasting plant, bunkhouse for 50 people, and excellent water-power and timber. A shaft is down 135 ft. on Excelsior vein No. 1. It is said that there is about \$35,000 in concentrate left in the bins. The management expects eventually to develop a capacity of 500 tons per day, treating ores by amalgamating and cyaniding.

The Gay & Sturgis Stock Exchange failure here is expected to show liabilities in excess of assets of about \$1,000,000. The

Company specialized on Lake issues and was largely interested in the Smokey Development Co. of Ely, Nevada, and the Terrible Bunderburg mines of Colorado, which issue the house had been planning to list on the Stock Exchange. The head of the house, Mr. Gay, is an invalid. The failure was another hard hit at the Lake stocks, which have had more than their share of trouble. Ahmeek, one of Mr. Sturgis' favorites, dropped 45 points on the sale of only 173 shares. Other stocks to suffer from being thrown on the market were Osceola, Wolverine, and Quincy. The Company owned also 3500 shares of Houghton Copper, 13,000 shares of Chief Consolidated, 3000 shares of Superior & Boston, and blocks of North Butte, Calumet & Arizona, Shattuck-Arizona, and Mohawk, besides local mill shares and bonds.

Boston copper traders generally would be glad to see a good war with Mexico in order to clean-up the situation there, believing that it would result in a big mining and copper boom. The shutting down of Greene Cananea, Motezuma, and the Guggenheim and United States Smelting properties, followed by sharp declines in these stocks, is not relished by Boston.

The suit of J. M. Hall, a Boston lawyer, against the Stock Exchange house of Paine, Webber & Co., alleging 'bucketing' of orders, drags along and draws into it many elements of past market feuds. A willing witness in behalf of the plaintiff has been Thomas W. Lawson, whose feeling against William A. Paine goes back for nearly ten years, to the time of the 'Copper Range war.' Another witness in the case is George E. Larnard, formerly a member of the Paine-Webber house, and afterward a member of Hooley, Larnard & Co., who is suing Lawson for certain amounts alleged to be due him in the Nevada-Utah 'clean-up' made by Lawson in the market here in the early part of 1907. The testimony of Lawson and Larnard has sharply crossed at several points.

The annual reports of Alaska Gold and the porphyry copper groups this year are said to be the most comprehensive and graphic ever put forth in mining literature. These interests go in strong for publicity.

TORONTO, ONTARIO

DIAMONDS IN ONTARIO.—THE MINING CORPORATION OF CANADA, LTD.—DOME REPORT.

The Ontario Bureau of Mines has issued a report announcing that the occurrence of diamonds in the province has been established. A sample of chrome iron ore, from Reaume township, about 20 miles north of Porcupine, was sent for examination to R. A. Johnston, of the Canadian Geological Survey, who a few years ago found small diamonds in British Columbia ore. Mr. Johnston reported that numerous microscopic diamonds occur in the ore. The discovery is one of scientific rather than economic interest, as the diamonds are too minute to have any commercial value. The rock in which the ore occurs is peridotite, a basic formation which weakens rapidly to serpentine. It is found extensively in the Porcupine area, and one analysis shows platinum to the value of \$1.50 per ton, which might be available as a by-product.

Special meetings of the shareholders of the Cobalt Township, Cobalt Lake, and City of Cobalt companies, held in Toronto, have ratified the merger of these Companies, arranged in England and approved by the English holding companies. The properties represented will be transferred to the new operating company incorporated under the name of The Mining Corporation of Canada, Ltd.

The Dome during the fiscal year ending March 31, 1914, crushed 101,812 tons of ore, yielding gold worth \$1,043,995, the average per ton being \$10.25. Compared with 1912 the tonnage milled showed an increase of 44%, and the output an increase of 13%, while the average value per ton was \$1.96 less.

General Mining News

ALASKA

The U. S. Geological Survey has just completed its preparations for the annual campaign of investigating the mineral resources of Alaska, the field plans for the year having been approved by the Secretary of the Interior, Franklin K. Lane. The parties have been made up, and some of the horses and camp equipment purchased. Making surveys in the isolated parts of the territory requires preparation long in advance, and part of the supplies are shipped in over the winter trails on account of the difficulties of summer transportation. For this season's work supplies were started inland from the coast early last January and are now cached at convenient points situated 200 to 300 miles inland for use of the parties during the working season, which lasts from June through September. Eleven parties will be put in the field this year, and as in the past special heed will be given to the investigation of the resources of those districts which are tributary to the several routes that have been advocated for the proposed government railways.

A party under the leadership of J. W. Bagley and Theodore Chapin will undertake the exploration of the region tributary to Talkeetna river and will connect with the surveys of the Broad Pass region made last year. This party, consisting of seven men with fifteen horses, will go up Matanuska river early in June, and start work near the scene of the new gold discovery on Albert creek. It will penetrate a region now but little known, lying in the headwater country of Talkeetna river. On returning, the party will sur-



MAP OF ALASKA.

vey the region between the headwaters of Matanuska and Copper rivers that has been advocated as a railway route.

An exploration of the region lying between Lake Clark on the east and the Iditarod district on the west will be undertaken by R. H. Sargent and Philip S. Smith. Here there is a belt of country, over 100 miles wide, which is almost an entire blank on the map. The party, made up of seven men, with twenty horses, will follow a route that has been suggested for a railway into the great Kuskokwim basin.

A. G. Madden will investigate the gold-placer districts tributary to the lower Kuskokwim. He will ascend Iditarod river, by canoe, portage across the divide to reach the Kuskokwim, and visit the Anniak, Tuluksak, and Goodnews Bay placer districts.

Stephen R. Capps and C. E. Giffin will carry geologic and topographic surveys across Skolai pass into the White River basin and thence to the international boundary. This is

also a region where railway building has been considered. Mr. Capps will give special attention to the investigation of the newly discovered gold district in the Chitana basin. This work is an extension of previous reconnaissance surveys in this field.

A detailed base map will be made of part of the Juneau district, now the most important gold lode camp in Alaska, and promising to become one of the most important on the continent. The purpose of the base map is to make possible an exhaustive study of the occurrence of the gold ores. D. C. Witherspoon will undertake the making of the base map, which will be on a scale of three inches to the mile.

A detailed survey of the Kotsina copper-bearing area was undertaken in 1912, but unfortunately the delay in the appropriation during the last two years has prevented its completion. It is planned that F. H. Moffit and J. B. Mertle now complete this work. B. L. Johnson, with one assistant, will undertake the detailed geologic survey of the Port Valdez gold and copper district. The base map necessary for this work was completed in 1913.

To coordinate and correlate the various geologic surveys in Alaska, it is necessary to continue the studies of the general geology and mineral resources. Three geologists will be engaged in this work during 1914. George C. Martin, assisted by R. M. Overbeck, will continue his studies of the Mesozoic stratigraphy. He will visit important localities in southeastern Alaska in the Chitina valley, and along the Yukon.

H. M. Eakin will undertake supplementary investigations of the tin deposits of Alaska. He will examine some of the occurrences of tin in the York region of Seward peninsula and in the Hot Springs district of the Tanana valley. Mr. Eakin will also undertake some general studies of the occurrence of mineral deposits and mining development in the Nome, Fairbanks, and Juneau districts.

Alfred H. Brooks, the geologist in charge of the Alaska surveys and investigations, expects to leave for Alaska as soon as office work permits, probably about the middle of June. He will devote special attention to the problems of Quaternary geology, including the genesis and occurrence of placer deposits. He will visit the Iditarod and Fairbanks districts and, time permitting, the Nome district. Mr. Brooks will also join the Moffit party in the Kotsina district and the Johnson party in the Valdez district for brief periods of time.

KETCHIKAN

(Special Correspondence.)—The property of the Alaska Venture Syndicate, 20 miles from this place, and controlled by the Great Boulder Proprietary of Western Australia, is developing fairly well. The natural facilities for economical mining and milling are so good that \$3 ore can be handled at a profit, on a tonnage of say 250 per day. This district has possibilities, but 'wild-cat' schemes several years ago greatly retarded interest and development.

Ketchikan, March 11.

NOME

The Noatak-Kobuk region is the subject of *Bulletin 536* by Philip S. Smith of the U. S. Geological Survey. In the preface, Alfred H. Brooks describes what is known as an area of 150,000 square miles of the territory above the Arctic Circle. The Noatak river region is around 68° latitude north. The mean annual temperature is about 16.5°, ranging from -31.3 to 60.8°F. Game and fish are fairly plentiful. Quartz veins are numerous, the older being in schists and limestones. About \$100,000 has been recovered from gravel in the Shungnak region. The other river deposits are described. Copper ores are also found. The cost of supplies and operations will not decrease much in the future; but observant prospectors, properly equipped, may find the country worth investigation.

ARIZONA

The Arizona State Tax Association has assessed the mining properties in the state at \$111,453,208, of which Cochise county contributes \$50,977,213.

COCHISE COUNTY

A modern dispensary, constructed of brick and to cost \$25,000, is being erected by the Copper Queen Consolidated company at Bisbee. Practically all the officials of the Moeztuma Copper Co., of Sonora, Mexico, have returned to Mexico. The general manager, C. I. Schuster, reports that production went on without interruption during his absence, capable Mexicans having been left in charge.

GILA COUNTY

During the quarter ended with March, the Iron Cap mine, at Globe, produced 343,141 lb. of copper and 19,663 oz. silver, returning \$37,689. The mine expense was \$21,620. Development at No. 8 level is opening good ore. Additional claims will probably be bought.

(Special Correspondence.)—Lessees at the Gibson mine are mining about 300 tons of high-grade ore per month, but the expiration of the present lease will end high-grade operations. O. B. Kemp and associates, who control the property, state that a 100-ton per day flotation plant will be installed before the end of summer. Tests show a recovery of 85% of the copper by this process.

Ore shipments from the Iron Cap averaged a carload per day during the latter part of April. This from the 800-ft. level, where the average is 7% copper and some silver.

About 20 ft. of ore was cut on the 1300-ft. level of the Arizona Commercial. April production of the Superior & Boston was about 70 cars of ore, containing from 5 to 10% copper.

Globe, April 29.

(Special Correspondence.)—The swelling nature of the ground in which the main shafts of the Inspiration mine have been sunk has given trouble in obtaining a good footing in the upper portion. Concrete is dropped through a vertical 4-in. pipe from the surface, a fall of over 300 ft. resulting in good tamping. A 16-ft. section is poured per day of three shifts. It was found advisable to concrete around the timbers. Good progress is being made at the mill shops and smelter. Work at the Inspiration Extended is promising, and ore is expected at 400 feet.

Miami, April 29.

(Special Correspondence.)—Probably an 80-ton concentrating plant will be erected by P. F. Curney and J. R. Davis, the new owners of the Gibson mine, to treat the low-grade sulphide ore. The richer ore is sent to smelters.

Gila Bend, April 30.

CALIFORNIA

Following is a tabulation of minerals concerning which final returns for 1913 are available to date, according to the California State Mining Bureau:

Mineral.	1913.		1912.	
	Amount.	Value.	Amount.	Value.
Cement, bbl.	6,167,806	\$7,743,024	6,198,634	\$6,074,661
Chromite, tons.	1,180	12,700	1,270	11,260
Coal, tons.	25,198	\$5,809	14,848	39,092
Graphite, lb.	2,500	25	.....	.....
Infusorial earth, tons.	8,595	35,760	4,129	17,074
Iron ore, tons.	2,343	4,485	2,508	2,508
Marble, cu. ft.	41,654	113,282	27,820	74,120
Pyrite, tons.	79,000	218,537	69,872	203,470
Pumice, tons.	90	2,000	100	2,500
Tungsten ore, tons.	7,592	234,673	8,042	206,000
Totals.		\$8,450,295		\$6,630,685

AMADOR COUNTY

It is said that B. Shuttleworth, recently arrived from Australia, has organized a company to erect cyanide plants at Defender and Drytown, to treat old tailing dumps there. A meeting of the Plymouth Consolidated company was held in London during April. On a tonnage of 8000 per month, the profits should be \$2.46 per ton, according to W. J. Loring.

BUTTE COUNTY

It is reported that H. Bartram has opened zinc ore on the Magalla ridge. A plant containing a roller mill with arrastra attachment will be started at the mine owned by H. Hamilton, D. E. Willis, and M. Stroehl at Inskip. During the week ended March 28, two dredges of the Oroville Dredging Co. recovered gold worth \$5625.

CALAVERAS COUNTY

Fire destroyed property valued at \$10,000 at Copperopolis on April 27. The houses were owned by the Calaveras Copper Co. and were insured.

ELDORADO COUNTY

There is more activity in the Empire district than for some time past, and several properties have changed hands.

NEVADA COUNTY

The trouble in Mexico, which resulted in the stoppage of traffic on the Tehauntepec railway, is likely to interfere with treatment at the Champion, North Star, Empire, and Pennsylvania mills at Grass Valley and Nevada City, as a shipment of cyanide has gone astray. The annual meeting of the Consolidated St. Gothard (Delhi) Gold Mining Co. was held at San Francisco on April 24. A long ditch and flume for water-supply has been constructed. The mine has been well developed, and the 20-stamp mill will soon be at work again.

SAN BERNARDINO COUNTY

(Special Correspondence.)—A 100-ton cyanide plant has just been erected at the Waterman mine, at Barstow, by George B. Phillips. Results so far have been satisfactory.

Barstow, May 1.

SHASTA COUNTY

All hope of extinguishing the fire in the Midas gold mine has been abandoned. The manager, W. H. Roberts, has stated that it can only burn on the 1200 and 1300-ft. levels. In the meantime the mine is filling with water. This will take six weeks to reach the 1200-ft. station. The Mammoth Copper Co. is repairing and enlarging the bag-house at the smelter, the cost to be about \$75,000.

SIERRA COUNTY

Work has been suspended at the Alaska mine at Pike, and 50 miners are attacking a landslide which threatens to carry the 40-stamp mill into the cañon. A drift, to open gravel in the Mountain House drift mine, is in over 210 ft., and is nearing the channel. The new mill at the Mexican quartz mine is nearly ready for work.

SISKIYOU COUNTY

(Special Correspondence.)—Messner & Cory have finished a test run on 13 tons of ore from their mine in Cedar gulch, and are pleased with results. Developments on the vein disclose a shoot of good ore. They have leased the French John hydraulic mine and are working good gravel. A shoot of rich ore has been intersected in the Big Cliff, in the Salmon River district. Los Angeles people are developing the Hardscrabble mine on South Russian creek, and fair-grade ore has been opened. Work has been resumed at the Highland, under John Mattern. Operations have been resumed at the Homestake, Cub Bear, and several other quartz mines in this district. Conditions are favorable for a long season, as an abundance of water is indicated far into the fall months. The Akin Mining Co., of San Francisco, has started work

at its placer holdings near Oak Bar. Explorations are being conducted with a view to installing a dredge. A. L. Akin is manager. Good ore is being milled at the Gold Run mine, near Gila. The property is opening in good shape, and additional mine equipment is contemplated. R. W. Bender is superintendent. Los Angeles people recently inspected the Commodore and other properties in the Oak Bar district, and are reported to be negotiating for a number of small quartz and placer mines.

Ema Mills, April 25

TRINITY COUNTY

It is said that a syndicate has acquired options on about nine miles of dredging ground along the Trinity river, including that of the Alta Bert and other companies. A large number of holes have been drilled to prospect the gravel. John Hays Hammond is expected in the district at an early date.

TULUMNE COUNTY

Specimen ore has been opened at a depth of 125 ft. in the Carlin mine by the Jamestown Exploration Co. Four veins are said to junction at this point. The Rawhide mine has been purchased by Eastern people. It is reported that the Melones Mining Co. may install more stamps in its present extensive plant.

The suit of Thomas A. Fisher against all the owners of the Black Oak mine, which was tried at Sonora last fall before Judge Plummer and decided in favor of the plaintiff, was settled on April 29, he accepting the \$119,000 left on deposit in full payment for the balance of the money due on the mortgage indebtedness he held against the property.

COLORADO

EAGLE COUNTY

Reports have been made of the discovery of high-grade gold ore in the Fulford district. As soon as the snow has disappeared, active work will be started.

LAKE COUNTY

A local branch of the Colorado Metal Miners' Association has been formed at Leadville.

TELLER COUNTY (CRIPPLE CREEK)

A contract for the installation of equipment for extending the Roosevelt tunnel has been signed by Harry J. Gehm, general manager for the Colorado Trading & Transfer Co. Work is to be done through the El Paso shaft, from which all rock will be removed to the surface. High-graders are busy in the Mary McKinney mine, and a collision with the sheriff is expected.

The estimated output of the district in April was 85,552 tons having a gross value of \$1,214,921.

Dividends paid during the month totaled \$176,189, contributed by the following: Golden Cycle, \$45,000; Mary McKinney, \$26,189; Portland, \$60,000; and Vindicator, \$45,000.

IDAHO

SHOSHONE COUNTY

The Bunker Hill & Sullivan company paid dividend No. 200, of \$81,750, on May 4. The total to date is \$15,138,000. The output in 1913 was 436,000 tons of ore worth \$3,889,758. The net profit was \$1,062,512. It was 15 years, on April 29, since the mill was dynamited. From 72,901 tons the Ontario Mines Co., in 1913, had a return of \$592,372, and profit of \$183,791. The Sierra Nevada mine produced 5031 tons of ore worth \$19,458, in 1913, but there was a loss of \$6047 on operations. The Stewart Mining Co. produced 174,126 tons of ore in 1913 worth \$1,629,474, at a cost of \$1,068,040, leaving a profit of \$561,434. The Gold Hunter Mining Co. mined 114,000 tons of ore, in 1913, worth \$489,148, resulting in a small loss on operations. The Snowstorm Mining Co. produced 105,674 tons, worth \$709,577, with a profit of \$137,455. The Hecla

Mining Co.'s yield in 1913 was 141,920 tons, valued at \$1,026,755, yielding a profit of \$292,696. The Alta Mining Co.'s return was 31,908 tons worth \$11,912, and a loss of \$3674.

MICHIGAN

Houghton County

Sand from the Redridge mill of the Copper Range Consolidated is being sent to the Company's Champion mine at Painesdale for filling old stopes. When the Battle and Tri-mountaine mines are ready for sand, the Copper Range railroad will move 30 cars per day from the above mill, also the Freda and Beacon Hill. The Mineral Range Railroad is moving 'rock' from 10 mines regularly and two intermittently.

ONTONAGON COUNTY

On the White Pine property, owned by the Calumet & Hecla company, and on which a large sum of money has been spent, material for a stamp-mill is being sent to the mine, to be erected this summer. The claims are in an isolated spot. The vein is narrow and irregular, and copper occurs in sandstone, but the 'rock' is rich.

MONTANA

CASCADE COUNTY

On the west side of the Missouri river, near Great Falls, the Power City Oil & Natural Gas Co. has its first hole down over 200 feet.

MISSOULA COUNTY

In the Saltse district, the Monitor and adjoining properties are to be consolidated, and a long adit will be driven to prospect the claims from the St. Joe side of the range. This will give a depth of 1700 ft. to cut the copper-gold ores.

SILVERBOW COUNTY

A report for the first quarter of 1914 has been published by the North Butte company, and shows that 4531 ft. of development was done, the Granite Mountain shaft being sunk 225 ft. to 10 ft. below the 3000-ft. station. Ore production was 118,187 dry tons, yielding 6,172,158 lb. copper, 365 oz. gold, and 374,833 oz. silver.

A contract has been let for an addition to the Butte-Duluth leaching plant costing \$100,000. This will be a 100-cell electrolytic plant, the present one having 47 cells, capable of treating the solutions of 300 tons of ore. The complete plant will have a daily capacity of 1000 tons. Estimates of ore available by open-cut mining are 15,000,000 tons.

On the 1400-ft. level of the Butte & Superior's Black Rock claim, the orebody is 1500 ft. long. In places it is 100 ft. wide. Reserves ready for stoping in the mine, above 1400 ft., are estimated at 1,125,000 tons.

During the eight months ended March 1, 1914, the Davis-Daly Copper Co. has produced 49,095 tons of ore averaging 3.08% copper and 6.2 oz. silver per ton. Mining cost \$5.66 per ton. Development during the past year totaled 8247 ft. It has been decided to sink the Colorado shaft from 2000 to 2600 ft. An assessment of 50c. each has been made on the stock.

NEVADA

ESMERALDA COUNTY

The estimated production of the Goldfield Consolidated company in April is as follows: ore treated, 28,215 tons; gold recovered, \$324,000; operating expenses, \$171,000; and net production, \$153,000. The Jumbo Extension company has paid the second installment of the option on the Velvet claim from the Goldfield Merger company. Encouraging development is being obtained from the Atlanta mine. The sum of \$50,000 has been raised by James Golden for a mill in the Klondike district.

NYE COUNTY

Work has been resumed by the Railroad Valley Co. in its

prospecting for potash deposits. The geologist, E. E. Free; superintendent, D. H. Walker; and driller, Mr. Weaver, recently left Tonopah for the property. The MacNamara Mining Co. is to be reorganized.

UTAH

JARVIS COUNTY

Part of the new Knight-Christensen mill is in operation. The race of the adit driven 1900 ft. into the Dragon Consolidated shows gold-silver ore averaging \$40 per ton. During April the Eagle & Blue Bell mine produced 2544 tons of ore worth about \$50,000.

SALT LAKE COUNTY

It is reported from Boston that the Utah Copper Co. will construct an immense leaching plant to treat the carbonate ore capping on the orebodies. The first unit will be of 2000-ton daily capacity, and the ultimate cost of the 10,000-ton plant about \$2,000,000.

SUMMIT COUNTY

Ore worth \$54,800 has been extracted from the Easter vein, in the American Flag mine, since it was discovered a year ago. Also 12,000 tons of \$15 ore has been blocked out for the mill. Shipments from the district in April amounted to 5289 tons, of which the Daly-Judge and Silver King Coalition contributed 2764 and 2157 tons respectively.

MEXICO

The Mines Company of America operates the Dolores and El Rayo mines in Chihuahua, and the Creston-Colorada and La Dura in Sonora. The report for 1913 contains the following information: Development in the Dolores showed good results, and reserves at the end of the year were 100,932 tons, assaying \$14.18 per ton. Costs were reduced by \$2 per ton treated. Owing to bandits, the mill was stopped on September 1, and the mine three weeks later. El Rayo was forced to suspend work on July 10, but will resume this month. Mining proved the extension of the known orebodies. Reserves are 54,800 tons of \$14.60 ore. The Creston-Colorada and Grand Central produced 130,664 tons of ore worth \$819,514. At the beginning of 1914, ore reserves were estimated as 306,300 tons averaging \$5.33 per ton. The Grand Central promises to be a profitable investment. Both mines and plants operated continuously during 1913. It is proposed to increase the monthly output from 10,000 to 18,000 tons of ore. From the Gloria and Prieta mines at La Dura, there were produced 4869 tons. The stoping operations carried on in these properties have proved the persistence of the veins. The Gloria vein, below the 900-ft. level, is showing strong and producing a good grade of ore, while on the 1040-ft. level of the Prieta mine, stoping shows a good tonnage of high-grade ore. Ore reserves are 23,229 tons, assaying \$44.21 per ton. Partly on account of the interruption to railway shipping facilities and partly on account of President Wilson's proclamation urging Americans to leave all isolated camps in Mexico, operations were suspended in September. The property is in charge of the *presidente* of the town, and has not been molested in any way. It is intended to resume operations upon the reestablishment of railway communication.

Ore reserves in all the mines are estimated to be 485,261 tons assaying \$4,888,605, compared with 334,876 tons assaying \$3,612,910 at the close of the preceding year.

The production of the Company's mines was 297,085 tons worth \$2,917,057. Revenue was \$1,734,626; operating profit, \$495,987; and net profit, \$467,232. The consolidated balance sheet of the Company shows current assets of \$1,539,378, accounts and drafts payable and suspense account \$392,065.

CHIHUAHUA

The Buena Tierra Mining Co., Ltd., which operates a lead-silver property in the Santa Eulalia district, 15 miles south-east of the town of Chihuahua, has just issued its report for 1913. Owing to the revolution, it was not possible to work continuously and the smelter at the centre was shut down on November 1, 1913. The ore mined was 25,972 tons, averaging 14.01% lead and 8.22 oz. silver. Net returns from the smelter were \$6.99 per ton, or \$181,689. Working costs were \$3.47 per ton, or \$89,512. The year's profit was \$77,000, after adding sundry receipts. The amount carried forward was \$97,000. Ore reserves are estimated at 300,000 tons. Generally, the year's results were satisfactory.

MEXICO

The Mexican Mines of El Oro produced bullion worth \$140,



MAP SHOWING PROPERTIES OF MINES COMPANY OF AMERICA.

580, from 10,750 tons of ore, in March. The profit was \$94,070.

SONORA

On May 1, a special train containing 125 American men, including J. S. Williams, Jr., of the Motezuma Copper Co. of Nacozari, and L. R. Budrow, of the Tigre Mining Co. of El Tigre, left Douglas, Arizona, for these places. Officers of the Cananea Consolidated Co. returned on May 7 to resume operations. Guns and ammunition taken from the Americans when they left are to be returned. Three things were responsible for the decision to return to Nacozari and El Tigre and resume operations. They were: a cordial invitation from the Mexican officials, telegraphic advices from Washington, and the raising of the embargo on the exportation of all products into Sonora except food. This assures the mining companies of fuel for operating purposes.

Personal

A. M. POND has gone to Brazil.
 A. E. THOMAS has gone to Portugal.
 THOMAS A. VORON is in New York.
 SIDNEY H. BART has gone to Europe.
 R. A. ARCHBOLD has returned from Nigeria.
 JAMES B. RISQUE was in New York last week.
 ERNEST WILLIAMS has gone to Dutch Guiana.
 NELSON DICKERMAN, of Pato, Colombia, is in London.
 P. N. NISSEN was in New York last week and has gone to Chicago.

FREDERICK E. CAIKENS is in Graham county, Arizona, inspecting mining property.

H. P. DAVIES has left Barranquilla, Colombia, and has made his home in London.

WILLIAM J. EMMENDORF, formerly of Victoria, is now at Stewart, British Columbia.

H. D. GRUBBINS has gone to India, but expects to return to England at the end of June.

JOHN T. REID has recently been in the Jarbidge district, Nevada, making extensive mine examinations.

H. A. BREMER is in St. Luke's hospital at St. Louis on account of infection following tonsillitis. He is recovering slowly.

F. L. G. KNOX has resigned as manager for the Natomas Consolidated and has been succeeded by Emory Oliver, formerly chief engineer.

R. H. FERNALD has been appointed a consulting engineer of the Bureau of Mines. He will go to Europe to make departmental investigations.

MARK R. LAMB is expected in San Francisco soon. During his absence from Chile, F. KARL LAMB will look after the Allis-Chalmers interests.

CARLTON R. ROSE has resigned as superintendent for the United States Zinc Co. to join the San Francisco staff of Smith, Emery & Company.

T. A. RICKARD is expected to arrive in New York on May 27, to attend the celebration of the fiftieth anniversary of the Columbia School of Mines.

WILLIAM C. EDES, of San Francisco, and Lieutenant FREDERICK MEARS have been appointed members of the Alaskan Railroad Commission by the President.

LAWRENCE ADDICKS has been engaged by Phelps, Dodge & Co. to take charge, in the field, of the hydrometallurgical research which that Company has under way.

ROY WETHERED, formerly with the Consolidated Mining & Smelting Co., of Canada, has opened an office as mining engineer in the Paulsen building, Spokane, Washington.

The following mine safety field meetings, at which the U. S. Bureau of Mines will cooperate, are to be held in May: 2nd, Saline County Mine Safety Association, Harrisburg, Illinois; 9th, Kentucky Mining Institute, and Kentucky Mine Operators' Association, Lexington, Kentucky; 13th to 15th, West Virginia Medical Association and Pocahontas Coal Operators' Association, Bluefield, West Virginia; 18th, Fort Smith, Arkansas; 21st, McAlester, Oklahoma; 25th, Pittsburg, Kansas; 28th, Moberly, Missouri; and at Des Moines, Iowa, on June 1.

The Rocky Mountain branch of the Canadian Mining Institute held a meeting at Fernie, British Columbia, on April 27. Papers were read on mine-rescue work by Charles Graham and Francis Aspinall, and discussed by the members during the day, and in the evening W. R. Wilson entertained the visitors and others at a theatre party. The program included a tour of inspection of the Coal Creek, Michel, and Hosmer mines.

Society Meetings

MAY	
Name	Date
American Iron and Steel Institute	22
Chemical, Metallurgical and Mining Society of South Africa, Mining Exhibition, Johannesburg	19-29
Geological Society of America (Cordilleran Section), Seattle	21-23
Institution of Mining and Metallurgy, London	21

JUNE	
American Institute of Electrical Engineers	22 or 26
American Society for Testing Materials	23-27
American Society of Mechanical Engineers	end of June
Colorado Scientific Society, Denver	6
Franklin Institute, Philadelphia	end of June
Society for the Promotion of Engineering Education	29 to July 2

AUGUST	
American Institute of Mining Engineers, Salt Lake City	10-14
Canadian Mining Institute, Rocky Mountain branch, Banff	
Lake Superior Mining Institute, Marquette, Michigan	17

SEPTEMBER	
American Chemical Society	9-12
American Institute of Electrical Engineers	not fixed
Colorado Scientific Society, Denver	3

OCTOBER	
American Institute of Electrical Engineers	9
American Iron and Steel Institute	23-24
Colorado Scientific Society, Denver	3

NOVEMBER	
American Institute of Electrical Engineers	13
Colorado Scientific Society, Denver	7

DECEMBER	
American Institute of Electrical Engineers	11
American Society of Mechanical Engineers	7-8
American Museum of Safety	11-20
Colorado Scientific Society, Denver	5 and 19
Geological Society of America, Philadelphia	29-31
Society of Gas Lighting (annual meeting)	10
Society of Naval Architects	11-12

JUNE 1915	
Sixth International Congress of Mining, Metallurgy, Applied Mechanics, and Practical Geology, London	

AUGUST 1915	
American Association for Advancement of Science, San Francisco	17

SEPTEMBER 1915	
American Institute of Mining Engineers, San Francisco	27-30
Engineering Congress, San Francisco	20-25

DECEMBER 1915	
Old Freibergers in America	19

The UNIVERSITY OF CALIFORNIA will hold its fifty-first Commencement at the Greek Theatre, Berkeley, on May 13. The graduating class will consist of over 600, while there will be 300 recipients of higher and professional degrees.

An effort is being made to have a large attendance of the Montana Section at the A. I. M. E. meeting at Salt Lake City, August 10 to 14.

A local charter has been granted to the Utah branch of the AMERICAN INSTITUTE OF MINING ENGINEERS.

The Metal Markets

LOCAL METAL PRICES

San Francisco, May 7.

Antimony	9 — 9½c
Electrolytic copper	15½ — 15¾c
Pig lead	4.15 — 5.10
Quicksilver (flask)	\$39.00
Tin	40½ — 42 c
Spelter	6½ — 6¾c
Zinc dust, 160 kg. zinc-lined cases, 7½ to 8c. per pound.	

EASTERN METAL MARKET

(By wire from New York.)

NEW YORK, May 7.—The market may be summed up as follows: copper is very dull with no new features; lead is quiet but firm; and spelter is firmer, although it has dropped slightly. Exports of copper in April were 31,787 tons, against 45,973 tons in March. Outputs in April were: Braden, 2,720,000 lb. (a record); and Miami, 3,227,600 lb. Nevada Consolidated's first quarter yielded 15,597,595 lb., compared with 14,523,365 lb. in 1913. Greene Cananea mines and smelters are to resume work at once. The dispute between the Butte & Superior and Clark interests may be settled early. Business is dull on 'Change.' St. Louis prices for lead and spelter are 3.55 and 5c. per pound. Bar silver in London is 27½d. per ounce. The Stock Exchange there, and the Paris Bourse are dull.

SILVER

Below are given the average New York quotations in cents per ounce, of fine silver.

Date.	Average week ending		
Apr. 30	59.25	Mch. 25	58.06
May 1	59.12	Apr. 1	58.92
" 2	59.12	" 8	58.45
" 3 Sunday		" 15	58.30
" 4	59.12	" 22	58.35
" 5	59.12	" 29	58.93
" 6	59.12	May 6	59.11
Monthly averages.			
1913.	1914.	1913.	1914.
Jan.	63.01	July	58.70
Feb.	61.25	Aug.	59.32
Mch.	57.87	Sept.	60.53
Apr.	59.26	Oct.	60.88
May	60.21	Nov.	58.76
June	59.03	Dec.	57.73

COPPER

Quotations on copper as published in this column represent average wholesale transactions on the New York market and refer to electrolytic copper. Lake copper commands normally 1-5 to 1-4c. per lb. more. Prices are in cents per pound.

Date.	Average week ending		
Apr. 30	14.10	Mch. 25	14.18
May 1	14.10	Apr. 1	14.28
" 2	14.00	" 8	14.46
" 3 Sunday		" 15	14.27
" 4	14.00	" 22	14.07
" 5	13.95	" 29	13.99
" 6	13.95	May 6	14.02
Monthly averages.			
1913.	1914.	1913.	1914.
Jan.	16.54	July	14.21
Feb.	14.93	Aug.	15.42
Mch.	14.72	Sept.	16.23
Apr.	15.22	Oct.	16.31
May	15.42	Nov.	15.08
June	14.71	Dec.	14.25

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.	Average week ending		
Apr. 30	3.90	Mch. 25	4.00
May 1	3.90	Apr. 1	3.80
" 2	3.90	" 8	3.80
" 3 Sunday		" 15	3.80
" 4	3.90	" 22	3.80
" 5	3.90	" 29	3.90
" 6	3.90	May 6	3.90
Monthly averages.			
1913.	1914.	1913.	1914.
Jan.	4.28	July	4.35
Feb.	4.23	Aug.	4.60
Mch.	4.22	Sept.	4.70
Apr.	4.36	Oct.	4.37
May	4.34	Nov.	4.16
June	4.33	Dec.	4.02

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can

usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending		Apr. 23	
Apr. 9	39.00	30	39.00
" 16	39.00	May 7	39.00
Monthly averages.			
1913.	1914.	1913.	1914.
Jan.	39.37	July	41.00
Feb.	41.00	Aug.	40.50
Mch.	40.20	Sept.	39.70
Apr.	41.00	Oct.	39.37
May	40.25	Nov.	39.40
June	41.00	Dec.	40.00

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date.	Average week ending		
Apr. 30	4.87	Mch. 25	5.10
May 1	4.87	Apr. 1	5.13
" 2	4.87	" 8	5.10
" 3 Sunday		" 15	5.00
" 4	4.87	" 22	4.90
" 5	4.87	" 29	4.90
" 6	4.87	May 6	4.87
Monthly averages.			
1913.	1914.	1913.	1914.
Jan.	6.88	July	5.11
Feb.	6.13	Aug.	5.51
Mch.	5.94	Sept.	5.55
Apr.	5.52	Oct.	5.22
May	5.23	Nov.	5.09
June	5.00	Dec.	5.07

London price of spelter in pounds (£) per ton, if divided by 4, gives the New York equivalent in cents per pound, including the duty payable. This does not include any allowance for freight. Shillings and pence should, of course, be reckoned as decimals of a pound.

At the beginning of April, spelter was quoted at around 5.27½c. New York, and 5.12½c. St. Louis; by the 15th, 2½ points had been lost, and immediately thereafter came one decline after another, until by April 24 the New York quotation was about 5.10c. and that at St. Louis about 4.95c. The declines followed smaller demand and pressure on the part of sellers to induce consumers to take metal. Producers and sellers were feeling in turn the falling off in business in galvanized sheets which was sufficient to not only curtail buying of spelter, but to cause reductions in the prices of sheets.

TIN

New York prices control in the American market for tin, since the metal is almost entirely imported. San Francisco quotations average about 5c. per lb. higher. Below are given average monthly New York quotations, in cents per pound:

1913.	1914.	1913.	1914.
Jan.	50.45	July	40.70
Feb.	49.07	Aug.	41.75
Mch.	46.95	Sept.	42.45
Apr.	49.00	Oct.	40.61
May	49.10	Nov.	39.77
June	45.10	Dec.	37.57

The Vulcan Detinning Co., which has plants at Sewaren, New Jersey, and at Streator, Illinois, reports as follows for the quarter ended March 31, 1914: Sales, etc., \$225,375; operating and office expenses, \$202,212; balance, with other income, \$23,502; previous surplus, \$114,881; and total surplus, \$138,383. The business generally is favorable, but the Company hopes for better prices in the steel and tin industries, by which its products largely are consumed.

ALUMINUM

Quotations changed but little in April, and the market presented no features of especial interest. Quotations on April 23 were 18 to 18.25c. for prompt, 98 to 99% pure, and 17.87 to 18.12½c. for futures.

During 1913 the Aluminum Industry Co., of Neuhausen, Germany, made a net profit of \$1,238,000, compared with \$883,000 in 1912. A dividend equal to 20% on the capital of \$5,000,000 was paid. In view of the uncertain trade outlook it is said consumers of aluminum have been very cautious for some time in placing contracts, and the stocks in their hands have fallen to a low level, with the result that quick delivery is required for the contracts now being placed. It is announced that the International Aluminum Syndicate has still several years to run.

ANTIMONY

This market was without features of interest in April except that dealers complained of low prices, some of them declaring that sales of Hallett's at below 7c. per pound were made at a loss. Prices changed but little in a dull market. For Hallett's, 6.75 to 6.95c. was asked; for Cookson's, 7.15 to 7.25c.; and other brands at 5.75 to 6.25 cents.

The Stock Markets

SAN FRANCISCO STOCKS AND BONDS

(San Francisco Stock and Bond Exchange)

May 6.

BONDS

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Associated Oil Co.	97 1/2	—	Natomas Consol. Co.	—	26
Natomas Con.	32 1/2	—	Pac. Port. Cement Co.	100	—
Unlisted.	—	—	Santa Cruz Cement Co.	86 1/2	87 1/2
Ass. Oil Co.	75	80 1/2	Union Oil	86 1/2	—
General Petroleum Co.	84	—			

STOCKS

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Amalgamated Oil	74	—	General Petroleum	2 1/2	5
Associated Oil	38	—	Noble Electric Steel	70c	1.20
Giant	86 1/2	—	Natomas Consol	50c	—
Pac. Ost. Borax, com	50	—	Pac. Port. Cement	90	94
Pacific Crude Oil	—	30c	Riverside Cement	—	6 1/2
Union Oil	—	74	Santa Cruz Cement	40	—
West Coast, pld	—	115	Stand. Port. Cement	19	—

NEVADA STOCKS

(By courtesy of San Francisco Stock Exchange.)

May 7.

Atlanta	25	Montana-Tonopah	8.87
Beicher	35	Nevada Hills	36
Belmont	7.40	North Star	20
Con. Virginia	.08	Ophir	11
Florence	.53	Pittsburg Silver Peak	27
Goldfield Con	1.40	Round Mountain	30
Goldfield Oro	.11	Sierra Nevada	.05
Halifax	.75	Tonopah Extension	2.50
Jim Butler	1.00	Tonopah Merker	.59
Jumbo Extension	.25	Tonopah of Nevada	6.60
MacNamara	.03	Union	.09
Mexican	1.00	Victor	.32
Midway	.31	West End	.89
Mizpah Extension	.36	Yellow Jacket	.16

CALIFORNIA STOCKS

(Latest Quotations.)

	Bid.	Ask.		Bid.	Ask.
Argonaut	\$2.50	—	Central Eureka	—	\$0.45
Brunswick Con.	1.05	—	Mountain King	\$0.42	0.44
Bunker Hill	1.90	—	South Eureka	1.25	—

COPPER SHARES—BOSTON

(By courtesy of J. C. Wilson, Mills Building.)

May 7.

	Bid	Ask		Bid	Ask
Allouez	\$ 40 1/2	41	Mohawk	\$ 43 1/2	45
Ariz. Commercial	4 1/2	4 1/2	Nevada Con	13 1/2	13 1/2
Butte & Superior	36 1/2	37	North Butte	25 1/2	25 1/2
Calumet & Arizona	64 1/2	64 1/2	Old Dominion	47	47
Calumet & Hecla	420	425	Oscoda	74 1/2	75
Copper Range	36	37	Quincy	59 1/2	60
Daly West	2	2 1/2	Shannon	6 1/2	6
East Butte	10 1/2	11 1/2	Superior & Boston	1 1/2	2
Franklin	4 1/2	5 1/2	Tamarack	35 1/2	36
Granby	80	80 1/2	U. S. Smelting, com	33 1/2	34 1/2
Greene Cananea	33	34 1/2	Utah Con	10 1/2	11
Isle-Royale	19 1/2	20	Winona	3 1/2	3 1/2
Mass Copper	4 1/2	4 1/2	Wolverine	42	44

NEW YORK CURB QUOTATIONS

(By courtesy of E. F. Hutton & Co., Kohl Building.)

May 7.

	Bid.	Ask.		Bid.	Ask.
Braden Copper	8	8 1/2	La Rose	1 1/2	1 1/2
Braden Co.	160	165	Mason Valley	2	3
B. C. Copper	1 1/2	1 1/2	McKinley-Dar.	62c.	64c.
Con. Cop. Mines	1 1/2	1 1/2	Mines Co. Am.	2 1/2	2 1/2
Davis-Daly	1 1/2	1 1/2	Nipissing	6	6 1/2
Ely Con.	2	4	Ohio Copper	1 1/2	1 1/2
First National	1 1/2	2	Stand. Oil of Cal.	30 1/2	30 1/2
Giroux	1 1/2	1 1/2	Tri Bullion	1 1/2	1 1/2
Hollinger	15 7/8	16 1/8	Tuolumne	5 1/2	5 1/2
Iron Blossom	1.15	1.25	United Cop. com.	1 1/2	1 1/2
Kerr Lake	4 1/2	4 1/2	Yukon Gold	2 1/2	2 1/2

NEW YORK STOCK EXCHANGE

(By courtesy of J. C. Wilson, Mills Building.)

May 7.

	Bid	Ask		Bid	Ask
Amalgamated	74 1/2	75 1/2	Miami	21	21 1/2
Anaconda	—	—	Nevada Con	13 1/2	14
A. S. & R. com	61 1/2	62 1/2	Quicksilver, com	14	2
Calif. Pet. com	19	19 1/2	Ray Con	20 1/2	21
Chino	41 1/2	42 1/2	Tenn. Copper	34	34 1/2
Guggenheim Ex	54 1/2	55 1/2	U. S. Steel, pld	107 1/2	108 1/2
Inspiration	16 1/2	17 1/2	U. S. Steel, com	50 1/2	50 1/2
Mexican Pet. com	54 1/2	55 1/2	Utah Copper	54 1/2	55 1/2

Mineral Production of Queensland in 1913

The output of various metals and ores last year was as follows, according to the annual report of the Under Secretary for Mines, A. R. Macdonald, published in the government *Mining Journal*:

Mineral.	1913. Tons.	1912 Tons.
Bismuth	1.60	5.95
Bismuth and wolfram	181.75	191.50
Coal	1,037,944	902,166
Copper	22,655	22,120
Fireclay	8,388	6,336
Gems (value)	£43,292	£40,016
Gold ounces	265,735	347,946
Ironstone (flux)	40,838	15,526
Lead	3,603	3,108
Limestone (flux)	161,165	97,175
Manganese	27	308
Molybdenite	66.3	102.3
Opal (value)	£3,000	£3,000
Scheelite	0.1	—
Silver	604,979	569,181
Tin	3,197	3,230
Wolfram	358.75	626.5
Total value	£3,857,881	£4,175,355
Dividends	469,619	522,920

Fuel Briquetting in 1913

Briquetted fuel made in the United States is essentially for domestic use, for which there was a slackened demand last year, according to Edward W. Parker of the U. S. Geological Survey. In the eastern, central and Pacific coast states there was a total of 17 plants producing 181,859 short tons of briquettes, eggettes, coalettes, boulettes, etc., worth \$1,007,327.

OPERATING OFFICIALS of the Utah Copper Co., in Utah, in 1913, were as follows, according to the annual report: general manager, Robert C. Gemmell; assistant secretary and cashier, John M. Hayes; assistant purchasing agent, C. F. Jennings; chief engineer of mines, H. C. Goodrich; superintendent of mines, J. D. Shilling; consulting mechanical engineer, George O. Bradley; manager of mills, F. G. Janney; superintendent of Magna mill, H. C. Smith; and superintendent of Arthur mill, F. G. Janney, Jr.

OPERATING OFFICIALS of the Ray Consolidated Copper Co., Arizona, in 1913, were as follows, according to the annual report: manager, L. S. Cates; superintendent of mines, W. S. Boyd; consulting engineer of mines, R. C. Gemmell; consulting mechanical engineer, George O. Bradley; superintendent of mills, D. D. Moffat; consulting engineer of mills, F. G. Janney; and cashier, A. J. MacLean.

Bullion received at the San Francisco Mint during April was as follows: gold, 179,491 fine oz., worth \$3,710,403; and silver, 125,891 fine oz., worth \$73,014. The coinage executed was worth \$4,117,000—in double eagles, \$4,000,000; dimes, \$100,000; and nickels, \$17,000. Coin, bullion, etc., on hand on April 30 amounted to \$241,128,196.78.

Company Reports

NEVADA CONSOLIDATED COPPER COMPANY

The report of this Company for 1913 is of great interest, and contains plans of the mines, and fine large colored half-tones showing the geology of the porphyry copper deposits. C. B. Lakenan is general manager, E. E. Vanderhoof, mine superintendent; R. E. H. Pomeroy, acting superintendent of the Steptoe smelter; and Pope Yeatman, consulting engineer. The combined reports contain the following data: Ore reserves are estimated at 39,108,590 tons, averaging 1.65% copper about 250,000 tons more than the previous figure. Drilling in the Josie-Montana ground has added to the reserves. The ore lies at the contact of limestone and porphyry, and is partly in both formations. Hope for proving more ore lies in sinking deeper holes in known orebodies, and this is to be done after moving the capping. Prospect holes drilled in the Copper Flat, Liberty, Eureka, and Veteran workings numbered 27, aggregating 9175 ft. The total to date is 307, with 93,377 feet.

Mining was done by underground caving at the Veteran, and steam-shovels at the Eureka, Hecla, and Liberty pits. These pits are in the one orebody, and produced 3,148,285 tons of 1.59% copper ore in 1913. Stripping amounted to 3,100,661 cubic yards.

Transport of ore to the Steptoe Valley plant cost 26.72c. per ton. This plant treated 3,139,137 tons of ore averaging 1.59% copper, producing 452,233 tons of concentrate assaying 7.61% copper. The recovery was 68.52%. There was also treated 280,041 tons of ore for the Giroux Consolidated Mines Co. A number of improvements were made to the concentrating, roasting, and smelting plants. The 18 roasting furnaces, in January 1914, treated 404,266 tons of concentrate. The reverberatories smelted 593,484 tons of produce. The converters produced 64,972,829 lb. of copper.

The gross revenue was \$10,225,493; net profit, \$3,482,886, including \$1,470,443 from dividends, interest, etc.; total profit, \$6,656,064, including balance from 1912; dividends paid in 1913, \$2,999,185; and balance at December 31, 1913, \$3,069,643.

MIAMI COPPER COMPANY

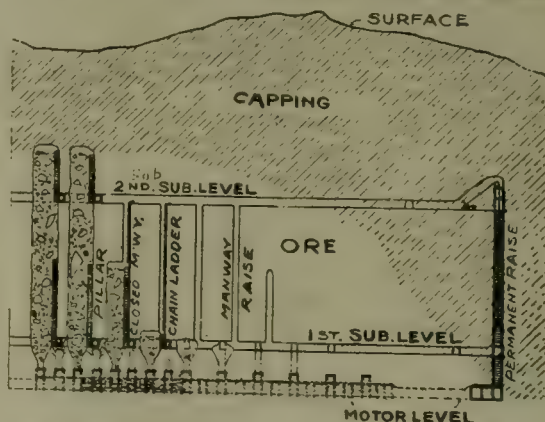
The general manager, B. Britton Gottsberger, reports as follows concerning the work done in 1913. The development totaled 37,697 ft., in drifts, raises, and shafts, at a cost of 31c. per ton. The ore extracted by stoping during the year is about equally divided between the shrinkage stopes in the Northwest orebody, and the square-set and slicing work in the eastern part of the mine. The ore in the East orebody has now been mined down to the 370-ft. level, with the exception of the shaft pillar. A new slice has been started below the 370-ft. level, and slicing of the shaft pillar is in progress. The shrinkage stopes in the southwest and northwest parts of the orebody have been completely broken, and blasting of the pillars between the rooms has progressed to the point where drawing of the broken ore in these areas can soon be started. Development work on the 420-ft. level, and above, was completed during the year in the older portion of the mine. The development of the Captain orebody, started in the previous year, is now well under way, and actual mining operations in this mine will begin during the current year. The sinking of the No. 1 or Captain shaft to the 420-ft. level was completed, thus furnishing an outlet from the mine to take the place of No. 2 shaft, which has been lost as the result of mining operations. Development work on the 570-ft. level was discontinued in the latter part of the year, as the outline of the orebody on that level has now been well defined, and actual mining need not begin for some time to come. The cave-in

last April interfered with mining for a time, and increased costs. Ore reserves are estimated at 29,300,000 tons, averaging 2.45% copper. This does not include 6,000,000 tons of 2% mixed oxide and sulphide ore, proved by drilling and underground work. Some leaching process may make this ore profitable. Churn-drilling has also developed 17,200,000 tons of 1.21% ore. Drilling amounted to 8774 ft. during 1913. The ore handled was as follows: stockpile, 101,888; development, 124,784; square-sets and slicing, 418,722; and shrinkage stopes, 409,890; a total of 1,055,284 tons. Stockpile costs were 35.6c., and mining, \$1.156 per ton.

The mill treated 1,058,784 tons of 2.3% ore, producing 45,410 tons of 38.09% concentrate, yielding 32,867,666 lb. of refined copper. The mill recovery was 71.06%, at a cost of 57.225c. per ton. The cost per pound of copper was 7.9c. Several efficient alterations were made and are being made to the mill. Sales of metal amounted to 33,134,334 lb., yielding a revenue of \$5,049,807. All operations cost \$3,515,122, leaving a profit of \$1,534,685. Interest increased this to \$1,582,185. Depreciation was \$223,874. Adding the balance from 1912 to the profit, the total is \$2,828,614, of which \$1,491,989 was paid in dividends. Ore and metals on hand were valued at \$797,894 at the beginning of 1914.

RAY CONSOLIDATED COPPER COMPANY

Of the great porphyry copper mines in the United States, the Ray in Arizona is worked only by underground methods, as compared with steam-shovel work at the Chino, Nevada Consolidated, and Utah mines. The report for 1913 contains the following information, in addition to an illustrated description of the methods of mining: The total development



CROSS-SECTION OF RAY MINE SHOWING SHRINKAGE STOPES AND PILLARS.

in the areas served by the three shafts was 84,729 ft., about 40% less than in 1912. Ore reserves are estimated at 78,380,966 tons, against 80,656,973 tons at the end of 1912. The limits of all the orebodies have not been defined, either laterally or as to depth, especially in the western portion. Broken ore in stopes amounts to about 5,000,000 tons. Mining costs were 73.23c. per ton, which include coarse crushing and loading this ore into railroad cars, 3.5c., and fixed and general charges. All surface improvements at the mine are finished. Ore mined amounted to 2,366,007 tons averaging 1.72% copper.

At the mill, No. 7 section was completed in January, and No. 8 in October, and a total of 8000 tons per day is now treated in the full plant. There were several important improvements made, resulting in higher recovery. Ore milled was 2,365,296 tons, or 6480 tons per day. The average content of the concentrate was 18.55%, and extraction 66.09%. The cost of milling was 51.93c. per ton. Including the metal in some high-grade ore smelted direct, the output was \$54,158,309 lb. of copper.

Financial results were as follows:

Revenue from copper	\$1,847,784
Revenue from gold and silver	51,956
Net miscellaneous income	177,974
Total	\$1,877,694
Operating expenses	5,402,502
Dividends paid	1,631,504
Surplus after dividends	\$1,043,688
Reserve for bond redemption and depreciation	513,466
Balance	\$ 530,222
Forward from 1912	2,227,903
Total at December 31, 1913	\$2,758,125

UTAH COPPER COMPANY

The area of mineral lands owned by this Company amount to 736 acres, also 6030 acres at the millsites, Bingham Canyon, and near Utah lake. During 1913, underground work in the original Boston claims totaled 24,812 ft., making a total of all underground development of 439,503 ft. Of this, 309,797 ft. has been rendered inaccessible by surface and other operations. [During March 1914, all underground mining was permanently stopped.—Editor.] Development drill holes totaled 10,153 ft. Underground development cost 1.59c. per ton on the total tonnage of all ore mined by stoping and steam-shovels. The cost of churn-drilling was 0.75c. per ton, so all development cost 2.34c. per ton. The depth of fully and partly developed ore is now 444.5 ft., against 424.3 ft. in 1912. Ore reserves are estimated, according to this depth, as 361,220,234 tons, averaging 1.59 and 1.15% copper respectively. The average thickness of overburden on the orebody is 114 ft. The amount of capping removed was 4,835,479 cu. yd., and 22,125,207 to date. Of the ore mined in 1913, steam-shovels recovered 91.02%, and underground mining 8.98%, compared with 77.81% and 22.19%, respectively in 1912. The cost of steam-shovel work was 29.26c., and underground mining 69.52c. per ton.

Ore treated at the Magna and Arthur mills was 4,142,700 and 3,376,692 tons respectively, an increase of 1,516,171 tons over the previous term. On low-grade ore the combined capacity of the plants is 24,000 tons per day; but on average grade ore, the economical capacity is 21,000 tons. The average copper content of the ore was 1.25%, and recoveries at the Magna and Arthur plants 63.78 and 64.18%. The average cost of treatment was 36.76c. per ton. In September this was 30.83c. Concentrate averaged 17.31% copper, and the production was 119,939,809 lb. of metal.

The total cost of mining, transport, and treatment was 97.6c. per ton. Financial results were as follows:

Revenue from copper	\$17,063,635
Revenue from gold and silver	732,583
Miscellaneous	1,346
Total	\$17,797,564
Operating expenses	11,494,341
Operating profit	6,203,223
Dividends on investments	2,176,000
Interest, rents, royalties	94,200
Total income	\$ 8,573,423
Interest paid	60,318
Net profit	\$ 8,513,105
Dividends	4,747,710
Surplus, after dividends	3,765,395
For depreciation	507,712
Balance to undivided profits	3,257,683
Balance from 1912	6,450,970
Balance at December 31, 1913	9,708,653

Decisions Relating to Mining

DISCOVERY OF LODGE—ADMISSIBILITY OF EVIDENCE

In a suit to determine title and right of possession to a lode mining claim in which plaintiff claimed that there was no well defined lode on defendant's property, which was claimed to be the same vein purported to have been discovered in defendant's discovery shaft, it was held that the court did not err in admitting such evidence and permitting the jury to visit the claim in dispute, where the jurors were duly instructed that such evidence should be considered solely on the question as to whether there was mineral-bearing rock found in defendant's discovery shaft.

Specie Payment Gold Mining Co. v. Kirke (Colorado), 139 Pacific, 21. March 2, 1914.

OUTCROP DEFINED JUDICIALLY

Outcrop is defined as the "edges of strata which appear at the surface of the ground"; "that portion of a vein appearing at the surface"; "the portion of a vein or strata emerging at the surface or appearing immediately under the soil and surface debris"; in general, "that part of a mineral strata that lies at or near the surface of the earth." At what point, at what line—from the outer edge of the strata, which necessarily retreats in progression, beneath the earth's surface—it can be said that the outcrop ends, the term "outcrop" alone does not define or describe.

Sloss-Sheffield Steel & Iron Co. v. Payne (Alabama), 64 Southern, 617. February 12, 1914.

OIL LEASE—FORFEITURE DENIED

An oil lease was granted upon consideration of \$1 and 10% royalties for a term of 20 years and as long thereafter as oil, gas, coal, or minerals were found in paying quantities, the lessee to commence a well within 30 days and complete it to a depth of 300 feet. The lessee drilled one well, pumped the oil, and paid royalties on the output, drilled two other wells which were failures, and stopped operations. Held, on a suit to cancel the lease that it could not be declared forfeit, the lessee's operations having constituted a sufficient performance on his part.

McAfee v. Grubb (Texas) 164 Southwestern, 925. March 7, 1914.

LODE WITHIN PLACER—PROOF REQUIRED

In a suit by a placer patentee in Montana to quiet title against an alleged location of a lode within the boundaries of his claims, it appeared from the location certificates introduced in evidence that the lode claims had been located long before the placer patent was applied for. No evidence, however, was introduced by the lode claimant to show whether or not there had been an actual discovery or whether the lodes contained mineral of such extent and value as to justify expenditures for the purpose of extracting it. Held, that in the absence of such showing decree quieting title of placer patentee was proper. Where mining claims which have passed out of the hands of the original owners have stood unchallenged for years, and have been developed to a considerable extent, the certificate of location, if in due form, may be deemed presumptive evidence of discovery and of a valid location. But in the absence of such grounds for indulging a presumption in favor of the integrity of the location, it is held that the location notice is, when recorded, *prima facie* evidence only of what the statute requires it to contain, and which is therein sufficiently set forth.

Thomas v. South Butte Mining Co. (Montana) 211 Federal, 105. February 2, 1914.

Recent Publications

U. S. Geological Survey Publications, Washington, 1913:
SOME ORE DEPOSITS IN NORTHWESTERN CUSTER COUNTY, IDAHO.
By Joseph B. Umpleby. Bulletin 539. P. 104. Ill., maps,
index.

INTERPRETATION OF ANOMALIES OF GRAVITY. By Grove Karl
Gilbert. Professional paper 85-C. Part 'C' of 'Contributions
to General Geology, 1913.' P. 37. Map.

THE SAN FRANCISCO VOLCANIC FIELD, ARIZONA. By Henry
Hollister Robinson. Professional paper 76. P. 213. Ill., maps,
index. This district covers about 3000 sq. mi. in the north-
central part of the state.

MUD LUMPS AT THE MOUTHS OF THE MISSISSIPPI. By Eugene
Wesley Shaw. Professional paper 85-B. Part 'B' of 'Contribu-
tions to General Geology, 1913.' P. 27. Ill., maps. The
peculiar formation of these lumps, containing gases, is de-
scribed.

THIRTY-FOURTH ANNUAL REPORT of the Director of the Sur-
vey. George Otis Smith, for the year ended June 30, 1913.
P. 183. Maps. This report covers the work done during the
period, and as the ramifications of the Survey and its publi-
cations are so well known, no extended notice of this book
is necessary.

THE CIRCLE QUADRANGLE, ALASKA. A geologic reconnais-
sance. By L. M. Prindle. Bulletin 538. P. 82. Ill., maps,
index. In the preface, Alfred H. Brooks briefly describes pre-
vious work done. This quadrangle contains about 17,000 sq.
mi. of well known territory, and includes the Birch Creek
placer district, which is the most important.

BIBLIOGRAPHY OF NORTH AMERICAN GEOLOGY, 1912. By John
M. Nickles. Bulletin 545. P. 192. Includes publications
bearing on the geology of the Continent of North America
and adjoining islands, also Panama and the Hawaiian Islands.
These total 1275 papers. The indexes include a classified
scheme of subject headings, lists of rocks and minerals men-
tioned, and the geologic formations described.

THE NOATAK-KOBUK REGION, ALASKA. By Philip S. Smith.
Bulletin 536. P. 160. Ill., maps, index. In the preface, Al-
fred H. Brooks describes what is known of an area of 150,000
square miles of the territory above the Arctic Circle. The
Noatak River region is around 68° latitude north. The mean
annual temperature is about 16.5°, ranging from -31.3 to
60.8°F. Game and fish are fairly plentiful. Quartz veins
are numerous, the older being in schists and limestones.
About \$100,000 has been recovered from gravel in the Shung-
nak region. The other river deposits are described. Copper
ores are also found. The cost of supplies and operations will
not decrease materially in the future; but observant prospec-
tors, properly equipped, may find the country worth investi-
gation.

MINERAL FUELS. Contributions to *Economic Geology*. Bul-
letin 531. P. 361. Ill., maps, index. The subjects deal with
petroleum and natural gas, and coal and lignite; prepared
by the following authors, Marius R. Campbell being geologist
in charge: M. J. Munn, R. H. Wood, E. G. Woodruff, G. H.
Ashley, M. R. Campbell, F. A. Herald, G. S. Rogers, J. T.
Pardee, C. F. Bowen, C. H. Wegemann, W. T. Lee, J. H.
Hance, and A. J. Collier.

California State Mining Bureau publications, San Fran-
cisco, 1913 and 1914:

MINERAL PRODUCTION OF CALIFORNIA, 1912. Compiled by E.
S. Boalich. Bulletin 65. P. 64. The total value of all min-
erals produced was \$88,972,385, of which gold contributed
\$19,713,478 and petroleum \$41,868,344.

MINING LAWS. Bulletin 66. P. 89. Covers certain federal
laws and those made by the state legislature.

Industrial Progress

THE ALBERGER PUMP & CONDENSER Co. has issued bulletin 19,
descriptive of Alberger expansion joints.

ABENDROTH & ROOT MFG. Co. announces a change of address
from 50 Church street to 45 Broadway, New York City.

THE LANE MILL & MACHINERY Co. is distributing a new
catalogue, No. 7, descriptive of the Lane slow speed Chilean
mills.

JOHNSON ELECTRIC SMELTING INC. has been formed to acquire
the patents and business of the Continuous Zinc Furnace
Company.

THE DENVER ENGINEERING WORKS Co. has published a special
description of the Isbell concentrator, which is now sold by
that firm.

THE SPRAGUE ELECTRIC WORKS is sending out now bulletin
41010, containing details of the Sprague direct current motors,
types, 'C' and 'D'.

THE FRED M. PRESCOTT STEAM PUMP Co. has published bulle-
tin P-105 containing descriptions of the Prescott, duplex, power-
driven, mine pumps.

THE HARDINGE CONICAL MILL Co. reports a repeat order for
two 8-ft. Hardinge mills from the Spassky Copper Co. The
original order included nine sizes but the 8-ft. mill has been
adopted as standard.

FAIRBANKS MORSE & Co. is distributing bulletins 27 and 29
descriptive of direct current, commuting pole, motors and gen-
erators, types 'CP' and 'TRC'; Bull. 210 dealing with internal
starter motors; and 202H, standard induction motors.

THE ROBINS CONVEYING BELT Co. has issued a circular letter
of warning regarding infringement of its patents. It is stated
that confusion has apparently arisen from the fact that one
of the patents of the Company has expired, though this leaves
all the essential features of the devices now manufactured,
fully protected.

THE INGERSOLL RAND Co. announces the opening of a branch
office at 1036 Union Oil Bdg., Los Angeles, which will be in
charge of W. A. Townsend, formerly at El Paso where he is
succeeded by J. D. Foster. At Juneau a branch in charge of
Frank Carroll has been established, and at Pittsburgh Walter
A. Johnson succeeds C. F. Overly, who goes to Cleveland, Ohio.

The Diesel Engine

The Busch-Sulzer Bros. Diesel Engine Co. has prepared
and is distributing a most attractive and valuable handbook
on the Diesel engine as developed in America. It is not
generally known that Diesel engine construction began in
the United States in 1898, only a year after Rudolf Diesel
completed his first successful engine at Augsburg, Germany.
Adolphus Busch was attracted to the matter while in Ger-
many, and, securing the assistance of E. D. Meier, he built
at St. Louis, in 1898, the first American Diesel engine,
which by the way is still in operation and doing good work.
Since then there have been many improvements and busi-
ness changes, but from this beginning has grown the business
which has spread over the whole country. The fundamental
economy of the Diesel principle, which permits a thermal
efficiency of 32 to 35%, was bound to make the engine suc-
cessful, and it has done so. One needs but to look at the
pictures illustrating the wide applications already made to
realize the possibilities of the future. These pictures, with
the concrete facts as to efficiency and economy presented in
this book, made it clear that the matter is one of first im-
portance to power users everywhere.

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EDITORIAL

LABOR camp sanitation is treated concisely but in-
formingly in a pamphlet issued by the Commission
of Immigration and Housing of California. Copies
may be obtained upon application to the Commission
at 525 Market street, San Francisco, and are well
worth having. Better quarters means more contented
and efficient labor; also, in California, it may mean
avoiding a fine.

DEVELOPMENT of a skilled staff for its new enter-
prises has been taken in hand by the Standard Oil
Company, and many of the graduates of technical
schools have been engaged to take a summer course in
business and instruction, after which they will be sent
to China on a contract at a very satisfactory salary.
The opportunity is one which adventurous young men
would naturally grasp at, and the chances for achieve-
ment somewhat parallel those on our own frontiers of
some decades ago.

CHISANA placers are not developing the bonanzas
which were anticipated a year ago. The latest
reports are very skeptical as to what the future of the
district will be and indications are far from encour-
aging. The old workings on Bonanza and Little El-
dorado creeks are the only producing properties and
no new discoveries of importance have been reported.
Bowen creek is attracting some attention at present
and is the most promising part of the district. Hopes
are expressed that the spring operations will result in
renewed activity, but optimists are few, and it is gen-
erally believed that Chisana will never be classed
among Alaska's large gold districts.

RAILROAD VALLEY COMPANY, which has spent
\$150,000 in prospecting for potash in Railroad
valley, Nevada, has given up hope of finding this salt
in profitable quantities. The last hole, which reached
a depth of 1122 feet, gave negative results, and the
Company will now devote its attention to further ex-
ploration of the gaylussite beds which were discovered
in the course of the work. The geology of the district
is most interesting through its association with the
dry-lake theory of potash deposition, which subject
was discussed by Mr. E. E. Free in our issue of August
2, 1913. While exploration has not proved the presence
of potash to warrant exploitation, the gaylussite beds
are of possible commercial importance.

THE Reinohl process of rapid cyanidation, a so-called new process of extraction, is, as is usual, being heralded with figures which savor of imagination rather than fact and with no very clear evidence in the literature distributed to prove the contentions. The mining public has become extremely skeptical of such statements as "the installation cost of the new process will be only 50 per cent of modern cyanide plants, labor charges will be reduced 25 per cent, cyanide consumption 50 per cent, and the extraction will be 95 to 100 per cent," etc. Such figures carry more weight if published in detail by a disinterested person after a plant has been installed and in operation for a reasonable length of time. Such statements, published for promotion purposes, only tend to discredit what may be a process of merit. We would like to accept them, but literature of this nature, which is apparently founded largely upon theory and imagination, is worthy of the waste-paper basket only, until actual figures are available.

ALL waste is deplorable, but the waste of human life is criminal. We have been curiously inconsistent in our thinking on this topic. The shooting down of a man on the public streets attracts widespread attention and is universally recognized as a crime, but the death of a workman who has been set to varnishing tanks without being told that the fumes of wood alcohol are deadly, has in the past been considered merely an accident. The president of a company, who would not for a moment think himself entitled to borrow a club member's racquet and return it to him with the strings broken, has too often thought himself entitled to employ some poor woman's son and return him to her with limbs broken or health shattered. Happily a new spirit now pervades the industrial field, and on another page Dr. J. W. Luther, chief surgeon for the New Jersey Zinc Company, interestingly describes the effective work which may be done for safeguarding the health of the worker when the organization which employs labor is sufficiently large to bear the overhead cost of such an organization. Work of this sort pays the best kind of dividends.

American Investments in Mexico

The question as to what will become of American investments in Mexico in the event of intervention has been the subject of a great deal of comment in this country, and fear is expressed by many that all American property within the confines of Mexico will be razed in the event of war. This opinion is largely the result of the much advertised anti-American feeling among the Mexican people, which in reality exists for the large part in the minds of American newspaper writers. American, together with all foreign and native investments in Mexico, are suffering as a result of the present conditions, and it is only with

the reestablishment of peace that any change may be expected. It is gratifying to note, however, that even where it has been necessary to completely suspend operations, foreign property has been generally respected in both Constitutional and Federal territory, and where looting has taken place it has been invariably by outlaws. Mining property has been abandoned in many instances, but in most cases operations can be resumed immediately after transportation is reestablished and local conditions will permit. The railways have been the greatest losers as a result of the present trouble. It is estimated that American investments in Mexico amount to \$1,057,770,000; of which investment \$223,000,000 is in mines and \$643,000,000 in railroads. English property is valued at \$321,302,800 and the Mexican investment totals \$793,187,000.

The smelter property of the American Smelting & Refining Company in Mexico is valued at \$10,000,000, while the surface plants and destructible property at the mines of the Company is valued at between \$3,500,000 and \$4,000,000, according to *The News Letter*. Two of the five smelters, 20 of the 26 mines, and one of the four railway lines are situated in the territory which is held by the Constitutionalists, and are therefore, in view of the stand taken by Villa, believed to be safe from attack. Of the total surface improvements of the Company's property \$6,300,000 is estimated as being invested in Constitutional territory. The smelter plants in Federal territory are valued at \$6,000,000, and in the event of this property being attacked, it is not likely that more than a 60 per cent loss would be incurred, or about \$3,600,000, and the damage to the mining property would not exceed \$1,000,000. This, with a possible loss to railways and expenses incident to the flooding of the mines, would bring the possible loss of the Company due to destruction of property in the Federal states of Mexico to not more than \$5,000,000. These figures are based upon hypotheses which at present seem hardly likely of fulfilment, and are only of interest as to what might happen to one of America's largest investors in the event of a general uprising against Americans in both the Federal and Constitutional territory of Mexico.

We cannot believe that such conditions are within the range of possibility. Mining and smelter property held by foreign interests in all parts of Mexico has been generally respected, and instances of vandalism are comparatively few. Throughout Mexico the mine and smelter operators have in general maintained friendly relations with the communities in which they operate, and from these people, who have been so largely dependent upon foreign investment for a livelihood, little or no apprehension need be felt. The much talked of anti-American feeling in Mexico has been greatly exaggerated. It is true that the student class of Mexico City occasionally give vent to such a feeling by parading the streets, making speeches, and breaking windows and the *pelado* element enjoy following in the wake of the procession lending their voices and making a

holiday of the *cofrades*. The sentiment, however, is not representative of the whole of the Mexican people, and even when spurred on by the approval of a drunken dictator, we doubt if any material damage would result to American property. *Mueren los gringos* is a popular slogan with the student class, as it has proved effective in more than one instance for starting a *huelga*, as the Mexicans say, but when it comes to the actual killing of American citizens or the wanton destruction of American property, there is yet to be recorded such an outbreak as the result of anti-American feeling. Americans have been insulted in the streets of Mexico City and windows in American establishments have been broken, but this has been the extent of the violence. The loss of American lives and property in Mexico may be almost wholly attributed to bandits and outlaws, whose sole purpose has been to plunder and as such have been no respecters of persons or nationalities.

Lead Production and Future Prices

Comment has been excited recently by the fact that among the metals, lead is the one most unresponsive to change in price. Comparing the production and price of lead for recent years, it may be noted that since 1875 the domestic output of lead has increased eight times, from 50,000 tons per year to over 400,000 tons per year. There has, however, been no consistent change in prices. For example, in 1880 the average New York price was 5.04 cents, and in 1896 it was 2.98; but the highest average yearly price for the entire period was realized in 1906. During that year and the first half of 1907 the average weekly price of lead in New York was between 6½ and 7 cents per pound. The business crisis in the autumn of 1907 carried the price down to 3½ cents per pound before the end of that year, and for a few months the market was only sustained by the disposition of the farmers to give their houses a new coat of paint. By the following July the price had risen to 4½ cents, near which figure it remained until the autumn of 1912, when it rose to 5 cents for a little while, soon declining to below 4½ cents. Last autumn the price rose slightly for a brief period and has since generally declined, being now below 4 cents per pound at New York. This would not by itself be remarkable, but another fact must be considered. Though the domestic output of lead has been steadily increasing in the past thirty-five years, no new lead deposits of any importance have been developed in the United States, or indeed, until within the past year or two, anywhere in the world. Here we have two apparently diametrically opposed sets of facts: increasing output from a limited supply, and a stationary or declining price. From these premises only one deduction is possible, namely, that the industrial world views with equanimity the possibility of having to get along without lead. Belief in this view is strengthened by the fact that the world's output has,

in the past five years, only shown an increase of 14 per cent.

Evidently the consumption of lead is on the increase. But in surveying the field it is hard to detect any great source of weakness in the lead market other than the depressed state of general business since 1907. It is true that lead pipe is largely going out of use in plumbing work, nicked iron being used for exposed plumbing and plain iron for covered work. On the other hand, the consumption of lead for covering electric cables has greatly increased in recent years. Probably the consumption of lead pigments for paint has also decreased, as zinc has cut into the field and there is a tendency to use a mixture of paint bases rather than lead alone. Even more important is the tendency toward the use of fireproof construction. The wooden house, painted white with green shutters, has gone out of fashion and cement or stucco houses, their interiors and exteriors colored by the use of ochre or other mineral pigments, are the prevailing style. The aggregate effect of such factors is tremendous, doubtless serving to explain why the lead market remains persistently weak while the future output of the metal seems so limited. Quite recently another factor has intervened to aggravate the situation. In the well known Burma Mines, Limited, large orebodies of complex lead-zinc ore have been discovered, and, as we recently have noted, even larger orebodies of somewhat similar nature have been developed in southern Siberia, with the possibility of more to come. By present metallurgical methods these ores can scarcely be worked at a profit, but it is hoped that by smelting in the electric furnace, both zinc and lead can be recovered at a good operating profit. In this case, the world's supply may be considerably augmented. However, the trend of events in the past nine months has been rather toward the export of lead, a condition which has not prevailed in many years. General business has been dull in this country, and although the total output in this country has slightly declined in the past three years, the price has declined, as already noted. The London price, on the contrary, has shown a tendency to increase since the first of last year, and in December 1913 was actually above the New York price in spite of the present duty which tends to maintain the domestic price at a fairly steady level above the London price. The present critical situation in Mexico further constricts the European supply, and as the new foreign lead already mentioned is still some distance in the future, it may be expected that, for a while at least, the European lead market will be strong and the domestic lead market weak. The outlook, on the whole, seems to be that the consumption of lead is not likely to continue strong enough to force up the price of the metal. In short, lead, as compared with other metals, is in much the same situation as the horse compared to the automobile; for many uses it will retain a permanent place, but the tide of development seems to be turning in other directions.

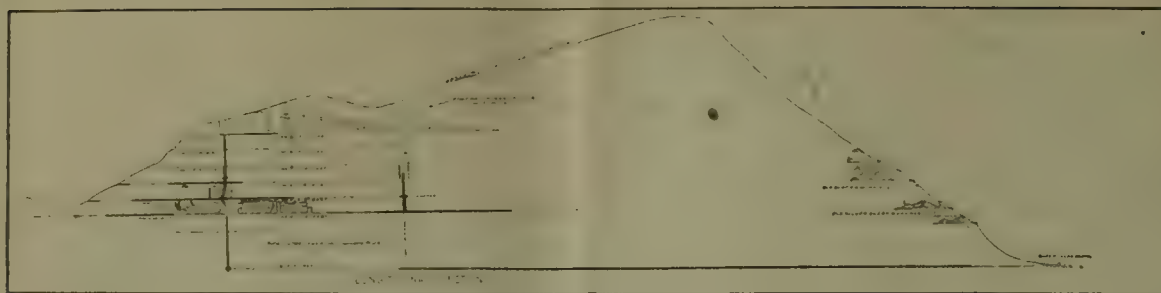


DIAGRAM SHOWING WORKINGS OF PERSEVERANCE MINE.

Preparatory Work of the Alaska Gold Mines Company

In an excellent report, accompanied by large half-tones and mine plans, the Alaska Gold Mines Company reports that the following work was done in 1913:

The president, Charles Hayden, states that the Company owned on December 31, 1913, \$3,267,500 par value of the \$3,500,000 bonds; and \$11,299,845, par value, of the \$12,000,000 stock of the operating company, the Alaska Gastineau Mining Co. It is not the intention of the management to make large expenditures at the present time in further developing the veins already disclosed, as the extent of ores now opened is deemed amply sufficient upon which to formulate operating plans. The cash in the bank on December 31, 1913, was \$1,740,750.

The vice-president in charge of operations, D. C. Jackling, reports as follows: Progress in development and construction throughout the past year was satisfactory in every way.

The principal group of mining claims is situated about three miles in an easterly direction from the town of Juneau, and covers the Gold Creek lode system of gold-bearing veins for a length of over two miles.

Mining

The lowest working shown in the accompanying plan is the Sheep Creek adit, which has been driven for the double purpose of further developing the property, both longitudinally and at depth, and to serve as a transportation outlet for delivery of ores to the new mill. This, on account of the importance of its early completion, took precedence over other development work during the year. The total length necessary to be driven from the portal of the adit near Sheep creek, to the bottom of the Perseverance shaft, is approximately 10,000 ft. During the year this adit was advanced 6431 ft., or at the rate of about 536 ft. per month. The advancement during the early part of the year was not so rapid on account of inadequate air-supply for machine-drills. For the last six months of the year the average distance driven monthly was 583 ft. For three of these months the advancement was over 600 ft., and in November 661 ft. was driven. This adit is driven parallel to and

in the foot-wall of the principal or Perseverance vein; but on account of the desirability of completing it as rapidly as possible, so that it can be equipped and available for use, not only for delivery of ores when the mill is ready, but for ventilation and the transportation of supplies prior to that time, it was not considered advisable to delay its progress by cross-cutting for the development of ore.

During the year the sinking of No. 1 shaft was completed to the Sheep Creek or No. 13 level, and it was enlarged to the surface. The total depth of this shaft is 1544 ft. Development on the vein in preparation for mining was continued on most of the proposed levels above the Alexander or No. 10 level. The extent of this work can be observed from the accompanying plan. It will be seen that No. 10 level has been extended to a total length along the vein of nearly 5000 ft. Throughout this distance the ore deposit has been developed by frequent cross-cuts and found to be substantially uniform in size and value. These characteristics have also been proved by numerous cross-cuts on other levels, and, as previously stated, the Sheep Creek adit has cut portions of the vein longitudinally at a few points throughout its course, this occurring more frequently under the easterly end of the mile-long zone developed on the No. 10 or Alexander level. The height of vein measured on its dip above the Sheep Creek adit and for the length of zone developed on the No. 10 level is nearly 2000 ft., and as previously stated, the length of zone so developed is about 5000 ft. The thickness of the main vein that has been used for previous estimates of tonnage and which may still be used conservatively, is 70 ft. A solid block of ore having the given dimensions would contain considerably more than 50,000,000 tons. It cannot be said that an orebody of this size has been fully developed, but nevertheless all of the underground work, including a large number of diamond-drill holes through the vein, taken together with extensive samplings both underground and on the surface, indicates a uniformly increased thickness of commercially valuable orebodies, as compared with that used in previous estimates and prevailing throughout

much greater lengths and depths on the ore deposit than those stated above. Furthermore, an entirely new orebody has been developed to the north of the main Perseverance vein, on No. 5 level, which is being opened for mining. At the time of writing this report, this development has extended for a length of several hundred feet, showing an ore deposit well over 100 ft. thick. In addition to the disclosures as described, on and adjacent to the main vein, substantial consideration must be given to that on No. 2 vein developed by the Alexander adit as referred to in the last annual report, and situated about 2000 ft. north of the principal vein series. The vein has been prospected for a length of over 600 ft. as indicated on the accompanying map. Its thickness is over 100 ft., and a mill-run sample of several hundred tons taken from across this full width showed a gross value of about \$1.60 per ton, or about the same as the recoverable value estimated for the ores of the principal vein series at the time the enterprise was undertaken. On the whole, there is every assurance that the tonnage of ore of commercial grade ultimately available from the property will be vastly in excess of any definite estimates heretofore or now made.

The total amount of development work done during the year, including that of the Sheep Creek adit, the main shaft, and other work such as drifts, cross-cuts, etc., but not including diamond-drill work, was 22,137 feet.

The surface improvements at the mine include substantial, commodious, and comfortable quarters for all of the mine employees who will be required when operating at the full capacity of the mill now under construction. A new compressor plant was constructed to accommodate two 3000-cu. ft. electrically driven compressors, which will furnish all the air the mine will require for the output now contemplated.

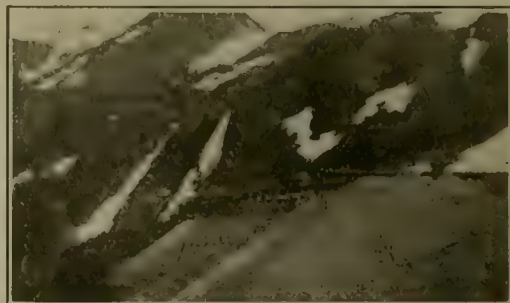
Power Supply

The development and equipment of the Salmon Creek water-power provides for a continuous year-round production of 6000 electric horse-power. In order to secure this output it is necessary to store some of the floodwaters in the summer time for use in balancing the supply during winter months, and therefore an essential part of the development is the construction of a reservoir, which made necessary the building of a concrete dam 165 ft. high and 700 ft. long on its crest. In order to get the maximum benefit from the total amount of water available, it is necessary to built two power-plants. One of these is situated about a mile from the dam and operated under a head of 600 ft. The water discharged from this upper power-plant, together with a considerable additional amount of water gathered from a drainage area lower than that serving the reservoir, is conveyed by a flume for a distance of about 10,000 ft. and used under a head of 500 ft. through another power-plant of similar design situated on the shore of the Gas-

teaux channel near the mouth of Salmon creek. Each of these power-plants will be equipped with two 1500-kw. generating units, and will therefore have a total capacity of 6000 kw., corresponding to 8000 horse-power.

Milling Plant

The work in this division comprises the construction of a reduction plant having a capacity of 6000 tons per day, together with the necessary accessories. In this division is also included the construction of a narrow-gage railroad in and from the Sheep Creek adit to the mill-site, for the transportation of ore. All portions of the mine above the Sheep Creek adit will



DUMP AT PERSEVERANCE MINE.

connect with it by chutes through which ore will be drawn into cars of about 10-ton capacity and hauled by electric locomotive in trainloads of about 300 tons to the coarse-crushing plant situated some distance above the main concentrating building. Here the ore will be dumped, crushed, and discharged into large underground storage-bins, from which it will be drawn to conveyors, and by them delivered to the main concentrator at a point about 300 ft. lower in elevation than the coarse-crushing department. This coarsely crushed ore will be received in the fine-crushing department at the upper part of the concentrator, and at an elevation of approximately 150 ft. above the lower floor of the mill, thus providing sufficient elevation between the upper and lower part of the mill to permit of its operation almost wholly by gravity, and contemplating the minimum use of elevators. The lower floor of the mill is approximately 200 ft. above tidewater, thus providing ample elevation for the disposal of tailing. During the year, actual grading for the coarse-crushing plant and concentrator was commenced, and about two-fifths finished before the end of the year. At the time of writing this report the grading for the coarse-crushing plant is entirely completed and that for the concentrating plant practically so. Concrete foundations have also been completed for the coarse-crushing department and commenced for the main concentrator. The structural steel for the coarse-crushing plant is practically all on the ground and will be in process of erection before this report is published.

Copper Matte Production in the Reverberatory Furnace

By HERBERT LANG

Remarkable progress has been made within the last two decades in the art of making copper matte in both the blast-furnace and in the reverberatory, especially in the latter, which has been the subject of much discussion. The surprising records of the big reverberatories which have been erected within the last few years have been the subject of many press communications and accounts in the technical papers, often accompanied with illustrations and statistics of importance. The various innovations in reverberatory construction and management have been fully described, especially the former, and it may seem that the subject has been sufficiently touched upon. There are, however, several matters of principle which, it seems to me, merit further consideration.

Long Reverberatories

It has often been said of late years that the chief improvement in the reverberatory has been in its increase in length; as if this increase were not necessarily attended by variations in its practical working. The fact is that the lengthening of the furnace has brought about, or rather made possible, a great improvement in practice, by which the performance has been enormously bettered. Not only has the daily duty been increased in correspondence with the enlarged hearth area, but the perfection of the smelting has been brought to a par with that of the well conducted blast-furnace, of which it has always in some measure been a rival. The tendency of these improvements, therefore, is not simply toward an increase of capacity, but largely toward better work. These and associated matters will be considered in the following discussion.

In order to understand thoroughly the line of development of the reverberatory copper-smelting furnace, it will be convenient to consider the former style used first in Swansea, Wales, or copied from that original. Swansea was the primal home, or at least the cradle of the reverberatory, records showing that it has been in use there for a continuous period of three centuries and more. It is not a little remarkable that during so prolonged an experience the furnace was never improved to any notable extent. It will be remembered by some, no doubt, that Vivian in his little treatise on copper smelting published in 1880 (a period which now seems historically ancient in this art), remarked that the charges used in his time varied little in weight, and probably in composition, from those used by the smelters in the time of Elizabeth, to which period he traces back the English practice of copper smelting. They had not, accordingly, enlarged their furnaces appreciably during all that time, nor, so far as I can learn, had they im-

proved to much extent the quality of the metal produced. This is very curious, and leads to a train of (unprofitable) moralizing with which I need not trouble anyone. The main thing to remember is that the furnaces had not outgrown the traditional size, nor had the art outgrown the traditional management. So late as Vivian's and LePlay's time, men were still engaged in 'packing' ore on their backs in the works of Swansea, and except for the tremendous stimulus given to this branch of metallurgy by American practitioners, they would probably still be doing the same. Modern English metallurgy, however, has become a very different thing, and although we may enjoy 'taking a fall' out of our British compeers, it is not fair not to acknowledge that they are rapidly catching up with the procession. The ancient British practitioner must have considered the art of smelting as a gift of Providence rather than something to be acquired, and I can fancy him saying in his customary vernacular: "L'arn it? Yer can't l'arn it. It's a bloom-in' gift!" Else we had not borrowed the Swansea type of furnace, perhaps. However, it was an Englishman, Pearce, who, under the stimulus of American conditions, first set about enlarging and improving, at the Boston & Colorado smelter, at Black Hawk, Colorado, the little Swansea reverberatories with which work had there been begun.

Early Practice

The original reverberatory consisted, to outward view, of a rectangular box of brickwork, about 20 ft. long by 10 ft. wide and 6 ft. high, surmounted by a flat arch, and containing within an elliptical space of about 15 ft. long by 9 ft. high in its greatest width, and of a height averaging three feet or thereabouts. This space was connected at one end with a fireplace, and at the other with a smoke flue, and was provided with doors on one or both sides and at one end, for the introduction of the charge and for the handling of tools for repairs, etc. The fuel at Swansea was coal, but dry wood at Black Hawk. About one and a half tons of ore was smelted with a ton of coal, while at Black Hawk a cord of wood smelted one ton of ore or a little more. Wood is not a very good fuel for the reverberatory, not giving enough heat, and requiring too much attention during combustion, with too frequent opening of the fire-doors. Coal, of course, is good, if it be the right kind, giving a long flame, but the ideal fuel is petroleum. This fuel requires little attention, and the heat is ample and easily controlled.

The cycle of operations at one of the little furnaces was as follows: The furnace being empty, the charge, composed of the crushed ore, reduced in size to pass a

1-in. ring or generally smaller, mixed with the appropriate fluxes (of which only small quantities were ever used, and frequently none at all), was brought to the furnace and dumped on the floor near the side door, which covered an opening from $1\frac{1}{2}$ to 2 ft. wide. This being opened, men shoveled the material into the elliptical space (the hearth), taking care to spread it evenly. It formed a layer some six or eight inches deep. This done, the door was closed and luted up with clay to prevent the influx of air, which has a cooling effect, of course. The fire was then replenished, it having been allowed to go down at the end of the previous operation, and the charge was heated up as quickly as possible, the greatest practicable amount of fuel being burned during the period of fusion. Unlike modern practice, the charge was cold and began to smelt very slowly. The slag and matte remained practically in the spot where first formed, displacing the ore gradually from its bed by sinking beneath it because of their greater gravity. The charge, varying from two and one-half to four tons, might average three tons in weight. If so, it would give rise, ordinarily, to perhaps two tons or 20 cu. ft. of slag, and three-fourths of a ton or 5 cu. ft. of matte. These quantities, infantile in the modern conception, varied, of course, according to circumstances, but may be taken as an average of the practice of ages.

Fusion in Furnaces

Fusion takes place in a reverberatory in a peculiar manner. The ore may be practically all melted, but the slag will remain non-homogeneous and stiff, requiring a further exposure to heat to thin it to the point at which it may be run out or be skimmed out properly. Unfused fragments, especially of difficult fusible substances, remain for a long while floating about, and as long as they come into contact with already melted stuff of a different composition there will ensue reactions which give rise to the evolution of gas, or to the fresh formation of matte, which will require additional time to settle out of the bath. Settling of the matte quite out of the slag is, of course, a *sine qua non*, since, no matter at what time it be formed it will contain metal of value. To remove (skim) the slag before the matte has settled from it is equivalent to a large waste, notwithstanding the time that may be saved thereby. Accordingly, a period of some length, even to an hour, is allowed to pass while the firing is kept up. This is to be particularly borne in mind since in the doing away with this time of waiting is one of the great modern improvements in this kind of smelting. At the end, when the molten mass had become quiescent, indicating the end of the reactions, the front door was opened and the slag skimmed from the surface of the matte. It ran into cavities scraped in the ground or perhaps into cast iron molds placed in a row, whereby a dozen or more cakes were formed, which after cooling and hardening were removed by hand and cast upon the dump, excepting the

cake nearest the furnace, which contained in general too much matte or ore particles to allow of its being thrown away. This cake was usually broken up and returned to the furnace. The matte, cast in similar cakes, was also taken away, to be subjected to further treatment by roasting and re-smelting. All this involved much hand labor. The furnace, now empty, invariably needed repairing, especially the material of the hearth and sides, which, due to erosion caused by the contact with the melting ore, commonly of a nature to unite with the material of the firebrick and sand, was usually much eaten into in spots. I may say here that the matte, in Swansea practice, was usually granulated by being allowed to run molten into water, which breaks it up into minute granules. The object is to save the expense of crushing previous to roasting, the operation next in line. Matte and slag both granulate freely in water, but are somewhat difficult to dry afterward. For this and for other reasons, in particular the danger of the operation, the granulation of matte is not commonly practised.

Accumulation of Matte

The first improvement of significance consisted in allowing the matte to accumulate on the hearth during the smelting of several charges, instead of tapping it out after every charge. This was first done at Black Hawk, where the ores were of such a character as to give rise to but a small proportion of matte. Here the tapping took place but once a week, as a rule, and the matte was very rich in the precious metals. It was discovered in this way that the hearth was better protected from corrosion, having the large body of matte over it by which air was excluded, and furthermore the charges were more easily spread, in fact they spread themselves mainly, as when dumped upon the molten bath they had a strong tendency to float outward to the borders of the hearth. This discovery led to another improvement, that of feeding the furnace from hoppers placed above the arch or roof, whereby the whole charge could be quickly introduced, without the opening of the side door, and consequently without the loss of heat and time attending the usual operation of shoveling the charge in. The hoppers were not a new thing, having been used before, but their appropriateness was much enhanced when it became the practice to feed the ore upon a bed of matte. Fine material, when charged in this way, requires no spreading with tools. The pile of ore, without touching the bottom, subsides rather quickly and within a short time forms a layer over the liquid surface and receives heat, as reflection will show, both from above and below. The radiant heat of the burning gases above affords the most, but a considerable reserve of heat in the matte is given up to the ore above; the result being to fuse the charge much more quickly than if spread upon a comparatively cold hearth. The saving of time is, therefore, considerable. Herein lies the advantage of the mod-

ern method of charging from hoppers as distinguished from side charging. The economy of labor is equally apparent. The lengthening of furnace hearths, which began with Argo practice, Argo being the successor of Black Hawk, spread from there to Anaconda and then to the rest of America. Pearce's largest furnace had a length of 35 ft., which was considered enormous for those days, but structures of more than three times that length are the fashion now, and one seldom hears of a new reverberatory less than 100 ft. long. The favorite size is 19 by 119 ft., dimensions reached in Anaconda practice but imitated almost slavishly, as if there were especial virtue in those figures. It will be noticed that the increase in width of hearth does not keep up with length; in fact, the width remaining almost stationary; or, more explicitly, it has increased only to double that of the Swansea type of furnace, while the length has increased no less than eight times. One of the principal reasons for this lies in the difficulty of supporting an arch of greater span, the limit having apparently been reached in the neighborhood of 20 ft., while, of course, no difficulties are encountered in increasing the length.

Matting Furnaces

Reverberatory matting furnaces perform two principal functions, namely, the fusion of the materials and the separation of the two molten products, the matte and the slag. These take place coincidentally to a great extent, but it is found that a considerable quantity of matte, in the form of fine drops termed 'prills', remains in suspension even in very fluid slag for quite a time, requiring for complete separation that the substances remain in the liquid condition throughout. To effect this, it would be quite feasible to attach a settling hearth to the furnace, as is done in blast-furnace matting, in which the mixture would have an opportunity to separate, or to provide a second furnace, kept hot by its own fire, into which the fused material could be tapped, and in which the separation could go on slowly. Either method would improve the percentage of extraction, and by shortening the cycle of the primary furnace, would conduce to more rapid running. But the same end is achieved by merely lengthening the hearth, giving ample opportunity both for fusion and separation. These long furnaces are virtually combinations of furnace and settling basin, the interior space not being given up wholly to the smelting, but a good part of the length being reserved for the separation. The part devoted to fusion, being that next to the firebox, is about one-third of the length. Upon this the ore is charged; after melting, it flows toward the other or flue end, and, still remaining at the fusion temperature, finds ample opportunity for the subsidence of the matte particles and for the conclusion of the reactions upon which the success of the work depends. There is opportunity also for the complete intermingling of the slag, which thereby attains a degree of homogeneity

not found in the product of the older furnaces. 'Floaters,' which are undecomposed silicious remnants of the charge, are formed in the modern reverberatories as they were in the ancient ones, but they have more ample opportunity to dissolve and mingle with the slag, which they will do if there be unsaturated bases to combine with.

The type of slag made in the modern reverberatory is perforce of a fusible kind, neither very acid nor very basic, but best described as neutral. It does not differ in the balance of its constituents from ordinary blast-furnace slags. The great capacity of the modern reverberatory, reaching into hundreds of tons daily, demands special and effective methods of getting rid of the slag formed in such vast quantities. The antique practice of charging, hit or miss, anything that would melt, wholly or partly, into a heterogeneous and oftentimes viscous slag, which was either skimmed or dragged from the furnace, according as to whether it was melted or only floated, is inapplicable to modern works, which demands an entirely liquid product, capable of flowing out of the furnace without being urged by the tool. Those silicious slags represented in Swansea practice, one-third of which was composed of unmelted fragments of quartz, could only be removed from a furnace by manual force, and could not be handled on a large scale at all. To get 300 or even 100 tons of such stuff out of a furnace would require that the skimming door be kept open all the time. Such proceedings have given way to the practice of calculating the composition of the slag as closely as is done in blast-furnace work, keeping the silica and bases in proper proportion to form a fusible and not too dense a slag, which flows out readily when the door is open, and leaves the hearth clear in ten or fifteen minutes, without the use of tools. Here, also, is a great saving, the labor account being much diminished beyond former practice.

Movement of Slag

It will be observed that the movement of the slag within the furnace is in the main from the firebridge to the skimming door at the other end of the structure. In order to utilize the full length of the hearth for the purposes indicated, the furnace must be skimmed at the extreme end, rather than from doors situated upon the side, as was the frequent practice in former days. The matte tap, however, still keeps its place on one side, about midway of the hearth, and the method of tapping and disposing of that substance has not changed appreciably, excepting in the well grounded improvement of keeping a thick bath of the molten stuff upon the hearth, to buoy up the fresh charge. From this has been evolved the practice of tapping only a comparatively small portion at once, the aim being to preserve a certain depth at all times. The slag need not be cleanly skimmed at any time, since the retention of a thin layer to receive the fresh charge is not at all prejudicial to the process. In

fact, the aim generally is to keep the liquid surface at approximately the same height at all times, thus avoiding unnecessary exposure of the brickwork to the heat and the fluxing action of the charge.

Hearth Foundations

The vault beneath the hearth, once deemed indispensable, has been given up, and reverberatories are now universally built with solid bottoms. The cooling effect of the open space, designed to prevent the penetration of the matte, has been proved prejudicial, since it involves a considerable loss of heat from that part which needs it most, namely, the hearth, and the temporary loss of metal cuts no great figure in large operations. The hearths are now invariably made of sand as formerly, the brick bottoms advocated some years since not having attained extensive use. Perhaps as much improvement has been made in materials as in forms of construction. The chemistry of brick-making is now thoroughly understood, and there is no reliance upon rule of thumb. The composition of the materials for different uses, as of silica brick for the arch, neutral ones for the inwalls, and silica sand for the hearth, have received ample consideration, with the result that almost all of the bugbears of the former age have been killed off and smelting reduced to a science. Further, the application of chemistry to the composition of the charges and of the refractory materials composing the furnace itself has brought about and maintained such conditions that the structure has become much more durable. It was formerly taken for granted that the interior surfaces in contact with the slag had necessarily to be eaten away, the waste being supplied by the copious and regular introduction of the so-called 'fettling', which is a loose aggregate of silicious stuff, as clay and quartz, whose application was a regular and laborious duty. By controlling the composition of the slag, and especially by the use of the right brick in the inwalls, this necessity has largely disappeared, and now we find furnaces running regularly which require repairs only once a month or even less often. This tends very much to economy in running. By thus obviating the causes of delay, the economy of the process has been largely increased.

Innumerable persons, perhaps visiting a smelting works for the first time, and taking note of the intensity of the heat at the flue, or even perceiving signs of fusion of the brick lining of the smokestack itself, accompanied perhaps by flames issuing from the top, many feet away, have inferred a great and unnecessary waste of heat and fuel. I have heard suggestions as to the lengthening or enlarging of the hearth, based on this idea, but although there is a waste of heat, it is not an unnecessary waste. The reason is that the whole working space within the furnace has to be kept at practically the same temperature throughout, in order to do the work of smelting and to keep the slag fluid at all points. Were the flue end of the

hearth appreciably cooler than the vicinity of the bridge, the process could not go on in a practical manner, for the slag would cool within the furnace and cease to flow. It will appear from this that the exit gases, which are necessarily as hot as the interior, must escape into the flue at the full temperature of the furnace and its contents, involving a loss of heat roughly estimated at one-half that due to the combustion of the fuel. One may therefore look upon the reverberatory as a wasteful agent which must lose in the flue alone one-half of the original heat of combustion. By the interposition of regenerators or waste-heat boilers in the flues, the loss of heat is much reduced. The former of these expedients, designed to heat the air for combustion, has not been successful, owing to the clogging of the checkerwork by the dust carried over by the gases; but the latter has achieved great and immediate success, and much power, estimated at above two horse-power for each ton of charge smelted daily, is returned by the steam plant, which, owing to the regularity of the furnace work and the consequent evenness of temperature of the exit gases, runs with as much smoothness as could be desired.

The Firebox

The firebox of a big modern coal-burning reverberatory is as large as an oil-furnished furnace, firebox, hearth, and all. It burns, of course, a great deal of fuel, but it smelts more ore with the same weight. It may smelt, say, 240 tons of charge with 60 of coal, while the older furnace smelted perhaps 15 tons with 6 of coal. This points to the tremendous saving of over one-third of the fuel cost. Furthermore, as the custom nowadays is to utilize the waste heat by interposing the steam boilers in the flues, whereby about half of the heat value of the original fuel is conserved, it is easy to see that the new style reverberatory is a most economical apparatus, beyond comparison with its predecessors. So far as I am aware, the high-water mark of capacity has been reached at Steptoe, Nevada, a single oil-fired reverberatory there having put through, according to the manager's statement, no less than 660 tons of material in one day of 24 hours. A portion of this consisted of hot calcines, another of cold ore, another of molten converter slag, etc. Contrast this with the former habit of charging 10 to 15 tons per day. But, of course, the old furnaces were devoid of facilities for charging either hot ore or molten slag; so the comparison is not so severely against them.

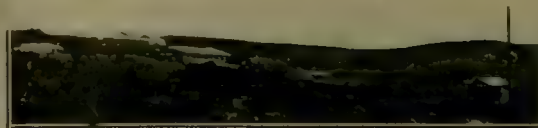
The crude method of casting the slag in sand molds near the furnace has been supplanted by the use of the granulating stream, and by the almost equally economical means of large railway pots, by either of which it may be removed with dispatch to comparatively distant dumps at slight cost. If one considers the means now employed, it will be confessed that the reverberatory practice of today has reached apparent perfection almost in every conceivable direc-

tion. There is certainly but small opportunity for new progress in this department of metallurgy unless the waste heat held by the slags at the the moment of skimming be excepted. These carry off, as has been amply demonstrated, an amount of heat which, were it to be saved, would suffice, for example, to heat the incoming air for the firebox to several hundred degrees, and thus serve an important purpose, saving a considerable proportion of the fuel. The method is patented; and the royalties demanded, though very small, have kept it from use thus far, although it is highly probable that on the expiration of the patents it will be adopted by several concerns that have made elaborate inquiries as to its adaptability to their conditions. Notwithstanding the preëminent success of the long reverberatory in the United States, the fashion has not yet spread to foreign shores, and we hear of the construction in various regions outside of our own country of short-hearthed furnaces of the reverberatory form. This conservatism is well illustrated by the building of the two furnaces at the now well known Messina copper mine, in the Transvaal, South Africa.*

Reverberatories at Messina

The directors of the Messina property seem to have approached the metallurgical subject with extraordinary timidity, considering the apparently favorable conditions surrounding their undertaking. Some British companies seem to enjoy working out the details from the beginning of a process, as if they were the first in the field, preferring to ignore the results and practice achieved by previous workers. Contrary to the general impression among metallurgists that the initial steps in the introduction of a smelting or other process are painful, some of our friends across the water appear to revel in the trying and fitting stage, possibly under the impression that the ground was never trodden before. American metallurgists, and no doubt many foreign ones also, will smile at the installation of "a pair of 23-ft. reverberatories," and more broadly at the production of a 50% matte in one operation, leaving 1.5% copper in the slags. But what will they say to shipping a 40% concentrate out from the heart of Africa, along with the aforesaid matte? And by what sort of legerdemain do the Messina metallurgists achieve "10 to 15% jig middlings"?

An immense amount of detail has been gathered about the apparently simple methods and apparatus of reverberatory smelting, and this brief article might be expanded to a portly volume without entirely exhausting the subject. The chemistry of the reactions; the scope of usefulness, the comparative advantages of the blast-furnace and reverberatory; the consideration of draft; the utilization of the waste heat, and the style of boilers best adapted thereto; and many other matters of importance in this inquiry might receive useful consideration.



SOPA DIAMOND MINES.

Diamond Mining in Brazil

Diamond-mining in Brazil is an ancient industry. The methods employed are said to be the same in many particulars as in 1700 when the work began. We present herewith a number of pictures illustrating the simplicity of equipment and methods that are still in vogue, furnished through the courtesy of William O. Taylor, of the Diamond King Mining Co. at Diamantina, Minas Geraes. The native method of work consists of open-pit digging, and concentration by hand in the *batea*, the sharp-pointed pan of Brazil, which is often, at least, made of wood. Where necessary and possible, the overburden is washed off by diverting water from the stream in ditches. The gravel is first concentrated in *baca*, losing thereby the fine gold and possibly some of the diamonds, and then re-concentrated in large wooden *bateas*.

Not all the work is so primitive. The Sopa Diamond Mines, Ltd., as will be seen, from the picture above, employs a more expensive plant and brings the diamond-bearing earth to it by means of side-dumping cars hauled by a Best steam tractor. This Company operates about six miles west of Diamantina, Minas Geraes. It is an English concern organized in February 1911 to acquire and operate properties, water rights, and mineral lands comprising a total of 3428 acres.

The Diamond King Mining Company has had a dredge in operation at Mendanha since 1907, dredging for gold and diamonds. The sand and gravel from the gold tables is passed to a revolving screen and then to jigs where the diamonds are recovered. The great part of the Brazilian diamond production is obtained by native labor who work as lessees on a royalty basis, the property owners purchasing the diamonds from the natives. As a producer of black diamonds, or 'carbons' as they are more commonly called, Brazil ranks first and an ever increasing demand makes the outlook of the industry most encouraging. While the gems are found to some extent in Brazil, the production is of a very secondary importance to that of the 'carbons'. During 1912 the total diamond import of the United States was valued at \$41,363,325.

Various attempts have been made to interest North Americans in the Brazilian diamond fields, and there are a number of companies that are controlled in the United States. For one reason or another, the business has not as yet achieved brilliant success, though the finding of a gem stone weighing 246.4 lb., as reported, would seem to warrant even large expectations.

*Mining and Scientific Press, February 14, 1914.



1. NATIVE METHOD OF WASHING GRAVEL.

2. WORKING A SMALL BENCH 10 FT. ABOVE THE RIVER.

3. WASHING GOLD AND DIAMONDS IN A BACU.

4. RE-TREATING BACU CONCENTRATE IN BATEA.

5. WASHING CONCENTRATE IN A BATEA.

6. THE SMALL PILE OF GRAVEL, LESS THAN $\frac{1}{2}$ CU. YD., YIELDED THREE DIAMONDS AND SOME GOLD.

Ore Transport in Rand Mines

The transport of ore underground in Rand mines has received considerable attention, and at several of the mines there has been a notable improvement in this work, according to John Munro, the retiring president of the Chamber of Mines. The tendency now at many properties is to use heavier tracks and larger cars, and to pay more attention to the upkeep of this equipment than has been the case hitherto. A great deal of time, labor, and money has been wasted in the past. In the mines of one group, the total cost of shoveling and tramping has varied from 34 to 72c. per ton handled, according to conditions. In the last three years, although many improvements have been effected in regard to ore-handling methods, there has been no diminution of cost, and the obvious explanation is that the economy resulting from better practice has been absorbed by the burden of extraneous expenditure. There is, of course, plenty of scope for economy in regard to this department of mining on the Rand, as indeed there is scope for economy in every branch, and under more favorable conditions charges in connection with ore handling should be substantially reduced.

The driving of main-haulage levels, and concentration of underground transport operations is an important factor in securing better underground ore transport conditions. At a number of the larger mines of the Rand these main haulage-levels are being driven right across the properties concerned along the strike of the 'reef' from one boundary to another. As a few examples of mines possessed of these main haulage levels, may be mentioned a few subsidiaries of the Central Mining & Investment Corporation. The Crown Mines has, for instance, the No. 13 level driven across a considerable portion of that property and equipped with electric locomotives. Below this, No. 16 has also been laid out as a main haulage-level. The Village Deep, City Deep, and Modderfontein B, among other companies, have also well equipped main haulage drifts. Main haulage levels are, of course, not practicable or economical in all mines. Where the width of the property from east to west is small, or where the dip is very steep, main haulage drifts would have little to be said in their favor. The value of levels of this nature depends on the extent of operations and the quantity of ore that can be concentrated on them. The life of the mine which it is proposed to equip in this manner is obviously another material consideration.

It is interesting to note the various methods of ore transport underground as practised on the Main Reef series. Hand tramping need not be discussed, which naturally obtains along levels not specially widened and equipped as main haulages. One of the most modern underground ore transport equipments in the world

is that possessed by the Crown Mines company on the No. 13 level. This level will eventually be about three miles in length, and it is 14½ ft. wide and 9 ft. high. The permanent way is laid with 45-lb. flat-bottom rails. Twelve-ton cars, with a maximum of eight in a train, are used for the conveyance of the ore. The employment of these large capacity trucks has proved so far a success. Their adoption and the method of running have resulted in a large saving of time and labor in loading and discharging, and in maintenance charges, which would have been incurred had small side-tipping cars or fixed well-bottom cars been used. They are of novel design, being of the side-discharge saddle type, mounted on four-wheel bogies, with buffer draw-bar attached to the bogie frame, instead of to the main body frame as usual. The cars are drawn by 100-hp. electric mining locomotives at a speed of 10 miles per hour. These locomotives weigh eight tons each and have two motors, which may be run in series or in multiple, thus giving two speeds without resistance losses. They are capable of exerting a draw-bar pull of 3200 lb. The current for the locomotives is furnished by two motor-generator sets, each consisting of 250-kw., 500-volt, compound-wound generator, direct coupled to a 2000-volt motor. These sets are placed in the pump chamber at No. 13 level, and will ultimately furnish current for No. 16 and 19 main levels, in addition to that now used on the No. 13 level.

In the western part of this great property, petrol locomotion is employed. On the first level drift of the Langlaagte Deep, locomotives of 16 to 25 hp. are installed. These pull 30 tons per trip in 3-ton saddle-back cars. Other methods of mechanical transport in use are endless-rope and tail-rope haulages. Animal transport is employed on the City Deep, and at the Modderfontein B both animal and tail-rope haulages are in use. The foregoing will serve briefly to show how much heed is today being given on the Rand to a branch of mining work which in the past was largely neglected. One is certainly justified in looking for some reduction in working expenses in this direction in the near future.

The probable tonnage that will pass through the Panama canal has been estimated as follows by experts for the French government:

	1915. Tons.	1925. Tons.
Westward movement	919,000	1,160,000
Eastward movement	746,000	941,000
Total	1,665,000	2,101,000
M. Douvry estimates for 1915 a total of 1,858,903 tons.		

The estimated population of the United States is 98,781,324, against 91,972,266 at April 15, 1910. With all of its possessions, the United States has a population of 109,000,000, according to the Bureau of the Census.

*Abstract from *The South African Mining Journal*.

Industrial Hygiene as Practised at Palmerton, Pennsylvania

By JOHN W. LUTHER

The fact that this Institute of Mining Engineers has invited us to address you on hygiene this evening I consider extremely significant, indicative of this time of social progress. Twenty-five years ago such a thing would have been an impossibility. Human life has, until quite recently, been held cheap, while material things have had a distinct value in all ages. A machine which has some intrinsic value has always been most thoughtfully selected and tenderly cared for; but what about the poor human machine? If old and disabled from accident or disease incident to his occupation or not, he could be discarded without pecuniary loss and a new human machine substituted. But this is no longer possible, profitable, or desirable.

The discovery of the cause of a great many diseases, through the remarkable advances in the study of bacteriology, has in a great many instances led to prevention and in some cases cure. This has led men of an inquiring mind to investigate practically all diseases resulting in the discovery of cause, and prevention in many of them. The known occupational diseases fell in the class that was investigated, and many of them were found to be preventable.

Government Control of Sanitation

Both federal and state governments looked into the unsanitary conditions in work-shops. The American Association for Labor Legislation sprang into existence, and now every state and the federal government have passed laws governing the sanitary conditions under which labor is to be performed. These investigations by the governments and individuals have done more, however. They have shown that almost every occupation has its peculiar pathology, or that certain diseases are more prone to occur there than in other occupations. The morbidity and mortality rate for tuberculosis is far higher in clerks than in farmers; in pottery men than in furnacemen; in brief in those whose work is light and confining than in those doing heavy work in the open. Certain occupations are classed as dangerous in consequence of attracting a class of workmen who may be peculiarly susceptible to disease. Hence the importance of examining every employee before he is employed to see that he is placed at work which he is physically fit to perform with the least possible detriment to his own well being. If this were carried out universally I believe the stigma of occupational disease would be removed from many occupations.

An outcome of legislation regulating the sanitary conditions of work shops has been the factory inspector. This is a good thing, for he helps those who

want to help their workmen, and forces into line those who do not. Another good result is the reporting of all cases of accidents and occupational disease and compilation of accurate statistics. But here a difficulty arises. Just what is an occupational disease?

Compensation and Liability Laws

The American Association for Labor Legislation is waging a most active and successful campaign to secure the enactment of a model bill by all states not already provided with similar legislation. Their bill, the Kern-McGilliendy (H. R. 14994), they are endeavoring to have passed by Congress to apply to all civilian employees of the federal government. It differs from many bills in that it provides compensation for occupational diseases as well as for injuries. It reduces the waiting time to 3 days instead of 15. It provides 66 $\frac{2}{3}$ % of regular pay for disabled workers during the period of their disability. It provides reasonable benefits for widows, children, and a limited class of other dependents.

The first thought of the employer is, how can I protect myself? How better than by sanitation, safety devices, and physical examination of all employees to determine the physical soundness of all of them. The ultimate outcome will be that instead of being employed and doing what they can, many will be debarred from work and will fall upon the taxpayer for support.

Physical Examination

Physical examination is one of the employer's defenses against compensation legislation, for without it great advantage may be taken of the employer by a workman demanding compensation for a pathological condition which may have existed before his employment. Hernia is a notable example of this. Having been examined before employment, each man placed in a position to counteract an occupational disease should be inspected monthly. This inspection should be directed toward the determination of the existence or absence of the disease peculiar to the occupation. In addition, each employee should be subjected to a semi-annual examination which should be fairly thorough.

By this method the development of almost any occupational disease can be discovered in its incipency and the man transferred to another part of the plant to prevent its advance and in a great many instances, perhaps, effect a cure. In addition to the eradication or diminution of occupational diseases, a record is made by means of which can be seen at a glance whether or not the man is fitted to the work for which he is employed. If not, he can be transferred to other work. Adopting this policy, the New Jersey Zinc Co. keeps

*Abstract of an address delivered before the New York section, Amer. Inst. Min. Eng., April 22, 1914.

its men in the highest degree of physical fitness and accordingly increases their efficiency. I think this will be found to be true in the quantity and quality of output, the returns for which will more than pay the cost. In addition to this there will be less lost time, the men will be more contented at work, consequently labor troubles will diminish, and it is natural to suppose that the influence of cleanliness, general hygiene, and physical care at work will be felt at home.

In connection with this might be mentioned our method of handling the sick and injured. Any man hurt or taken ill on the plant is referred to our emergency hospital, where he is given first-aid treatment and then referred to the hospital. This man cannot return to work until given a written release by the surgeon, who states whether he can resume his usual work or should be given light employment. Any man who reports off on account of sickness is reported to our district nurse, who looks him up and reports on his condition. Before this man returns to work the physician in attendance must fill out a form giving the diagnosis of the case. This is sent with the man to the surgeon, who releases him and allows him to return to work. By this means we try to overcome malingering.

Value of Coöperation

There is one important point in all sanitary, safety, and welfare work which must not be forgotten. That is, that to carry out effectively any plans it is essential to secure the coöperation of the men. How can this be better assured than by educating them? This can be accomplished by health talks, illustrated lectures, distribution of health pamphlets, training of the first-aid squad, and by the use of Tolman's "Hygiene for the Worker" (American Book Co., New York). Our first-aid squad makes regular tours of inspection of the plant, reporting not only unsafe places, but notes what they may consider to be unsanitary conditions.

Cleanliness is essential everywhere and is, to my mind, the keynote of sanitation. Infection of wounds is reduced to a minimum by first-aid treatment. Dust, fumes, gases, and vapors are cured for by adequate ventilation, and by hoods. In such places as the bag-room and the packing house of the oxide department, where the dust cannot be removed by any means, the men are required to wear respirators. The ordinary cover respirator is used, though one of our men is working on one which will far exceed this in efficiency, while a large part of the objectionable features will be done away with. Clean sponges are provided and given to the men whenever they want them and every respirator is sterilized by soaking in carbolic acid, 1 to 40, for an hour and then thoroughly washed every week, or more frequently, if necessary. I often hear the remarks, "We cannot get our men to wear respirators," and until I visited the Palmerton plant I supposed this to be true. They demonstrated to me con-

clusively that it can be done; that men will wear them if the fact that they must, that failure to comply means immediate dismissal, is impressed upon them when they are employed. Success or failure here depends on the atmosphere created by the men above. Respirators at their best are dirty, warm, uncomfortable, and not wholly efficient, so any improvement will be welcome. The present respirators when not in use, before being transferred to another man, should be kept in an atmosphere of formaldehyde for at least 24 hours, then washed in weak ammonia solution and aired, and clean sponges and rubber straps supplied. This treatment will not only sterilize them, but will prevent the rapid deterioration of the rubber and will not harm the metal parts.

Zinc Poisoning

Is zinc poisonous? We maintain that it is not. For over six years I have been surgeon to the largest zinc plant in the world, and I have yet to see a case that even approximated a metallic poisoning. On questioning some of our old hands as to their knowledge of zinc poisoning, some of them will admit to having had acute attacks in the old days, but not recently. The symptoms described by them resemble carbon-monoxide poisoning rather than the so-called 'zinc-shakes' associated with the brass founder's trade.

Sir Thomas Oliver, the greatest living authority on occupational diseases, states that zinc is non-toxic and claims that "animals exposed to oxide of zinc in the form of dust or who received it in their food over a length of time" showed no signs of poisoning. This we have ourselves confirmed. In his visits to the large smelting works at Bleiberg, Belgium, he could not find any evidence of ill health among the workmen traceable to the zinc itself. Rambousek, professor of factory hygiene, and Chief State Health Officer, Prague, and many others state that "industrial poisoning from zinc is unknown. The chronic zinc poisoning among spelter workers described by Schloekow with nervous symptoms is undoubtedly to be attributed to lead."

Brass Founders Sickness

As regards the 'spelter-shakes' or 'brass founders sickness' already mentioned, the balance of the evidence appears to be in favor of copper being the main, if not the only cause of the trouble. As stated before, this particular sickness does not occur in spelter workers, and my own experience shows it to be non-existent at the Palmerton plant.

In our oxide department the men live in the atmosphere of zinc. They inhale it, eat, and absorb it through the skin. The only effect I have found is a drying of the nasal mucous membranes and a tendency to develop bronchitis, though pneumonia among them is very rare. For this reason the use of respirators is insisted on. It must be remembered that this product contains no lead.

There is a tendency among all workmen to attribute any indisposition to their employment. Workers in

the oxide bag-room and packing house show this disposition. I have gone carefully over the records for the past six years and find that gastro-intestinal discomfort occurs with almost equal frequency in all departments, including the shops, but only in the oxide department is it attributed to zinc. In the spelter department, where zinc poisoning would be more likely to occur, owing to the vaporization of the metal, zinc is never given the credit. Here it is attributed to carbon monoxide.

Carbon Monoxide Poisoning

Acute cases of carbon monoxide poisoning do occur occasionally on our plants in both the spelter and spiegle departments, and it does not seem possible to absolutely prevent it. Leaky pipes in the spelter department and the escape of gas during the cleaning of dust catchers in the spiegle department seem to be responsible. Since January 1913 we have had 55 cases of carbon monoxide poisoning, but only a few were sufficiently severe to actually require the pulmotor, and in most of these it was used for the administration of oxygen and not because of suspended respiration. Only once during my connection with the plant was it necessary to remove the man to the hospital to perform venesection before he regained consciousness, and he was an alcoholic. In the history of the plant only one death from gas is recorded and this was due to carelessness on the part of the attendants.

The gas being odorless and colorless, a man may be overcome before he has time to realize his danger. The greatest care must be exercised to avoid leaks, but at times they will occur, notwithstanding the greatest vigilance. Our first-aid squad is regularly drilled in the treatment of these cases. Recently we inaugurated a definite system of gradually drilling the employees in this work. Our active squad in actual training consists of eight men under the leadership of our safety inspector, who devotes his entire time to this work. Every two weeks two of the men leave this squad and two new men come on, so each man serves eight weeks. The men are as equally divided as possible among the various departments. We now have 60 men scattered throughout the works who have served their time and who are entitled to wear our safety button. In case of a carbon monoxide poisoning, one or more of these men are sure to be nearby and immediately starts artificial respiration until the pulmotor can be secured. This is used in all cases. The surgeon on the plant is always summoned, but only twice in the past year has he arrived on the scene before the First Aid squad succeeded in reviving the patient.

Drinking Fountains

After guarding the men against the risk of occupational disease, they must be protected against the danger of contracting disease from their fellow workmen. For this purpose sanitary drinking fountains are installed. Our industrial water supply is not pure, at

all outlets from these mains, therefore signs are posted prohibiting its use. The drinking water is of a good temperature, so the use of ice is forbidden and intestinal colic has been almost eliminated.

Of the greatest importance are the change houses and toilets. We have been working for some months on the plans of what we consider an ideal change house and have finally adopted it as a standard. In it we have made some radical changes. It is arranged so as to be readily connected by covered passage or directly with the shop for which it is intended, as is required by the Pennsylvania law for foundries. Just inside the door is a battery of toilets. The ordinary toilets are poor affairs at their best, and are difficult to keep clean, and many men will refuse to use them for fear of infection. To obviate these objections a toilet has been selected which cannot be used as a seat, doing away with the obvious objections. These toilets are separated one from the other by metal screens painted white.

Change Houses

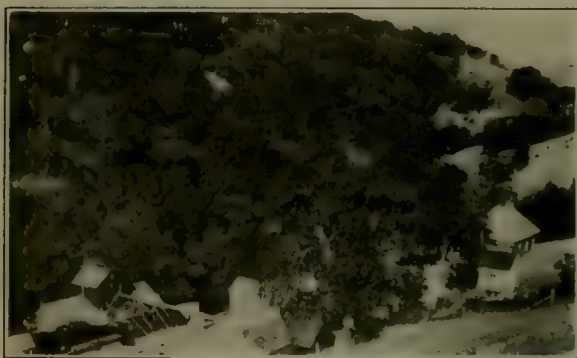
Just beyond the toilet and separated from it by double swing doors is the change house proper. Here are benches arranged in parallel rows and elevated the usual distance from the floor on enameled pipe legs with aisles sufficiently wide to enable men on opposite sides to change their clothing without entirely obstructing the aisle. The actual distance from the centre of one bench to the centre of another is 10 ft. and each man is allowed 2 ft. on a bench, giving him 10 sq. ft. for his own use. Instead of the usual locker we have substituted a woven wire basket fastened to an endless wire cable which runs between the back of the bench and the ceiling. The basket provides accommodations for a lunch can, and on the under surface are attached 4 hooks, one from each corner, on which the clothing is hung. This being elevated from the ceiling, the warmest part of the room, the clothing dries quickly and all odors arising from them are carried out through the monitor on the roof. They are elevated sufficiently to prevent the possibility of anyone passing underneath touching them. They are so arranged that each man can lock his basket in position. In lowering it, it drops in front of his bench at proper height for him to comfortably reach his clothing and yet sufficiently far away from the bench to enable him to clothe himself readily. The opposite end of the room is provided with ample shower baths, sufficient to take care of the number of men provided for in the change house. This plan provides for 60 men and one shower is provided for every ten men. At the other side at the end of this room are the wash troughs. The individual basin has been done away with and the space given up to an enameled trough with tempered water running continuously from a pipe above. Water is tempered from one end so that there is no possibility of the men scalding themselves. In addition to the tempered water, a cold water pipe is also provided. The wash trough is

so placed that a man standing at one spot can see that every man has washed his hands and face thoroughly before passing through a double swing door, a covered passageway, another double swing door into the lunch room. This is of importance where leaded ores are worked, but in Palmerton, where at present no lead is contained in the ores handled, it is of but little importance. In the lunch room ample table and bench space is provided for each man. Should it be necessary to conserve ground space, the covered passage way can readily be connected with a checking station at the gate of the plant, so that if necessary it again can be seen that the men thoroughly wash themselves before going home; this is not only important, but required in certain states where leaded ore is handled. The floor is made of concrete, the shower bath and wash trough space is covered with wooden slats so that the men do not have to walk on the cold floor in bathing.

Ore Occurrence at the Cloverdale Mine

By LEROY A. PALMER

The Cloverdale mine, in Sonoma county, California, presents an occurrence of quicksilver ore that is of interest in that it is not found in veins, but as disseminations through a quartzite matrix. The mine is situated about 12 miles east of the town of Cloverdale and has been operated for the past 40 years.



THE CLOVERDALE MINE.

the total production of quicksilver therefrom being valued at about \$400,000. Refining is conducted in a furnace on the ground. Several adits have been driven into the steep hillside, a shaft sunk, and a haulage system, including two balanced gravity planes, has been installed. The ore treated averages about 10 lb. of mercury per ton.

The cinnabar, which is the form in which the mercury occurs, is found in the quartzite which forms the upper portion of a hill which rises steeply on the north side of Sulphur creek. The general age of the formation is about Jurassic, and the hill consists of a coarse-grained friable sandstone and the quartzite, the latter overlying the sandstone with apparent un-

The walls are of hollow tile cemented on both sides. The advantage of having the lunch room entirely separate from the change room is obvious. Odors from the wash room are bound to arise, and by this method they are kept out of the lunch room. Where leaded ores are handled and it is necessary to supply working clothing and towels, a supply closet for these materials can readily be built in at one end.

The results of our efforts in the conservation of human life and limb are perhaps best shown by the fact that, among an average of 2000 employees since January 1908, we have had but 9 deaths that could in any way be attributed to occupation; 2 from heart disease that might have been avoided had the men been examined before employment, 4 in consequence of violating rules and disregarding safety devices, 1 from thermic fever, 1 from delirium tremens precipitated by a burn, and 1 from the result of a faulty machine.

conformity. The difference in the hardness of the two rocks produces such an effect on the erosion of the hill that the approximate contact can readily be traced from the topography. The quartzite is many colored and often shows extensive mineralization.

The strata making up this hill have been subjected to strong lateral pressure, resulting in a series of very abrupt folds, the axes of which have general northerly and southerly strikes, in which the rocks have been crumpled almost within their own thickness. Where the quartzite has been thus folded the layers have been forced apart and the interstices filled with gray and light-green talc. It is probable that these convolutions are fracture folds, as it is in their vicinity that the cinnabar is found as blotches and disseminated grains in the quartzite; that is, not between layers that have been separated by folding, but in tiny crevices in the quartzite itself. The general appearance of the ore, so far as this feature goes, is very similar to the disseminated copper ores of Bingham and Ely. The folds mentioned are naturally accompanied by many faults, but none of these is prominent. Instances of slickensiding are pronounced.

The source of mineralization is presumably a strong fissure of general easterly strike which has been observed west of the quicksilver deposits and striking toward them, but which has not been opened on the quicksilver ground. It is a notable fact that there are no intrusives which appear to have any connection with the mineralization of the district, the only intrusive near being a dike, presumably monzonite, which is found with northerly strike some distance west of the cinnabar deposits. On top of the hill is a capping of sandstone in which a small amount of the ore has been found as a contact deposit, but it is evident that the real supply is in the quartzite. There is evidence that this will be productive for some time to come, as the mineral seems to be abundant in the vicinity of the folds and there are many of these which are still unexplored.

Graphic Solutions of Certain Compound Interest Problems

By HORACE F. LUNT

The problem of arriving at the value of a mine often takes the following form: The mine may be expected to produce a certain net income for a certain number of years, what is its present value at a given rate of interest? This may be solved by one of the two following formulae for the present value of an annuity of one for n years:

$$(1) \frac{1 - (1 + i)^{-n}}{i} \quad (2) (1 + i)^{-n} \frac{1 - (1 + i)^{-n}}{i}$$

The first is to be used when the annuity is to begin at once, and the second when its beginning is deferred for d years.*

So far as I have been able to ascertain, the published

means of which most of the calculations involved in the solution of these problems may be avoided. Their use may be explained by the following example.

Assume that an examination has shown a mine to contain 1,000,000 tons of ore having a net value of \$3 per ton which can be extracted at the rate of 100,000 tons per year, and that the interest desired is 12½%. From the chart, Fig. 1, it is found that the present value of an annuity of \$1 at 12½% is \$5.50. Multiplying this by 300,000, the annuity the mine will pay, there results \$1,650,000. If the mine is a going concern and profits can be obtained from the start, this represents its present value. If it will be, say, three years before profits begin, the second

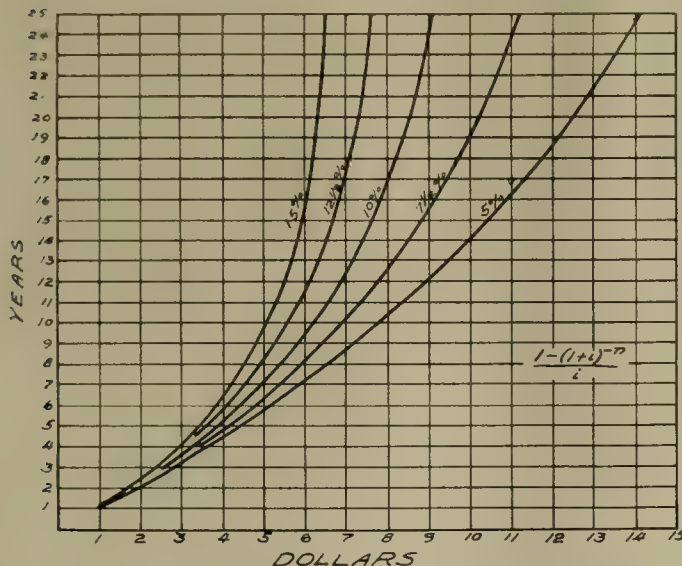


FIG. 1.

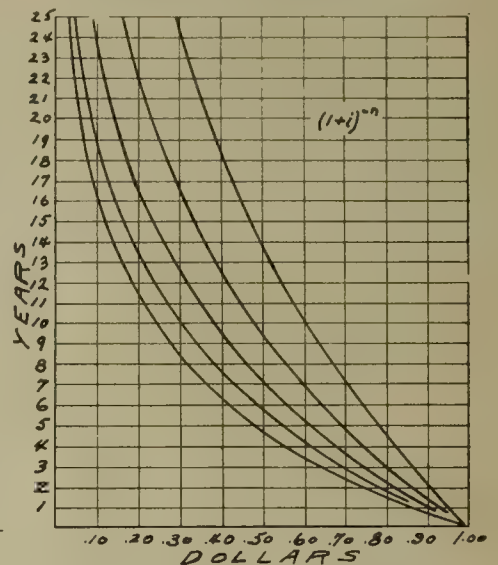


FIG. 2.

tables of compound interest are only for the low rates used by trust companies, savings banks, and so on. As mining investments have to promise returns of 10% or more to be attractive, these tables are seldom of use to the mining engineer. To solve a single problem by one of the above formulae is not much trouble, but when negotiations are in progress and several results are desired in a hurry, the calculations become laborious. To facilitate my own work I have constructed two charts for various rates of interest by

formula must be used. From the chart, Fig. 2, the value of $(1 + i)^{-n}$ is found to be 0.70, and multiplying this by \$1,650,000 I get \$1,115,000 as the present value of the mine. In the latter case it would very likely be necessary to subtract, from the value found by the method given, the cost of improvements that would be necessary before profits began.

This method gives results that are somewhat low, as it is assumed that the interest is compounded annually, whereas in practice dividends are usually paid more often than once a year. Generally, however, this is as accurate as the data on which it is based. If it is desired to be more accurate, exact results can be obtained by taking as i the amount paid at any period and as n the number of periods. In the assumed case, suppose dividends are to be paid quar-

*All problems in compound interest, including sinking funds and present values, depend for their solution on one or more of the six formulae, given below for convenient reference. In these formulae n is equal to the number of years (or periods) and i to the amount of the interest for one year (or period). Care must be taken to give i its correct numerical value: for instance, the value in the first example given, where the rate is 12½% and the period one year, i is equal to 0.125.

terly; then i will be equal to 0.03125 and n will be equal to 40, and by formula (1) the present value of the mine will be \$1,702,500.

(1) The sum which l will amount to in n years is $(1+i)^n$

(2) The present value of l due in n years is $(1+i)^{-n}$

(3) The amount of an annuity of l in n years is $\frac{(1+i)^n - 1}{i}$

(4) The present value of an annuity of l for n years is $\frac{l - (1+i)^{-n}}{i}$

(5) The annuity which l will purchase for n years is $\frac{l - (1+i)^{-n}}{i}$

(6) The annuity which will amount to l in n years is $\frac{l(1+i)^n - l}{(1+i)^n - 1}$

Assaying Concentrate and Black Sand for Gold and Platinum

By ANDREW F. CROSSE

*Little has been published on the methods used for estimating the amount of platinum contained in ores and concentrate, etc., but a great deal of work has been conducted on the separation of alluvial platinum, the results of which have been published. Considerably more testing must be done before the best methods can be determined, but this must be paid for by those who would derive benefit from it. The following table shows three methods of assaying black sand, etc., for platinum. Parts of the process are original, and the combination is new.

Elevating Pulp

In deciding upon a suitable scheme for lifting ore pulp in mills, it is necessary that due regard should be paid to two important factors. One of these is the question of the fineness to which the ore has been ground, and the other refers to the height required to elevate. The necessary velocity of vertical flow is in a direct ratio to the coarseness of the ore in the pulp. The specific gravity of the ore also influences the operations in the same way. Hence, where coarse crushing is practised, it is obvious that the cost of elevation of the unground ore must be high, whatever pumping system is adopted. A high velocity is needed to prevent the settlement of gravel in the suction and delivery pipes, and heavy wear and tear is unavoidable. Practically the only type of pump suitable for such work is the centrifugal. In these pumps the economical lift with an ore pulp is limited to about 30 ft. An additional disadvantage resulting from their use lies in the fact that ample gland clearance water at pressure is necessary. This means additional power consumption, and generally an unwelcome dilution of the pulp. As an alternative to the centrifugal pump, the tailing wheel is quite suitable for the elevation of a mill pulp carrying coarsely crushed ore. Although somewhat clumsy in appearance, their cost of upkeep is less than in the case where centrifugal pumps are used. With an ore which is comparatively finely crushed in the batteries, or in tubes after a direct flow from batteries to them, the problem of pulp elevation is simple. Frenier pumps are suitable for lifts up to about 20 ft. or so

METHOD OF ASSAYING BLACK SANDS, ETC., FOR PLATINUM GROUP METALS

J. Gray.		Proposed by C. Toombs.		A. F. Crosse.	
Obtain a lead button and cupel with Ag Residue	To get rid of Pb	Obtain a lead silver button, cupel, Residue	To get rid of Pb	Obtain Pb button, cupel	To get rid of Pb
Treat with hot conc. H_2SO_4	Ag	Treat with HNO_3 aq (1:2.4)	Ag	Add Ag, obtain Ag button and add to melted Cd under fused NaCN giving Alloy of Cd, Ag, Au, Pt, etc.,	Cd, Ag
Dissolve Au, Pt in aq. reg.	Insoluble Pt group metals	Weigh the residue		Treat with HNO_3 aq Residue	
$H_2AuCl_4 + H_2PtCl_6$		Dissolve out Au with 10% aq. reg	Au	Treat with $KHSO_4$ Residue Au and Pt	Rh, Pd
Make alkaline with $NaOHAq$		Residue Pt metals		Dissolve in aq. reg	Os, Ir
Add H_2O_2 filter	Au	Wash, decant, ignite, weigh		Solution H_2AuCl_4 and H_2PtCl_6 Pass SO_2	Au
H_2PtCl_6 Pass H_2S	Pt			Treat filtrate with Mg and HCl	Pt

The value of the lead and zinc* produced at mines in Kansas in 1913 was \$1,343,432, compared with \$1,680,744 in 1912, according to J. P. Dunlop, of the U. S. Geological Survey. In Arkansas the value was \$55,120 in 1913, compared with \$106,014 in 1912.

*Abstract from *Journal of the Chem. Met. & Min. Soc. of S. Africa*.

and an air-lift has an additional advantage over this type of pump in that, besides requiring no gland clearance water, the cost of upkeep is practically nil. For elevations above 20 ft. or so, the three-throw pump of the plunger type is a satisfactory machine if designed properly. Wear and tear is small, the velocity of the pulp is low, and sudden break-downs are few.

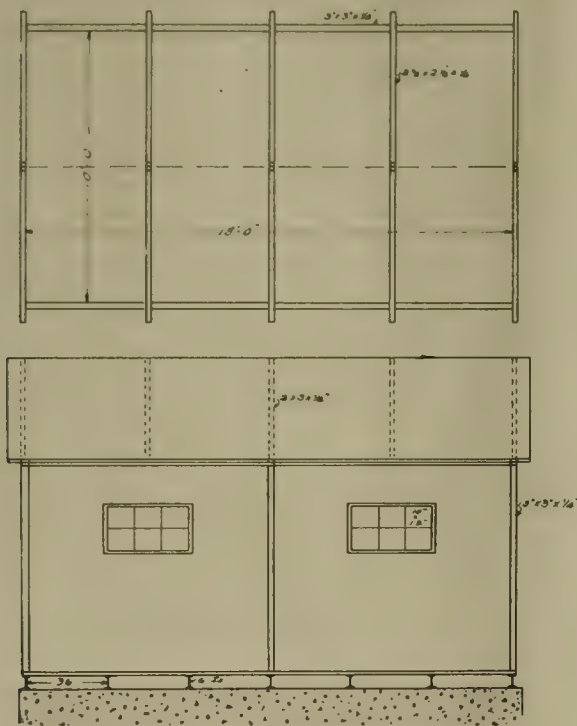
Mine Oil-Houses

By P. B. McDONALD

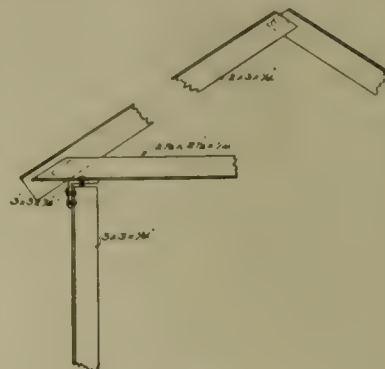
The chief objection to a wooden oil-house is the tendency of wood to soak up oil. Besides being dangerous on account of fire, such a construction is undesirable for many reasons. However, if the oil-house is carefully tended by one man, he can keep a wooden building in good condition by using trays or pans to

found to be a good plan to keep all the oils under the steel floor and pump the oil up into the cans to be filled, then if any is spilled it will drain back. The oil coming to the mine in wooden barrels is placed on the floor of the oil-house and emptied into the steel barrels below. Barrels of grease have to be kept on top with the heads knocked in, but grease never gives much trouble.

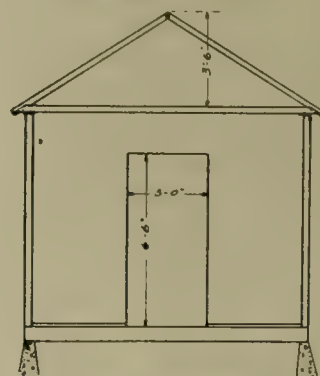
The accompanying sketches show the construction of a steel-frame oil-house. The foundation of this oil-



TRUSSES AND SIDE ELEVATION OF OIL-HOUSE.



DETAIL OF FRAMING.



FRONT ELEVATION.

catch drippings. Usually several men have access to a mine oil-house, and sudden demands for oil for some obdurate rock-drill or tram-car result in oil being spilled. In cold weather when the oil runs slowly, such measures as knocking in the head of the barrel and shoveling the oil into pails have been known. In all cold climates the oil-house should be heated; exhaust steam is a cheap method. Oil-houses fitted with broad shelves are well liked when the oil barrels lie on their side and so inclined as to bring the drainings of the barrel to the front. It pays to buy good faucets for the barrels; the cheaper ones leak and require a pail set under them. A regular molasses spigot is satisfactory for cylinder and engine oil. It is difficult to keep kerosene from leaking with any spigot, and is better handled by a pump. One company in the Lake Superior district, after a thorough investigation, recently drew plans for a standard fire-proof oil-house to be used at all its mines. It was

house is made of concrete, and on the concrete foundation lie seven I-beams 3 ft. apart. The floor is of sheet steel. The columns are made of angle irons, as are the five trusses, which are 5 ft. 3 in. centre to centre. There are four windows. The building in this case was covered with a material bearing the trade name 'Hy-rib.' This material is a combination of light steel wickerwork over which is plastered concrete. There are usually two layers, leaving an air space between. Besides being used for walls, it is sometimes used for floors and roofs. Other materials, such as galvanized sheet iron and special sheetings, are also used. Some special roofings have chicken-coop wire mesh as a framework. The cost of each truss as shown in the sketch, figuring steel at 2c. per pound, is about \$2, making the five trusses cost only \$10 in material. Old, second-hand, light rails can be used to reinforce a concrete roof. This type of oil-house is both fireproof and convenient.

Geological Investigations at the Ivanhoe Mine, at Kalgoorlie

The following notes are from the last annual (1913) report of the general manager of the Ivanhoe company. During the year, J. Malcolm MacLaren was requested to examine and report on the question of the East lode and the influence of the porphyry dike at depth, as disclosed by developments subsequent to his previous examination. This report was submitted in August, and by way of a brief summary of same it may be stated that Mr. MacLaren predicted that the East lode would pass through the porphyry at a vertical depth of 3380 ft., taking the point at Section 8, but while the porphyry zone would be unreliable, it would not necessarily be barren, and profitable ore would probably be opened in places within the same. In order to further test the location of the porphyry dike, a diamond-drill bore-hole was put down from the station at the 2870-ft. level, going east and inclined at an angle of 39°. This bore-hole entered the porphyry at a vertical depth of 3028 ft., and 215 ft. east of the shaft, passing out of same at a vertical depth of 3200 ft. and 6 ft. west of the eastern boundary, thus showing the dike to be 271 ft. wide at the point passed through by the bore. In the bore-hole a vein of mineralized rock was cut in the porphyry at a vertical depth of 3067 ft. and 263 ft. east of the main shaft, showing a width of 8 ft. 9 in., but assays proved 2 ft. having a value of \$2.04 per ton, and the balance traces. This is assumed to be the East lode thrown west, and if this assumption be correct, its position and the location of the eastern boundary of the porphyry would mean an increased depth of approximately 120 ft. before the East lode would pass out of the porphyry, in Section 8, and assume its normal conditions as proved above the influence of the dike.

It is proposed to bore at a similar angle from the station at the 3170-ft. level, when the main shaft reaches that depth, and further prove the dip of the intrusive bar. In order to sink the shaft as rapidly as possible, four men are engaged per shift working two machine-drills, and good progress is being made.

The tonnage of ore estimated to be in reserve at the close of 1913 shows a decrease of 99,433 tons compared with the results for the previous year, and a reduction in value of 25c. per ton. This, in the main, is due to the fact that all the important development work for the year has been on the East lode in the porphyry zone at the lower levels, and although profitable ore was opened in places, it has been considered too unreliable to include in estimations, and a large quantity was unsuitable to treat in reduction works. This necessitated rather heavy withdrawals from the reserves in the upper levels, which have proved most satisfactory and continue to develop to highest expectations. The details of ore reserves down to 2420 ft. are as follows. East lode, 738,365 tons worth \$8 72.

Middle lode, 175,536 tons worth \$10.24; New lode, 53,600 tons worth \$10.68; and Boulder lode, 23,916 tons worth \$14.82 per ton; a total of 991,417 tons, averaging \$9.24 per ton.

World's Production of Lead

By C. E. SIEBENTHAL

The following table shows the world's production of lead apportioned according to source of ore. The figures are those of the Metallgesellschaft, reduced to tons of 2000 lb., except for the United States, for which the figures of the United States Geological Survey are used.

Country.	1911.	1912.
Australia	109,789	118,387
Austria-Hungary	21,605	23,589
Belgium	48,832	62,941
Canada	11,795	17,968
France	26,014	36,376
Germany	177,801	181,880
Great Britain	28,660	31,967
Greece	15,763	15,983
Italy	18,408	22,597
Japan	4,630	4,960
Mexico	137,347	132,276
Russia	1,102	1,102
Spain	193,013	205,799
Sweden	1,213	1,433
Turkey in Asia	13,668	13,779
Other countries	22,597	13,448
United States (domestic refined)	391,995	392,517
Total	1,224,232	1,277,002
U. S. percentage of world's production.	32.0	30.7

Nome Geology

The United States Geological Survey has just published a bulletin (No. 533), describing the geology of the Nome and Grand Central region of Seward Peninsula, Alaska, by Fred H. Moffit. The investigation of the mineral resources of Seward Peninsula by the Survey was begun in 1899, and geologic and topographic surveys have been made at various times since. The present report brings together all the information at hand regarding the occurrence of the auriferous gravels of the area. Much of this information is stated to be of scientific interest only, as many of the rich placers have been worked out. However, a knowledge of their mode of occurrence will be valuable, not only in this but in other regions, in helping to establish the natural laws which determine the distribution of gold in alluvium. As a record of one of the richest placer camps of Alaska, the report will have permanent value; moreover, as has been stated, there still remain many large bodies of gold gravels as yet unworked.

A diamond weighing 229 carats, was recently found by F. J. Van Zyle in the Pniel diggings of the Transvaal. It was slightly yellow, and was sold for \$11,000.

Discussion

Readers of the MINING AND SCIENTIFIC PRESS are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment. Insertion of any contribution is determined by its probable interest to the readers of this journal.

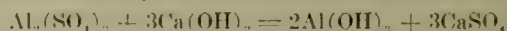
Foaming During Slime Agitation

The Editor:

Sir—In the article, 'Air Agitation by Continuous Method,' published in the *Mining and Scientific Press* of April 4, 1914, Donald F. Irvin mentions the large amount of foam that sometimes collects on the top of the pulp in the agitators at El Tigre. A case of similar foaming that I experienced may prove of interest to cyanide workers. The agitators used were 10 ft. diameter and 20 ft. high; and, like those at El Tigre, the height of the central pipe was only 66% of that of the tank. Continuous agitation was not practised, but the agitators were filled and emptied intermittently. The pulp was kept somewhat low to prevent the foam from going over the top. Mr. Irvin states that the foaming at El Tigre is aggravated by excessive alkalinity, but I found that it was apt to foam with low alkalinity, especially if the alkalinity was low at the beginning of agitation. The addition of lime, as soon as the agitator was charged, would prevent foaming, and, if no lime had been added, and foam was becoming troublesome, the latter would subside after lime had been added. If the alkalinity got too low during the period of agitation, there was always a decrease. I added more lime, but the alkalinity was never high, the idea being to keep it between 0.5 and 1 lb. per ton. The lime was slaked, thoroughly stirred with water and solution, and the resulting milk of lime poured into the charge, the amount added each time being sufficient to raise the alkalinity only a fraction of a pound per ton. Of course, if sufficient quantities of lime were added early in the period of agitation, there was little need for its addition in the latter part.

I cannot give a reason for the foaming; but in the case of which I write, the presence in the pulp of a soluble aluminum salt, presumably the sulphate, undoubtedly had a great influence on the foaming, and I believe it to be the sole cause. While all slime will make foam, yet the presence of some other substance seems to be necessary for the formation of a large quantity. Qualitative analyses, and the quantity of flocculent precipitate that formed in the zinc-boxes showed the presence of a large amount of aluminum oxide in the solutions. The ore occurred in a large dike of a light-colored volcanic rock, and that which was milled came from near the surface, so it was oxidized material. It contained considerable clayey matter. The sulphuric acid formed by the oxidation of the sulphide had acted on the decomposing feldspars

of the dike, and formed aluminum sulphate, which, being readily soluble in water, was quickly dissolved by the cyanide solution. Mr. Irvin states that "ore containing the largest proportion of slime, causes the formation of more foam than quartzose ores." As the water percolating through the ore and wall rock while they were in place, would carry but little, if any, of the aluminum sulphate, and other soluble salts out of the clay seams, while carrying them away more easily from the harder and more granular portions; as the soft formations are more thoroughly decomposed than the harder ones; also as the most silicious rocks are the last decomposed, the amount of soluble salts present in the pulp would vary with the amount of slime present. The slime at El Tigre may carry some soluble salt that causes foaming, though of course I cannot say that it is aluminum sulphate, as was the case in the instance I give. The aluminum sulphate or other salt, or perhaps a compound that is formed with the cyanide, probably acts as does soap in water. The blowing of bubbles in childhood has made us all familiar with the effect of blowing air into this common solution. The addition of slaked lime caused the precipitation of aluminum hydroxide and calcium sulphate according to the reaction:



and so removed the cause of foaming. Caustic soda has been used to precipitate aluminum compounds from cyanide solutions, but its use is undesirable because the sodium sulphate remains in solution, causing fouling; and also because an excess of the sodium hydroxide will cause the aluminum hydroxide to dissolve as sodium aluminate. Calcium sulphate, being but slightly soluble in water, will not remain to foul the solution, and calcium aluminate, being insoluble, would be precipitated if formed.

F. J. GIRARD.

Dedrick, California, April 22.

Specific Gravity of Specimen Gold

The Editor:

Sir—Under the heading of 'Concentrates' in your issues of November 1 and 8 last, I notice that there is a considerable discrepancy between the two formulae given for estimating the amount of gold in a specimen when its specific gravity and that of the gold and quartz are known.

In your issue of November 1, the percentage of gold is given as $= \frac{100g_2(g_1 - g_3)}{g_1(g_2 - g_3)}$, whereas in your issue of November 8 the percentage of gold is given as $= \frac{100(g_1 - g_3)}{g_2 - g_1}$. As it is manifest that both cannot be right, in order to obviate misleading statements, I have deemed it well to draw your attention to the discrepancy. I think you will find that the first-mentioned formula is the correct one, as I have often used a modification of this formula in estimating the percentage of cassiterite ($g_2 = 7$) in a gangue ($g_3 = 2.65$)

whereby the percentage of cassiterite P is given by the simple formula $P = 160 - \frac{426}{\kappa_1}$, or, conversely, the specific gravity of the ore is given by $\kappa_1 = \frac{426}{160 - P}$.

J. JERVIS GARRARD.

Johannesburg, February 2.

We are glad Mr. Garrard has called attention to the error in the formula printed in our issue of November 8. The correspondent who transmitted it evidently made use of wrong assumptions in forming his original equation. The correct assumption is that the value of the specimen is equal to the volume of its two constituents, or $\frac{100}{\kappa_1} + \frac{x}{\kappa_2} = \frac{100 + x}{\kappa_2}$.

The computations by means of which this is reduced to the form $x = 100 \frac{\kappa_2 (\kappa_1 - \kappa_2)}{\kappa_1 (\kappa_2 - \kappa_1)}$ may be found in our issue of February 24, 1912.—EDITOR.]

The Rand Banket

The Editor:

Sir—I have read with the greatest interest the important series of articles contributed by C. B. Horwood on the subject of the gold-bearing conglomerates of the Witwatersrand region. Many phases of the subject are exhaustively treated and much has certainly been added to our knowledge of these deposits. I feel great hesitation in entering this discussion even in a superficial way, for I have never visited the field, and confess frankly to having no strong attachment to any of the various theories advanced. In occurrence and mineralization the deposits are unlike any to which an origin by hydrothermal solutions can unhesitatingly be ascribed, and at least equally great difficulties apply to the placer theory, even if modified by the explanation of recrystallization.

Mr. Horwood has given much merited attention to the pyrite 'pebbles', and his demonstration of their origin by replacement is an admirable piece of work. I have no doubt that this replacement has proceeded by approximately equal volumes, and his explanation of the narrow rings of silica, often surrounding these pebbles, by contraction of the hot pyrite is probably correct. Similar narrow bands of calcite or quartz often surround metasomatically developed crystals of pyrite. That the diabase dikes influence the metallization is a most interesting feature, though the influence is not universal. The constant connection of the occurrence of gold with that of carbon and in part also with that of pyrite are certainly important and significant facts. On the other hand, I fail to see any argument for the infiltration theory in the occurrence of traces of platinum metals, for such would inevitably be present in a conglomerate accumulated on the shores of ancient lands of schist and granite. Most important are also the statements and diagrams referring to the distribution of the gold in the various conglomerates; these sections are perhaps the most convincing arguments brought forward to support the infiltration theory.

On the other hand, it is certain that any conglomerate accumulated as noted above must contain detrital gold from the veins in the granite and the Swaziland schists. It is equally certain that the conglomerates were penetrated by hot waters containing hydrogen sulphide, which were competent to recrystallize the gold and convert detrital magnetite into pyrite.

This being admitted, what is the objection to assuming that the gold was precipitated with the pyrite and that it was contained in the 'magmatic' waters from the magmas of the Ventersdorp series of effusives? In spite of all that has been said, one objection consists in the absence of fissures; for, granted that the conglomerates are little more easily permeable than the sandstones, the whole series must at the time of deposition have been very porous and hot 'magmatic' waters would necessarily permeate the whole. In view of this, the concentration of gold in the conglomerates is still a problem. The volume of gold-bearing solutions must have been enormous.

In gold-bearing veins we often find fissures entering from porphyries into tuffs or sandstones. In such cases the usual rule is that the vein immediately breaks up and becomes poor.

Furthermore, the mineralization is unlike any other form of gold deposit. There are no 'mineralizers' like boron, phosphorus, or fluorine. Sulphur, of course, is present, but this is not unusual in a sedimentary series. There are practically no other sulphides, nor are the metals present which we usually find associated with gold.

The gold-bearing veins of California and Australia were deposited by solutions rich in carbonates as well as silica, and the carbonates are extremely abundant in the altered wall rocks. If the solutions of the Rand had been similar, much replacement of pebbles by carbonates would have taken place.

The solutions were not strongly alkaline, for much chlorite is present. They deposited no ordinary gangue minerals but quartz, and apparently not much of that. They deposited chloritoid—a mineral of regional metamorphism and unknown in hydrothermal deposits. Some of this so-called 'chloritoid' appears to me to be cyanite, and this aluminum silicate is equally unknown in hydrothermal deposits except in one instance of a high temperature vein.² If these solutions were connected with the intrusion of the diabase dikes, they were assuredly different from most of those which have formed gold deposits in other parts of the world.

WALDEMAR LINDGREN.

Boston, Massachusetts, April 16.

The Messina mine, Transvaal, reports as follows for February: ore treated, 5405 tons; concentrate, (39.7% copper) 1069 tons; smelter treatment, 316 tons middling yielding 66.75 tons of 59.4% matte; total output of concentrate and matte, 1136 tons averaging 40.8% copper.

*Taber, Stephen, Virginia Geol. Surv., Bull. VII, 1913, p. 214.

Concentrates

Most of these are in reply to questions received by mail. Our readers are invited to ask questions and give information dealing with the practice of mining, milling, and smelting.

Copper, lead, nickel, silver, gold, and some of the less common metals are now commercially refined by electrolysis.

Flint pebbles, weighing about 20,000 tons, were exported from the coast near Havre, France, to the United States in 1914.

White lead is a definite compound with the formula $(\text{PbCO}_3)_2\text{PbO} \cdot \text{H}_2\text{O}$, and the commercial white leads do not vary much from this composition.

Thermit recently mended a broken crank shaft, weighing 3 tons, of a suction gas engine at the Queen of the Hills mine, Western Australia.

Coke used in smelting 766,414 tons of ore, fluxes, and furnace products of the Tennessee Copper Co., in 1913, amounted to 42,152 tons, or 5.5 per cent.

Grinding-pans at the Ivanhoe 100-stamp mill, Kalgoorlie, now number one for each battery of five stamps. They are used as intermediate grinders.

Cut herringbone-type gear was fitted to the Belmont shaft hoist, Tonopah, in place of straight-tooth main gear, in 1913, greatly improving its operation.

Wireless telegraph stations, on coasts and ships throughout the world, numbered 3998 at the end of 1913, according to the International Bureau at Berne, Switzerland.

Power absorbed by the modern electric furnace is enormous. A furnace about 16 ft. square will consume 12,000 hp., sufficient energy for the requirements of a small city.

A geological examination of the rocks of the lower levels of the Perseverance mine, Kalgoorlie, shows that no danger is to be apprehended of the calc-schist having any deleterious effect upon the orebodies until much greater depths are reached.

Cost of producing copper at the Wallaroo and Moonta mines, South Australia, in 1913, was £56 15s. 10d., against an average realization of £69 15s. 9d. per ton. In United States currency these figures are equivalent to 12.18c. and 14.06c. per lb. respectively.

The approximate cost of preventing yellow fever is as follows, according to Colonel W. G. Gorgas: A village of 600 houses, \$1900 per month; and a city of 30,000 people and 6000 houses, \$5000 per month. This is on the basis of paying native labor \$1 per day, and solutions costing \$18 per gallon.

Water amounting to 21,000,000 gal. must be pumped for every foot sunk in the Tasmania gold mine, Tasmania. The present pumps have a combined capacity of 6,500,000 gal. per day, so only 400 ft. could be sunk per year with the present equipment.

Costs at the Tennessee Copper Co.'s mine and smelter in 1913 were as follows: development, 11.82c.; mining, \$1.02; freight, 7.37c.; smelting, \$1.39; converting, 14.32c.; and general, 19.26c., a total of \$2.93. There was 470,135 tons of Tennessee and 35,516 tons of eastern ore smelted.

Rubber production of the world in 1913 was 108,500 tons, against 96,000 tons in 1912. The Malay Peninsula contributed 47,000 tons of plantation rubber. Shipments of crude rubber from the Amazon valley in February 1914 was 4,074,442 lb. to the United States, and 7,406,037 lb. to Europe.

Imitation gold leaf, known as *blatt-metall*, is being manufactured in Germany. It consists of 75 to 85% copper, and 15 to 25% zinc, and sells for 17c. per book of 10 bundles. There were 73.4 metric tons of gold and silver leaf, value \$313,446, exported from Germany in 1913, of which the United States took 13.8, Great Britain 9.9, Russia 7.5, and France 4.6 tons.

Amicable relations between mining companies whose properties adjoin often leads to economies. The Ivanhoe and Horse-Shoe companies, at Kalgoorlie, have constructed an auxiliary electric circuit, so that in the event of a stoppage of the power-plant on either mine, current can be supplied during such stoppage from the mine not affected. The former's plant includes vertical high-speed English engines, and the latter German turbines direct connected to generators.

Snow disappears at high altitudes without melting, a fact apparently not generally understood. The matter is not a mysterious one for the snow actually does disappear as water vapor into the atmosphere, without melting. A reference to the equilibrium curve between solid, liquid, and gaseous water, which appears in nearly every recent textbook on physical chemistry will show that the change from the solid to the gaseous state is the normal one at low pressures and temperatures.

The amount of silver to be added to the gold in an assay to insure efficient parting with nitric acid, should vary with the grade of the ore and the size of the gold bead resulting. With a 2-assay ton charge on gold ores, assaying \$1 per ton and under, the amount of silver to be added may result in a ratio as high as 20 to 1. This amount may be proportionately decreased as the value of the ore increases from \$1 to \$10 per ton, the latter value with a 2-assay ton charge requiring a ratio of about 5 to 1. The parting in gold bullion assays is usually done with a ratio of 2.5 to 2.25 parts of silver to 1 of fine gold.

Special Correspondence

JOHANNESBURG, TRANSVAAL

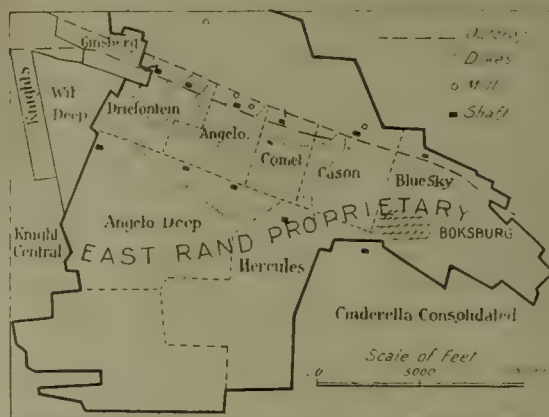
RESULTS OF THE EAST RAND PROPRIETARY MINES CO. IN 1913:
ORE RESERVES, PROPOSED DEVELOPMENT, AND PROBABILITIES
IN CERTAIN AREAS.

The appearance of the annual report of the East Rand Proprietary Mines Co. has lately been regarded as an event of some importance in the mining world, more especially on the Rand, as since the fiasco of 1911 the progress of this mammoth Eastern Rand undertaking has been watched with interest. The net profits earned during the year amounted to £831,565, of which £611,474 was devoted to the payment of a 12.5% dividend. The most interesting feature of the report was, however, that of the superintending engineer, who considers that if allowance be made for the effects of the strike in July 1913 the results obtained may be considered satisfactory. The gold recovered per ton has fallen during the year from \$7.70 for the previous year to \$7.38 per ton, a decrease of 32c. per ton; but the engineer points out that the gold recovered last year more closely approaches the average value of the profitable ore reserves. The following statement shows the condition of these on December 31, 1913:

	Tons.	Dwt.	Width.
Main Reef	392,376	5.1	60
Main Reef Leader	3,994,656	7.0	49
Main Reef & Leader	1,212,968	6.3	75
Total and averages	5,600,000	6.7	54

It will be remembered that under the old administration the profitable reserves, with a lower average working cost than that of today, were estimated as over 10,000,000 tons, and the engineer points out the need of increasing them, and it is in development for them that most interest centres. In 1913 no less than 56,601 ft. of work was done, developing a total of 1,530,226 tons, of which, however, only 904,046 tons, or 59%, was profitable, and of an average value of \$6.90 per ton. It is evident that in such a property as that of the East Rand Proprietary, quite double the amount of development needs to be accomplished; but there would appear to be so many difficulties to contend against in opening the 'reef' to the dip of the outcrop properties, which are fast becoming fully developed, that no surprise need be expressed at the developed ore reserve falling for the past year to come up to the tonnage milled. It will be remembered that, at the Hercules shaft, lying on the dip of the Cason and Comet vein, the Main Reef series was intersected at a depth of 4236 ft. from the surface; but the reef was unprofitable, and considerable interest centres in what will be found in continuing this shaft along the reef to the dip, where there exists a long stretch of unproved property. The advisability of a similar step being taken in connection with the western shaft of the Angelo Deep is pointed out in the engineer's report, but this area has been somewhat disappointing at depths exceeding 4000 ft., and the driving of inclines to the dip will be watched with more than ordinary interest. It may be pointed out that the small area proved by the levels connecting the Angelo Deep shafts as also by the Hercules shaft, show a marked decrease in gold content, and unless there is a material improvement to the dip of these shafts, a considerable area must prove unprofitable. To the dip of the Driefontein property the conditions are much more encouraging. No. 27 level, west from the Angelo Deep west shaft, opening much better ground as the Wit Deep water dike is approached. Water, however, proved so abundant that a dam

had to be constructed until adequate pumping arrangements could be made, which have only just been completed. Good ore has been found in the reef wherever an abundance of water was met with, in fact, beyond the water dike running north and south, there would seem to exist a richer area perhaps than anywhere else at this depth on the Rand. Boreholes through the water dike, at depths of 3000 and 4000 ft., encountered water at the rate of 200,000 to 250,000 gal. per day, so that large pumping equipments are necessary to prove the reef beyond the water dike. At the present time, how-



PROPERTIES OF THE EAST RAND PROPRIETARY.

ever, the future of the East Rand Proprietary mines depends upon the development and opening of the country beyond the dike. There is every indication of the gold being there to pay for the extra expense likely to be incurred; but before this can be accomplished it is not impossible that the working profits of the East Rand Proprietary mines may in the interval decline.

BULAWAYO, RHODESIA

HEALTH AND DEATH RATE AT RHODESIA MINES.—ANTELOPE PRODUCTION.—THE FIDELITY DISTRICT.—COAL RESERVES IN RHODESIA.

The mining authorities of Southern Rhodesia, like those of the Witwatersrand, have of recent years made a vigorous campaign in the direction of improved health conditions. Although this subject in and on the mines is of far more pressing importance along the Main Reef of the Transvaal, the mines of Matabeleland and Mashonaland certainly have problems relative to the fitness of laborers, which demand constant attention. Happily for Rhodesia, the dread disease, miners' phthisis, which has so decimated the ranks of Rand miners, is, comparatively speaking, of little consequence. In some of the Rhodesian mines, men who are phthisical are occasionally met with, but a close investigation of these cases would probably make it clear that the sufferers contracted their malady on the Witwatersrand before they ever saw Rhodesian soil. Generally speaking, the nature of the rock in the mines of the Chartered company's territory is such, that it does not break up into the fine powder that the Rand sandstone does when drilled into. There has, however, in consequence of legislation of the Union of South Africa, been something in the nature of an influx of affected miners into Rhodesia of late. The Rhodesian Chamber of Mines, considering that a danger to the sanitary conditions of the mines was threatened, thereby advocated the restriction of employment of sufferers from this disease, and the government has introduced and promulgated the miners' phthisis ordinance, which prohibits the employment of victims of this

disease. A most gratifying feature in connection with the health conditions of Rhodesian mines, is that in regard to native labor mortality, statistics disclose a considerably lower death rate for last year than has hitherto been experienced.

During the year ended December 31, 1913 the mortality from disease was 23.69, and from accidents 4.72, giving the low total of 28.41 per 1000 per year from all causes. This compares favorably with 55.83 in 1912 and 49.27 in 1910. The most noticeable decrease was effected in pneumonia, which in 1913 caused 409 deaths, compared with 668 in 1912. While it is probable that mildness of last winter season assisted toward the diminution of disease, the main causes for the existing satisfactory death rate are undoubtedly the thorough and efficient system of medical examination of recruits, and the continued and increasing care, attention and feeding which the natives receive. A further improvement in health conditions on the mines of Southern Rhodesia is anticipated in consequence of the visit of Colonel Gorgas and his assistants from the United States, to this territory. After a short, but careful investigation, he has submitted to the administrator a most closely reasoned statement regarding malarial and blackwater fever in Rhodesia, and the best means of preventing these terrible diseases.

One of the five new and important mines of the country that have recently commenced ore treatment has already announced an initial profit of \$1500, while the cost of operation is given at the high figure of \$9.84 per ton. It is officially explained that these excessive charges were due to the low tonnage treated, caused by difficulties in connection with the new plant. Obviously it is not fair to the Company to regard the results of the initial crushing as a criterion of the capabilities of the mine, but at the same time there is some apprehension as to the future working of the Antelope equipment. At the time of writing, figures as to treatment operations at the Cam & Motor are not available; but particulars of the first month's production and the running of the new plant, which has been modeled a great deal on Kalgoorlie lines and is quite new to Rhodesia, are anxiously awaited. [The first return was 10,693 tons averaging \$7.58 per ton.—EDITOR.]

Good reports continue to come from the properties of the Hanover syndicate, a local concern, situated in the Filabusi district of Matabeleland. Of recent years there has not been much activity in this area, and the news from the Hanover is most encouraging. Until just lately development work was confined to the Teutonic vein, but work has now been decided on for the North and Hanover veins as well. In this last named orebody, a part of the vein about 200 ft. long, and assaying about \$12.50 per ton over 36 in., has been opened at the 300-ft. level. Nine dividends have been paid by this syndicate to date, and the last distribution, that for February, 1913, was 25%. Last month's output was the largest so far recorded. The prospects of this concern are admittedly bright, and the success achieved should assist in directing attention to the extensive Filabusi mining area.

An interesting bulletin has just been issued by the Geological Survey of Southern Rhodesia, dealing with the coal resources of Southern and Northern Rhodesia. Hitherto, only one colliery has produced appreciable quantities of coal, but it has been known for some time that, in addition to the deposit worked by this colliery, the Wankie in northern Matabeleland, Carboniferous measures extend over a considerable area, and it is probable that other mines will be brought to the productive stage in the near future. H. B. Maufe, director of the survey, estimates the actual reserve of coal in Southern Rhodesia at 419,317,000 tons, of which 201,200,000 tons is in the Wankie area of Matabeleland. The probable reserves, extending over a total area of 157 square miles, are estimated at a further 550,094,000 tons, making a total for actual and probable reserves of 969,411,000 tons. The majority of the coals of Rhodesia, like those of South Africa, contain a large

percentage of ash, which is high in comparison with the coals of Great Britain. However, the Wankie and one of the Tura coals contain only 8 to 13%, which compares favorably with the usual 15 to 20% in the South African coals.

LONDON

PROSPECTS FOR OIL IN SOUTH AFRICA.—CONSOLIDATED OIL FIELDS OF SOUTH AFRICA, LTD.—REPORT BY E. H. CUNNINGHAM CRAIG.

The investigation of possible petroleum deposits in South Africa has loomed large during recent years in London circles, as well as in Johannesburg and Cape Town. Deposits have been found in Madagascar, and have been exploited by South African promoters and capital. For some occult reason, other promoters have argued that, because petroleum is found in the Jura-Trias in an island off the coast, it is also to be found in the Permo-Carboniferous and Carboniferous Devonian of the mainland. One of the companies that has noisily attracted attention is the Consolidated Oil Fields of South Africa, Limited, its very name being objectionable, seeing that it may mislead intending investors into a belief that it has some connection with the celebrated Consolidated Gold Fields of South Africa, Limited. This Company was formed to acquire a property at Ceres, in the Cape Province, about 50 miles east of Cape Town. The rocks here belong to the Cape system, analogous to the Carboniferous-Devonian age, mostly sandstones of varying character, with a few beds of shale. In no case has any geologist noted indications of the strata being petroliferous. Attention was attracted to the Ceres district by occasional outbreaks of gas. Moreover, marine fossils found in the neighborhood were supposed to be indicative of the probable presence of organic matter. Ferric hydroxide films on the water in swampy land misled investigators, who mistook the cause of the iridescent color. E. H. Cunningham Craig, the oil expert commissioned by the South African Government to report on petroleum prospects, pricked the bubble by showing that the occasional show of gas came from a buried bog, and was nothing but marsh gas. The Company, however, though expressing regret at Mr. Craig's pronouncement, fails to adopt his views, and announces its determination not to abandon the search at present. The directors state that they are encouraged to proceed by the many favorable reports on the oil possibilities of the district that they have in their possession. They state that gas has been found in the strata below the marsh. Mills Davies, of Johannesburg, is therefore continuing boring for the Company.

It is of timely interest to say something of Mr. Craig's report. He shows that traces of petroleum and allied compounds have been found in the Permo-Carboniferous, locally called the 'Karoo,' beds in the Cape province, associated with and in the neighborhood of dolerite sills and dikes. In spite of extensive drilling, occasionally to great depths, nothing but 'indications' have been found. The report is in form and nature admirably adapted to requirements, suitable for readers who know little or nothing about the subject. He starts with a general dissertation on indications. He shows that, in many cases besides the Ceres, emanations of marsh gas have been mistaken for natural gas, and that the iridescent film of ferric hydroxide on the surface of swamps has often led the prospector astray. With regard to the petroleum and allied compounds in association with the dolerite dikes and sills in the 'Karoo' beds, he shows that these carbonaceous substances have been formed by the passage of the intrusive rock through coal seams and oil-shales. At no place except in a line east and west through the centre of the Cape province, where a fold in the 'Karoo' beds occurs, does the geological structure contain the anticlines and domes so often associated with petroleum accumu-

lations. Mr. Craig is not hopeful, however, of favorable results following boring in the region of this fold. The possibility of petroleum having been found in the neighborhood of saltpans is also adversely discussed. He shows that these are the accumulations during geologic ages of the denudation of a country continuously above the sea, and that in many cases fresh water can be obtained from wells in their vicinity. Thus the salt has no connection with the brine and rock-salt so often found in conjunction with petroleum. Mr. Craig describes the oil-shales in the Ermelo district in the eastern Transvaal, and in the Drakensberg range in Natal. Owing to the thinness of the seams at Ermelo, none being much over a foot wide, it would be impossible to mine them at a profit. On the other hand, the Natal deposits are more hopeful, and he recommends that they should be tested on a large scale. As to natural gas, he is of opinion that in many places accumulations would be found under dolerite sills that might afford small local supplies for lighting purposes. Altogether, Mr. Craig's report presents a hopeless sort of outlook, and it has caused many bad attacks of grouchingness.

CHISANA, ALASKA

DESCRIPTION OF THE GLACIER TRAIL AFTER LEAVING SHUSHANNA JUNCTION.—WORK DONE IN THE WINTER.—COST OF FREIGHTING AND FOOD.

A week's inspection of this new placer-mining district left the following impressions: The trail from McCarty over the Nizina and Chisana glaciers, which so far has proved the best winter route, though at best it is a hard pull, was taken. From McCarty, renamed Shushanna Junction by the railroad peo-

commission ought to have an emergency fund at its disposal, that would enable it to place a couple of men on such a trail to keep it safe to travel over. Once past these eight miles, which part is about five miles from the summit, it is all clear going, with only an occasional rough place. From the foot of the glacier it is about six or seven miles across the river, and through the woods to the town, all easy traveling over the ice.

Actual information about the camp is almost as lacking as it was last September. This is due to a number of causes. In the first place, many of those who got in on the known ground, went outside for the winter, and have just returned, and their ground has not been prospected. In many other cases, probably 75%, the holes have encountered water before they reached bedrock, so the only thing the prospector could do was to wait till the spring and commence sluicing. A large portion of the claims are above timber line, and the men have worked like slaves 'necking' up wood to thaw down the holes. A few boilers have been taken into the district, but little work has been done with them so far. Most of the shorter creeks have steep gradients and flow through narrow cañons.

Freight fell to 10c. per pound during the spring when the trail was at its best, but will go up rapidly when the trail breaks up. Meals are \$2 each, but worth it as the food is good. Wages will probably be \$6 or \$7 per day with board; but with the number of prospectors in the district looking for work to continue prospecting, it would be a poor place for anyone to come to 'rustle a job'. Actual cash is scarce, and probably many of the outfits will work 'on bedrock.'

A map in the U. S. Geological Survey bulletin on the Nebesna-White River district shows the general contour of the Chisana area. Chavolda creek, on the map, has been changed to Wilson creek; and Chatnenda to Johnson.

WASHINGTON, D. C.

SMOOT BILL PASSES THE SENATE; NOW IN THE HOUSE.—IMPORTANCE OF THE MINING INDUSTRY.

The Senate has passed the bill providing for the codification of the federal mining laws, and it now remains for the House to act. The bill passed in the Senate without opposition or debate, Mr. Smoot, Senator from Utah, directing its course. It provides for a commission of three members instead of five, as had been hoped by certain mining people. Senator Smoot made no attempt to amend his measure on that score, although offering several amendments, which the Senate accepted, relating to other provisions in the bill. Instead of providing a commission which shall be composed of a member of practical experience in the operation of mines, a lawyer of experience in the practice of mining law, and a member connected with the U. S. Geological Survey, the bill as passed by the Senate was amended to provide a commission to be appointed by the President and confirmed by the Senate, two members of which shall be lawyers of considerable experience in the practice of mining law, and one a mining engineer who shall have had practical experience in the operation of mines. No miner is provided for.

While the Senate passed its bill, the House committee on mining reported out to the House the Taylor bill, providing for a similar commission, but differing in its terms. It provides for a commission of five members, and carries no salary. The House committee has learned that persons who favor the commission are willing to provide their services free. Inasmuch as the House committee is quite a pro-labor body, it may be expected to work hard for a member who shall be a miner. It is expected that the differences between the two bills will be adjusted in a conference committee between the two houses when the House shall have



MAP OF THE CHISANA DISTRICT, ALASKA.

ple, there is a good river trail to the foot of the glacier; but once on the glacier there is a continual ascent for about 25 miles, reaching an altitude of about 9000 ft. Although a large portion of the trail is not excessively steep, practically all of the freight was being relayed in, and at the steepest pitch a 'Brunton' gave a reading of 25°. At this point the carriers were only loading 250 lb. on the sleds, as that was about the limit of the average horse.

On the Chisana side the glacier is far more active, and for eight miles of the trail it is as much as a man's life is worth to step out of the beaten trail. This distance has been the hardest on the freighters, as about 25 or 30 horses have been lost in the crevasses, and a number of men have fallen in, but somebody has been there to pull them out. Many of the crevasses have been bridged by poles brought up by the freighters, but they are poor makeshifts. It seems as if the road

passed its own version. As things now are, the House will take the Senate committee bill from the Speaker's desk and amend it, and the conference committee will do the rest. It is probable that the House will insist on a committee of five members. The House bill carries the provision that the code shall not deal with lands containing deposits of coal, oil, gas, phosphates, or soluble potassium salts, and with that amendment it is acceptable to the Department of the Interior. In reporting out the bill, the House committee on mining said:

The essential features of the general mining laws of the United States were determined over 40 years ago, when the total production of mineral substances in this country did not amount to more than \$300,000,000 per year. Since that time the value of the total mineral output has increased to \$2,250,000,000 per year, a sevenfold increase. This growth has in part resulted from the discovery and utilization of many mineral substances not previously known to be of any economic value. Since these substances were not within the purview of the original law, no provision was made for their development, and only through the use of strained and forced constructions of the law has it been possible to develop such deposits at all. Of all the defects of the general mining law, the most serious is the present uncertainty of title of a locator to the mineral land he claims. This works an especial hardship on the prospectors and men of small means by whom the discoveries of new mineral deposits are chiefly made. The vital importance of this matter is not alone measured by the 2,300,000 men engaged in the mining industry, and the value of products which results from their labors, but rather by its effects on the whole of the people. More than half the freight hauled by the railroads is the product of the mining industry, and of the \$20,000,000,000 worth of manufactured products annually produced in this country, almost the whole involves the employment of metallic mineral substances. The committee believes that this bill will meet with the hearty approval of prospectors, miners, operators, and the people generally everywhere, and it is sincerely hoped that it will pass."

BRUSSELS, BELGIUM

IMPROVEMENTS AT KATANGA, CENTRAL AFRICA.—AMERICAN ENGINEERS EMPLOYED.

The Union Minière Du Haut-Katanga is making big plans. An important extension to the smelter has been decided upon. R. M. Johnson, of the East Butte Mining Co., Montana, has been engaged as manager at Kambove. He left for the Katanga at the end of April. The Company will soon have two steam-shovels at work at Kambove, and has already two at work at the Star mine. Mr. Wheeler, consulting engineer, left for the Katanga early in May. F. W. Snow has been engaged by the Union Minière for mill and smelter experimental work. F. D. Kehew, of the Cananea Consolidated Copper Co., Sonora, has been engaged as smelter superintendent at Lubumbashi. These men will leave soon for the Katanga. The Company has signed an important contract for Nyassaland labor, and several hundred boys have already been recruited. With Horner, Wheeler, Snow, Johnson, and Kehew on the job the Union Minière should soon get good results. The Company is going into the work in a big way and one can expect some progress from now on compatible with the importance of the copper deposits of the region. It speaks well for American engineers that a Belgian-English company should put its future entirely into their hands. The Brussels company just received the third shipment of about 5000 carats of diamonds from the Kasai field. Among them is a 14-carat stone of good quality. Mining operations at Katanga have a brighter aspect at the present time than at any period in the past and results are expected soon.

NEW YORK

EFFECT OF THE RECENT DECISION ON FLOTATION PATENTS. ANACONDA IN 1913. GREENE-CANANEA DIVIDENDS.

The announcement of the handing down of the court's decision in the Butte Superior and Minerals Separation flotation suit has, of course, been the topic of interest of the week. Statements from the two parties to the suit have appeared, and there has been considerable discussion of its effect. The Butte & Superior is relieved by it of the payment of big royalties as well as of large sums for the tonnage which it has treated already. Aside from this Company, however, the situation actually seems to be much the same as it was before the decision was brought, because of the peculiar fact that in our patent law one court is not bound by another's decision in a patent case. As the Minerals Separation Co. has been fighting its patents for two decades in Australia and England, and has carried its suits up to the House of Lords, it can be taken for granted that a single adverse decision in this country is not going to end the matter with them, and they no doubt would like nothing better than an early opportunity to start a suit in another one of the 96 district courts. It will, of course, leave no stone unturned to bring the suit, if possible, before the Supreme Court of the United States, though this is a rather difficult matter to do. Probably the net result of the adverse decision will be to cause the Minerals Separation to demand more modest royalties in order to encourage people to pay them rather than defend infringement suits. As a matter of fact, any small company where the amount of royalty in a year would not amount to very much, would be a great deal better off in paying the royalties demanded, and getting the coöperation of the Minerals Separation staff, than it would in trying to develop its technique alone and fight an infringement suit.

The Anaconda has issued its report for last year [this will be published in the next issue of this journal], and the lessened output and the decreased net earnings have been made the most of in the market. There is a deficit of over \$1,500,000 in the net earnings for the year as compared to the dividends paid, but as the Anaconda has a surplus of about \$9,000,000 this is not a serious affair. During most of last year the copper market looked weak, and it was obviously not the time to make any great attempts to increase output except on the part of the companies which were able to make copper at the lowest cost figure. The Anaconda was engaged in making many changes in its procedure, and quite naturally utilized this period when economic conditions seemed to call for a slightly lessened production. Important changes are on the way in the milling and smelting plant.

For the new leaching plant to be erected by the Utah Copper Co. it is understood that the sulphuric acid needed for the process will be produced at the Garfield smelter, where a chamber process acid plant will be built.

Two weeks ago it was noted that the Greene Consolidated and the Greene Cananea had postponed action on dividends on account of the uncertainty of the situation in Mexico. Meanwhile the operating staff at Cananea has been withdrawn and then sent back again, so that the work is now under way. The Companies have therefore declared quarterly dividends of 50c. per share, and judging from advices from Mexico, Cananea ought to be able to operate at approximately its normal rate. Greene Consolidated, it will be remembered, is the Company which owns the Cananea Consolidated Copper Co., which operates the mines and smelters. Practically the whole share issue of the Company is owned by the Greene Consolidated Copper Co., capitalized at \$60,000,000, and is the only Company in which the public owns shares.

At Nacozari, operations have been resumed, while at the Tigre and several others of the mines in the north, work has not been interrupted. Recent reports from Pachuca, El Oro, and Guanajuato are discouraging.

General Mining News

ALASKA

The lignitic coal reserves of the Bonni field, Alaska, are estimated by the U. S. Geological Survey to be nearly 10,000,000,000 tons, which exceeds by nearly 3,000,000,000 tons the estimate made a few years ago, on the information then available, of the total quantity of lignitic coal in the territory. The new estimates, which are very moderate, indicate that the quantity of coal available in the Bonni field is greater than that of all the other surveyed fields of the territory.

CHISANA

Reports on this new placer district vary considerably, as is shown by the following notes and also in the 'Special Correspondence' pages of this issue: Larry Peppard arrived at Dawson on April 24. He said the trail was good, no new discoveries have been made, prospecting is still under way, the hauling of wood is difficult, and Bowen creek, on the Canadian side, is promising. John Raymond also arrived at Dawson. The trail was good. The camp is an uncertain quantity, according to his statement. Outside of the Bonanza and Little Eldorado gravels, little has been found. F. T. Hamshaw has six boilers and 20 men at work prospecting, and has gone to Cordova to complete a deal with Manley and Ives. There are from 400 to 500 people in the district. Supplies are plentiful. Eggs are \$1 per dozen, and a good meal costs \$1. Last, but not least, the saloon at Johnson City will be closed if the camp does not improve, the owner, F. Miller, being dissatisfied with prospects.

ARIZONA

COCHISE COUNTY

(Special Correspondence.)—After being shut down for 14 years, the Cochise Copper Co.'s property, two miles north of this place, is to be reopened. For this purpose the Southwestern Copper Co. of San Simon, has been incorporated. A good deal of equipment has remained on the surface all this time, and is in fair order.

Paradise, April 30.

At 1800 ft. in the Junction shaft of the Calumet & Arizona a large station is being cut. Large electric pumps are to be installed here when it is finished. The present flow of water in this shaft, 1500-ft. level, is 3000 gal. per minute, so manufacturers of pumps will have an opportunity of bidding for a large plant later on.

GILA COUNTY

(Special Correspondence.)—Twelve vertical raises have been started from the 600-ft. level of the Inspiration mine. A total of 48 faces are being worked in ore throughout the mine. Concreting the main east shaft station on the 400-ft. level is nearly completed, and with this in place the shaft work will be resumed, 40 ft. of it already being done. A 6 by 20-ft. tube-mill was installed at the test-mill during the week, and will be started within a few days. A 66-in. Bradley mill also is soon to be tried at the experimental plant for the purpose of comparing its efficiency as a fine crusher with several other types of mills which have already been given exhaustive tests. The type of bin to be used at the new concentrator is of the suspension class. It will run the entire length of the mill and will have an available capacity of 12,000 tons, or 2000 tons per mill unit.

Development at the Miami mine during April totaled 4937 ft. Masses of chalcocite and carbonate ore have been opened in a shattered zone of the Independence mine in the Miami district.

Miami, May 7.

The 6 by 20-ft. tube-mill which is to be used in the above test is a Chalmers & Williams adjustable quick-discharge machine, described in this journal on page 1040 of the issue of December 27, 1913.

The Inspiration company will install new station equipment consisting of three 6000-kw. Curtis turbo-generator units with 45-kw. exciters. The contract for the apparatus has been awarded to the General Electric Company.

MARICOPA COUNTY

(Special Correspondence.)—Two engineers of the U. S. Geological Survey are to examine the cinnabar deposits in the northeast corner of this county. A good deal of development has been done on them. Four feet of good gold ore has been opened in the Old Kentuck mine, 20 miles south of Phoenix, by John White. This is in a promising district. At the Max Delta mine, the main incline shaft is down 400 ft., and will be sunk to 500 ft. Sixteen men are employed. Ten stamps are being added to the Goldfield mill, near Mesa. Phoenix, May 2.

MOHAVE COUNTY

The State Tax Commission has just made its report to the assessor of this county on account of mine tax for the year 1914. Owing to the large amount of dead work done by the Golconda last year and the stoppage of production by reason of the sinking of the new shaft to the 600-ft. level, and overhauling the old shaft to the surface, there was no net production from that property, according to the *Mohave County Miner*. The same was true of the Grand Gulch and the Frisco Gold mines. This left only three corporations in the county that paid net on their production, the Gold Road, Tom Reed, and Needles Mining & Smelting companies. The following is the production of these corporations as shown on the tax roll:

	Gold Road, ounces.	Tom Reed, ounces.	Needles, ounces.
Gold	31,875	52,538	1,370
Silver	14,246	25,697	101,577
			Pounds.
Copper			16,568
Lead			4,266,250
Zinc			3,984,604
Value	\$667,375	\$1,101,748	\$503,961
Net	\$3,876	789,759	33,663

YAVAPAI COUNTY

(Special Correspondence.)—The old Sunset mill is to be overhauled by W. Sisson, who will treat custom ores.

Harrisburg, April 30.

CALIFORNIA

Section director Cole, of the U. S. Weather Bureau, with headquarters in Reno, Nevada, has made measurements of snow in the Sierras and finds considerable snow there for this time of the year. The deepest drift was 225 in., and there were many others ranging from that depth down to 53 in. At the measuring station the snow was 63 in. deep. There was practically none on the south slope of the range.

BUTTE COUNTY

A bond upon the property of W. P. Lynch in Sawmill ravine near Pentz has been taken by O. C. Perry and R. S. Kitrick. They have sent a Keystone drill there to prospect the land for gold. If results are satisfactory, a dredge will be constructed there. It is known that much amalgam escaped from the sluice-boxes at the old Cherokee hydraulic mine.

An English syndicate has bought shares worth \$30,000 in the Nimshaw Ridge Mining & Development Co., 18 miles south-east of Chico.

ELDORADO COUNTY

The old Union mine, 11 miles south of Placerville, which has been opened to 1600 ft., has a 60-stamp mill and other equipment, and has been shut down for seven years, has been

ceded to Tevis Bros. of San Francisco. It is to be reopened at once. Past production is said to be about \$1,000,000.

CALAVERAS COUNTY

Through the medium of R. E. Whitecomb, of San Francisco, a deal has been completed whereby the Royal Consolidated Mines have been purchased for \$500,000 by Edwin A. Fordice & Co. of Boston. The property has been the object of litigation for about six years. A large stampmill is on the ground ready for work.

NEVADA COUNTY

Five feet of 25% copper, \$50 gold, and 41-oz. silver ore is reported at a depth of 50 ft. in an old mine, on the Norton ground near Newton, toward the Yuba river. It is owned by Luke Williams and J. W. Watson.

SHASTA COUNTY

After six years of litigation, the Accident Gold Mining Co. of French Gulch, has a clear title to the Sybil group of claims. Feeling ran high at various stages of the disputes. George Von Krueze has been superintendent for many years. The Shasta County Farmers' Protective Association is again active, and is said to be about to try to enforce the smelter fume decree.

TUOLUMNE COUNTY

Good progress is being made with the adit of the Springfield Tunnel & Development Co. being driven to drain the Springfield gravel mine. The new electric plant, costing about \$200,000, in the Eagle Shawmut mine, is ready for work.

COLORADO

On account of the strike situation in the coalfields of the southern counties, a special session of the legislature is to be held at Denver, to arrange for some system of arbitration and inquire into the dispute. The Colorado Fuel & Iron Co. is suing *The Rocky Mountain News* for \$600,000, for alleged libel in connection with the trouble.

By an order of the Secretary of War, L. M. Garrison, no mines are to be reopened in the strike districts until further notice. He denied that orders had been issued forbidding the importation of 'strike-breakers,' but explained that while the situation remained threatening the mines not already running probably would be kept closed until in his judgment their opening would precipitate no further trouble.

CLEAR CREEK COUNTY

At the Capital mine, the main raise has been lined to the 750-ft. level, it now being up 801 ft. Lessees are doing the following work: Hummer & Son are crushing 300 tons in the mill. Brandstetter & Moscript are raising on a small vein of smelting ore; Warren, Oliver & Co. are shipping a car of smelting ore; and DeMasters & Oldfield have opened 10 to 14 in. of ore 16 ft. above the adit-level, assaying 2.6 oz. gold, 7.84 oz. silver, 4% copper, and 15% lead. Several new lessees are about to start work. In the Rosebud, on Democrat mountain, there is 6 in. of 100-oz. silver ore, with a good percentage of lead. Electric power for the Bellevue-Hudson mine is now available. Lessees on the 275-ft. level of the Seven-Thirty mine have a stope opened for 100 ft., showing 24 in. of \$50 ore. Lessees at 210 ft. have 50 ft. of ore. Experimental runs have been made at the Edison mill at Silver Plume. There has been a little trouble with foundations. J. B. Ballantine is in charge.

DENVER COUNTY

(Special Correspondence.)—The suit of the Mine & Smelter Supply Co. against the Deister Concentrator Co. for infringement of patents in the U. S. District Court here, was dismissed by Judge Anderson for "want of equity." The suit was a blanket one covering Deister tables 2, 3, 4, and 5.

Denver, May 6.

LAKE COUNTY (LEADVILLE)

Leadville, with a gross output of \$400,000,000 from its gold,

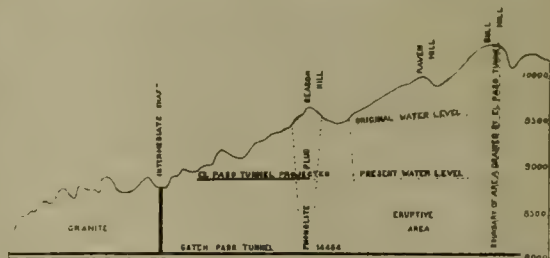
silver, lead, zinc, copper, manganese, and iron ores, has nevertheless had a checkered history, according to Philip Arrell in *The Mineral Magazine* for April 1914, who discusses the 'Zinc Carbonate Ores of Leadville.' The mineral sequence of the district might be roughly classified as placer gold only in the early 'sixties', silver-lead carbonate ores in the 'seventies', silver-lead sulphide ores in the 'eighties', gold ores from veins and blanket deposits in the 'nineties', and zinc sulphides in the first decade of this century, starting the second decade with zinc carbonate ore. This means, of course, that while most of these various ores have been mined during the greater part of the 50 years, those indicated may be said to have furnished the principal sales during the decades noted, particularly gold after the silver panic of the early 'nineties,' and zinc carbonate during the last three years, the district adapting its output, as it were, to the changing conditions of the ore market.

OURAY COUNTY

April shipments from Ouray were as follows: crude ore, American Nettie, 13; and Wedge 30 tons; concentrate, Atlas, 240; Camp Bird, 125; Wanakah, 192; and Barstow (zinc), 18 tons; and matte from the Wanakah smelter, 260 tons; a total of 878 tons. Shipments from the Camp Bird and Atlas were low on account of bad roads. J. C. Ingersoll is now in charge of the Wanakah smelter. More miners have been engaged at the Five Metals property.

TELLER COUNTY (CRIPPLE CREEK)

According to T. R. Countryman, engineer for the drainage company, the flow of water from the Roosevelt tunnel is 7515 gal. per minute. Lessees at the Isabella mine produced 1800 tons of about ounce ore during April. Eight mines of



SECTION OF CRIPPLE CREEK DISTRICT SHOWING DRAINAGE TUNNELS.

the United Gold Mines Co. yielded ore in April, the total being 650 tons. E. M. De La Vergne is superintendent. The Golden Cycle company will add to its electric equipment a 300-hp. induction motor and starting panel recently ordered from the General Electric Co. Seven feet of \$40 to \$60 ore has been opened at 100 ft. in the Caledonia mine on Gold hill.

IDAHO

SHOSHONE COUNTY

An adit, which will extend 3700 ft. to the Gertie boundary line, is to be driven by the Gertie Mining Co., which owns this mine adjoining the Hecla at Burke. The adit will have a vertical depth of 1500 ft. in the Gertie claim. Fifteen months will be occupied in this work, which will cost about \$75,000. No commercial ore has been opened in the mine, which is controlled by Spokane people.

According to the report of the Bunker Hill & Sullivan company for 1913, the total ore mined to the end of last year was 6,021,548 tons, valued at \$56,869,043. The net smelter returns totaled \$33,810,802, of which \$18,867,627 was profit, and \$14,729,250 was paid in dividends.

A magnetic separating plant is in full operation at the Success mill, treating concentrate. This product is dried in a revolving tube, 3 by 30 ft., and then treated by four

New Century magnetic machines, which now produce a 46% zinc product. C. C. Samuels is superintendent of the mill.

The Hercules Mining Co. has driven its No. 5 or Hummingbird adit a distance of 8185 ft., and has cut 25 ft. of ore. Profits of this Company in 1913 were \$1,207,326. Work has been resumed at the Polaris mine after several years of idleness. The faulted vein in the Snowstorm mine has been found again.

Mining operations on Pine creek are beginning for the summer, and several properties have started work, including the Spokane group, International Crown Point, and Odd Fellow group.

MICHIGAN

HOUGHTON COUNTY

The Tamarack Mining Co. has decided to erect a re-grinding and leaching plant to treat its current and old sand which has accumulated in Torch lake for 30 years. The plant will cost about \$250,000. Mining operations have been resumed at the Tamarack, conditions being fairly good for regular work. On May 6 the Carroll foundry at Houghton was destroyed by fire. The loss is between \$500,000 and \$600,000, of which \$400,000 was in valuable patterns. The insurance was \$250,000. The plant has been in operation for 21 years.

MISSOURI

JASPER COUNTY

Zincblende containing 60% metallic zinc ranged from \$40 to \$35 per ton, during the week ended May 2, according to Lucius L. Wittich in the *Joplin News Herald*. There is a stock of about 15,000 tons of unsold ore in bins. Calamine was in fairly good demand at \$19 to \$20 per ton, basis of 40% metallic zinc. Lead ore was stronger at \$46 per ton, basis of 80% metal. Shipments for 18 weeks of the current year were: blende, 172,233,198 lb., worth \$3,422,739; calamine, 11,675,250 lb., worth \$125,182; and lead, 32,316,130 lb., worth \$755,676. The first turn-in from the Boston-Aurora mine has been made. The mill has a capacity of 100 tons per shift. Ore occurs at a depth of 180 ft. In April, the Continental Zinc Co., of Cartersville, produced 318,000 lb. of blende and 223,000 lb. of lead concentrate, working single shift. The mill can treat about 400 tons of ore per shift. Sheet ore, at 190 ft. in the Bippo, west Joplin, is being worked. Two developments of rich galena and blende were made in the Lone Elm lease of the Granby company's land at 95 ft. A flotation plant is being installed at the Priscilla mine, west of Joplin, by G. S. Thomas and D. I. Hayes. The ore is typically sheet ground, containing 58% blende. The sludge is to be treated by this process.

MONTANA

Billings car No. 5, of the U. S. Bureau of Mines, will be at the Bear Creek, Montana Coal & Iron, and International Coal companies' mines, Bear Creek, from May 25 to 30; at the Anaconda Copper Mining Co. and Smokeless and Sootless Coal Co. from June 1 to 6, and at the Northwest Improvement Co., Red Lodge, from June 8 to 13.

LINCOLN COUNTY

A great deal of preparatory work has been done at the gravel areas at Libby, and good returns are expected before long.

SHAWNEE COUNTY

From 4 to 5 ft. of 30% zinc ore is reported to have been opened at 2200 ft. in the Pilot-Butte mine. Copper has also been opened on this level.

NEVADA

ELKO COUNTY

After the expiration of the option on the Elko Prince mine at Midas, it will be taken over by the old company.

the estate of W. C. Savage having the largest interest. A test run is being made in the cyanide plant of the Rex, nearby on the south, also samples are being tested in San Francisco. It is hoped at an early date to have enough data to let a contract for the plant. The mine has sufficient high-grade ore in one shoot to supply a 35-ton mill for four years or more.

LYON COUNTY

The annual report of the Mason Valley Mines Co. for 1913 shows that 228,855 tons of ore was smelted, of which 116,636 tons was from the Company's property and 111,219 tons from custom ore. Matte produced was 17,166 tons, containing 14,601,520 lb. copper, 9922 oz. gold, and 121,835 oz. silver. The profit was \$120,564, and the balance from 1912 was \$226,897, making available the sum of \$347,461. Charges against this totaled \$259,325. The smelting capacity is now 1800 tons of ore per day in two furnaces. The general manager, Jules Lebarth, has arranged with the Southern Pacific railroad to haul 100 tons of ore per day from the Balaklala mine, California, to the smelter.

NYE COUNTY

The two Packard auto-trucks have so far proved a great success in hauling ore from the Rellly Fraction open-cut to the War Eagle mill at Manhattan, a distance of 1.9 miles per round trip. The average loads are from 6 to 7 tons, and the time per trip is about a half-hour. The loaded cars run by gravity to the foot of the War Eagle hill, so that the gasoline consumption amounts to less than 1 gal. per trip. The cars keep the mill supplied with about 250 tons for each day's crushing, and the cost of transportation per ton is less than one-third of the cost when horses were used.

The main gulch at Manhattan continues to be the scene of active placer operations, and the yield is said to average from \$4 to \$6 per yard. A nugget worth \$108 was recently found in the Polaris ground. Other good nuggets have been recovered.

The annual report of the Dexter White Caps Mining Co., of Manhattan, gives the following information: On November 15, 1913, the Company took over the property from the White Caps Leasing Co. Cross-cuts and shaft-sinking have since been done at respective costs of \$7.59 and \$19.48 per foot. There are three well defined lodes in the mine, and reserves total 16,679 tons averaging \$14.35 per ton. During 1913 the output was 3555 tons of \$24.30 ore. Royalties received totaled \$6584; balance from 1912, \$9235; and cash at end of 1913, \$9374. A sum of \$1674 is due from the leasing company. It is proposed to consolidate the Associated mill, the White Caps Leasing Co.'s equipment, and the property of the White Caps Mining Company.

The western ore zone of Tonopah has revealed some good developments, and is attracting considerable attention of late. This is especially so in the Extension at 1100 ft., Victor at 1500 ft., Merger at 1170 ft., and also in the Cash Boy. The output of the district during the past week was 11,379 tons of ore, worth \$278,680.

WHITE PINE COUNTY

During the first quarter of 1914 the Giroux Consolidated company produced 20,428 tons of ore yielding copper worth \$79,157, at a cost of \$93,136.

The Nevada Consolidated reports as follows for the first quarter:

Overburden moved, cubic yards	906,097
Ore milled, tons	792,754
Copper production, pounds	15,597,592
Earnings from mine, etc.	\$ 801,441
Dividend No. 18	749,796
Undivided profits	2,892,599
Metals at refinery and in transit	2,690,958
The output was 1,087,363 lb. less than the preceding quarter.	

NEW MEXICO**GRANT COUNTY**

During the first quarter of 1914 the Chino Copper Co. reports the following results:

Overburden moved, cubic yards	938,590
Ore mined, tons	606,990
Ore milled, tons	582,200
Copper, per cent	2.18
Copper production, pounds (including 798,450 lb. from ore smelted)	18,078,128
Extraction, per cent	68.05
Total profit	\$812,087
Dividends paid	\$645,405
Copper on hand and in transit (sold and unsold), pounds	23,444,209

There was an all-round improvement compared with the previous quarter. First-mortgage bonds worth \$112,000 were retired.

(Special Correspondence).—The Oaks Co. holds an option on the Eberle mine and has ordered the necessary equipment for development. Some good ore is showing about 300 ft. in a crosscut, and work will be started there. A survey has been completed for an aerial wire-rope tramway to properties about one mile distant, upon which the Socorro Mining & Milling Co. holds option to purchase. The mill handled 5000 tons of ore in April and shipped over 2 tons of bullion, in addition to several tons of high-grade concentrate. Dividends of 1½ per month are paid on the common stock, the preferred issue being retired from earnings several months ago. This and the Ernestine company are producing over \$2000 per day each.

Mogollon, May 4.

OREGON

The geology and mineral resources of the John Day district, situated in the north central part of Oregon, is described by Arthur J. Collier, in the March issue of 'The Mineral Resources of Oregon,' published by the Oregon Bureau of Mines and Geology, at Corvallis. The area contains coal, limestone, building stone, slate, basalt, chromite, copper, gold and silver, and artesian water.

SOUTH DAKOTA

The 'Minerals of the Black Hills,' by Victor Ziegler, is the subject of *Bulletin 10*, published by the South Dakota School of Mines at Rapid City. It consists of 250 pages, and is well illustrated by halftones, maps, and charts. There are 300 minerals described, as occurring in this area, many of them being rare species. The total production of gold, the most important product of the Black Hills, amounts to about \$180,000,000.

UTAH**JUAB COUNTY**

The North Tintic district is more active than for some time past. A small cave was recently opened above the 400-ft. level of the Iron Blossom at Tintic, and good ore is showing.

SALT LAKE COUNTY

The Utah Copper Co. reports as follows for the first quarter of 1914:

Capping moved, cubic yards (March record, 608,517 cu. yd.)	1,519,940
Bingham & Garfield Railway, average per day, tons of ore	16,399
Ore milled at Magna and Arthur plants, tons	1,962,100
Average copper content, per cent	1.3411
Copper production, pounds	32,846,155
Net profit from mills, rents, dividends, etc.	\$1,965,074
Dividends paid	1,189,440
Surplus for quarter	775,634

Wet and frozen ore interfered with the regular mining and milling but although the tonnage milled was lower, the yield was higher than the last quarter of 1913.

SUMMIT COUNTY

The Snake Creek adit was driven 314 ft. in April. The flow of water is now 5000 gal. per minute. An 18-in. ad-pipe is kept within about 100 ft. of the face of the adit, and operating by suction quickly clears away the smoke and gases after each shot. After connection is made with the Daly Judge workings, this pipe will not be needed for air, but can be used to help take care of any flow of water that may exceed the capacity of the ditch, which is 12,000 gal. per minute. It is estimated the pipe would carry, with suitable head, 10,000 gal. per minute.

Good progress is being made with the erection of the plant for the Park City Milling Co. A number of tanks have been shipped from San Francisco by the Mine & Smelter Supply Co. G. H. Seibold is in charge of construction.

WASHINGTON

A Bureau of Mines rescue car, for mine rescue and first-aid training, from the Seattle station, J. J. Corey, foreman, will be at Fairfax from May 11 to 16, Seattle from May 16 to 24, and at Roslyn from May 24 to June 4. Billings car No. 5 will be at Spokane for repairs from May 18 to 23.

OKANOGAN COUNTY

A vein from 16 to 20 ft. wide, containing lead and silver, averaging \$7 per ton, has been opened for a good distance in the Caaba mine, near Oroville. Below this the ore contains 5% of copper. The shaft is being sunk to 1000 ft. The property is under option to the United Mines Co. There is a 20-stamp mill near this mine, also 10 stamps and a 60-ton electrically driven Morris pulverizer on the Owasco group, held under option, five miles distant.

SPOKANE COUNTY

Dealings on the Spokane Stock Exchange in April, in 36 different mining companies in Idaho, Washington, and British Columbia amounted to 392,490 shares worth \$67,995.

STEVENS COUNTY

Smelter returns from the Grand Forks plant, on 33 tons of ore from the United Copper mine at Chewelah, amounted to \$3290 net. The ore averaged 20% copper, 174 oz. silver, and some gold. A raise is being driven in the new shoot, and should connect with the upper workings about the middle of June. An output of 200 tons of ore per day is expected when this is through.

CANADA**BRITISH COLUMBIA**

Copper weighing 122 tons has been shipped from the Granby company's new smelter at Hidden Creek to New Jersey for refining. This is the first return. Between 700 and 800 men are employed at the mine and plant. The Grand Forks smelter treated 101,153 tons of ore in April yielding 1,692,102 lb. copper, and for the first four months of 1914, 401,246 tons of ore yielding 6,900,652 lb. copper.

ONTARIO

The richest shipment of silver ore for the current year from Cobalt has recently been sent to Saxony, Germany, from the Crown Reserve mine. Twenty tons will average about 4000 oz. per ton, worth a total of \$50,000. From 125 to 150 tons of ore is being sent daily from this mine to the Dominion Reduction mill. The shareholders of the Chambers-Ferland company recently had a stormy meeting at Cobalt. Prospecting by hydraulicking has been started for the season at the Nipissing mine. At the Dome, the main shaft is down 514 ft. Additions to the mill should be finished at the end of the current month.

Personal

E. B. KIRBY is in New York.
H. FOSTER BAIN has gone to New York.
M. B. KURYLA has returned from Costa Rica.
E. M. HAMILTON is returning from San Salvador.
KARL EILERS was in San Francisco on Monday.
CHARLES BUTTERS is in the hospital in New York.
KIRBY THOMAS is in Virginia on professional work.
F. F. SHARPLESS was in San Francisco over Sunday.
S. W. AUSTIN has gone to Washington and New York.
ALFRED VON DER ROPPE left New York for California on May 8.
ALFRED JAMES is expected in New York on his way to Canada.

A. W. GEIGER has resigned as manager for the California Ore Testing Company.

C. R. VAN ARSDALE has gone to Arizona, expecting to return to New York within a month.

H. W. ALDRICH, who has been visiting smelters in the South was in San Francisco this week.

C. E. BUNKER is manager for the Oroya Leonesa, Matagalpa, Nicaragua, succeeding H. W. COE.

L. D. RICKETTS has been elected a director of the Inspiration Consolidated Copper Company.

A. C. H. GERHARDT, formerly of South Africa, is with the Iron Mountain Copper Co. in charge of engineering operations.

W. A. HAYWOOD is at Aroa, Venezuela, superintending the blowing in of the smelter of the South American Copper Syndicate.

MORTON WEBBER is in Idaho on examination work. His other professional engagements will make his return to New York indefinite.

SUMNER S. SMITH and WILLIAM J. MALONEY, the federal and territorial mine inspectors of Alaska, recently visited the Goldstream district and report very little activity at present.

H. C. H. CARPENTER, professor of metallurgy at the Royal School of Mines, London, has been in San Francisco, and is to visit Tonopah, Goldfield, Butte, Houghton, Colbalt, and Porcupine. He has already studied metallurgical methods at Cripple Creek and in Utah.

Obituary

NEWTON H. WINCHELL, geologist, and archeologist, was born at North East in Dutchess county, New York, on December 17, 1829. He received the bachelors degree from the University of Michigan in 1866 and in 1869 the master's degree. Upon graduation he became the assistant state geologist of Michigan, and in 1870 was appointed to the same position for the state of Ohio. In 1872 he became the state geologist of Minnesota, which position he held until 1900. In 1906 he was appointed archeologist for the Minnesota Historical Society. Among his many attainments in the course of a long and useful professional career may be mentioned his membership on the U. S. Assay Commission in 1887; founder and editor of the *American Geologist*; fellow in the A. A. A. S.; president of the Geol. Soc. of America; member of Soc. de Min. Francaise; Soc. Geol. de Belge; American Anthropol. Assn.; Minn. Acad. of Science, of which he was a founder and three times the president; N. Y. Acad. of Science; Washington Acad. of Science; Am. Geol. Soc.; and many other scientific organizations. His writings on geological subjects in some of which he collaborated with his sons, Horace V. Winchell and Alexander N. Winchell, will be remembered as valuable additions to the literature. His death, which occurred last week, will be mourned by his many friends and colleagues in the field of science.

Society Meetings

Name.	MAY	Date.
American Institute of Mining Engineers, Columbia Section, Roseland-Trail, B. C.	22-24
American Iron and Steel Institute	22
Chemical, Metallurgical and Mining Society of South Africa, Mining Exhibition, Johannesburg	19-29
Geological Society of America (Cordilleran Section), Seattle	21-23
Institution of Mining and Metallurgy, London	21
Seismological Society of America, Seattle	21-23

JUNE

American Institute of Electrical Engineers	.....	22 or 26
American Society for Testing Materials	.....	23-27
American Society of Mechanical Engineers	.....	end of June
Cleveland Engineering Society	.....	9
Colorado Scientific Society, Denver	.....	6
Franklin Institute, Philadelphia	.....	end of June
Society for the Promotion of Engineering Education	.....	29 to July 2

JULY

Northern California and Southern Oregon Mining Congress, Ashland, Oregon	9-10
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AUGUST

American Institute of Mining Engineers, Salt Lake City	10-14
Canadian Mining Institute, Rocky Mountain branch, Banff	
Lake Superior Mining Institute, Marquette, Michigan	.....	17

SEPTEMBER

American Chemical Society	.....	9-12
American Institute of Electrical Engineers	.....	not fixed
Colorado Scientific Society, Denver	.....	3

OCTOBER

American Institute of Electrical Engineers	.....	9
American Iron and Steel Institute	.....	23-24
Colorado Scientific Society, Denver	.....	3

NOVEMBER

American Institute of Electrical Engineers	.....	13
Colorado Scientific Society, Denver	.....	7

DECEMBER

American Institute of Electrical Engineers	.....	11
American Society of Mechanical Engineers	.....	7-8
American Museum of Safety	.....	11-20
Colorado Scientific Society, Denver	.....	6 and 19
Geological Society of America, Philadelphia	.....	29-31
Society of Gas Lighting (annual meeting)	.....	10
Society of Naval Architects	.....	11-12

JUNE 1915

Sixth International Congress of Mining, Metallurgy, Applied Mechanics, and Practical Geology, London	
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AUGUST 1915

American Association for Advancement of Science, San Francisco	17
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SEPTEMBER 1915

American Institute of Mining Engineers, San Francisco	27-30
Engineering Congress, San Francisco	20-26

DECEMBER 1915

Old Freibergers in America	19
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The CLEVELAND ENGINEERING SOCIETY met on May 12, when 'The Preservation of Iron and Steel' was discussed by Robert Cathcart. On May 16 the subject, by George W. Tillson, is 'The Relative Merits of Paving Materials.' The annual meeting will be held on June 9.

The Metal Markets

LOCAL METAL PRICES San Francisco, May 14

Antimony	9 — 9 3/4 c
Electrolytic copper	15 1/2 — 15 3/4 c
Pig lead	4 1 1/2 — 5 1/4
Quicksilver (flask)	\$32.00
Tin	40 1/2 — 42 c
Spelter	6 1/2 — 6 3/4 c
Zinc dust, 100 kg zinc-lined cases, 7 1/2 to 8 c per pound	

EASTERN METAL MARKET

(By wire from New York)

NEW YORK, May 14. There has been little movement in copper, although it shows a slight upward tendency. Lead and spelter are quiet but steady. Copper shares are strong, business being done in Utah Consolidated, Chino, Nevada Consolidated, and Tennessee; Amalgamated moved slowly, but Anaconda was neglected. Generally there was dullness on 'Change. Trouble on the London market has affected business somewhat. Tin is firm at 33 7/8 to 33 9/8 in New York, and antimony dull at 7 1/2 to 7 3/8. In London, copper is quiet at 63 2s. 6d to 63 12s. 6d, tin at 1153 5s. to 1155 2s. 6d, and spelter 121 7s. 6d. Bar silver is 26 9/16. Mining in Mexico is further curtailed, according to reliable reports of Americans who have left Pachuca, El Oro, and Guadalajara.

SILVER

Below are given the average New York quotations in cents per ounce, of fine silver.

Date	Average week ending
May 7	58.75
" 8	58.87
" 9	58.87
" 10 Sunday	58.35
" 11	58.75
" 12	58.50
" 13	58.62

Monthly averages.

Monthly Average					
	1913.	1914.		1913.	1914.
Jan.	63.01	57.58	July	58.70	
Feb.	61.25	57.53	Aug.	59.32	
Mch.	57.87	58.01	Sept.	60.53	
Apr.	59.26	58.52	Oct.	60.88	
May	60.21		Nov.	58.76	
June	59.03		Dec.	57.73	

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date	Average week ending
May 7	3.90
" 8	3.90
" 9	3.90
" 10 Sunday	3.90
" 11	3.90
" 12	3.90
" 13	3.90

Monthly averages.

	1913.	1914.		1913.	1914
Jan.	4.28	4 11	July	4.35	.....
Feb.	4.33	4 02	Aug.	4.60	.....
Mch.	4.32	3.94	Sept.	4.70	.....
Apr.	4.36	2 86	Oct.	4.37	.....
May	4.34	.....	Nov.	4.16	.....
June	4.33	.....	Dec.	4.02	.....

COPPER

Quotations on copper as published in this column represent average wholesale transactions on the New York market and refer to electrolytic copper. Lake copper commands normally 1-5 to 1-4c. per lb. more. Prices are in cents per pound.

Date	Average week ending
May 7	13.90
" 8	13.90
" 9	13.90
" 10 Sunday	13.90
" 11	13.95
" 12	13.95
" 13	14.00

Monthly averages.

	1913.	1914.		1913.	1914.
Jan.	16.54	14.21	July ..	14.21	....
Feb.	14.93	14.46	Aug.	15.42	....
Mch.	14.72	14.11	Sept.	16.23	....
Apr.	15.22	14.19	Oct.	16.31	....
May	15.42	....	Nov.	15.08	....
June	14.71	....	Dec.	14.25	....

German consumption of foreign copper during the first quarter of 1914 totaled 53,622 tons, against 44,955 tons in the same term of 1913. Of the current year's consumption, 48,399 tons was imported from the United States.

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below.

Week ending	Apr. 29	May 7
Apr. 16	39.00	39.00
" 23	38.50	39.00

Monthly averages	1913.	1914.
Jan.	39.47	39.55
Feb.	41.00	39.00
Mch.	40.20	39.00
Apr.	41.00	38.90
May	40.25	39.00
June	41.00	39.00

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date	Average week ending
May 7	4.90
" 8	4.90
" 9	4.90
" 10 Sunday	4.90
" 11	4.90
" 12	4.90
" 13	4.90

Monthly averages.

1913.		1914.		1913.		1914.	
Jan.	6.88	5.14	July	5.11			
Feb.	6.13	5.22	Aug.	5.51			
Mch.	5.94	5.12	Sept.	5.55			
Apr.	5.52	4.95	Oct.	5.22			
May	5.23		Nov.	5.09			
June	5.00		Dec.	5.07			

TIN

New York prices control in the American market for tin, since the metal is almost entirely imported. San Francisco quotations average about 5c. per lb. higher. Below are given average monthly New York quotations, in cents per pound:

Monthly averages.					
	1913.	1914.		1913.	1914
Jan.	50.45	37.85	July	40.70	...
Feb.	49.07	39.76	Aug.	41.75	...
Mch.	46.95	38.10	Sept.	42.45	...
Apr.	49.00	36.10	Oct.	40.61	...
May	49.10	...	Nov.	39.77	...
June	45.10	...	Dec.	37.57	...

April tin statistics were as follows, according to L. Vogelstein & Co: supplies from all sources, into Europe and the United States, 8265 tons; deliveries, 9858 tons; visible supplies, landing and in transit, 16,597 tons; average price per pound in New York, 36 11c.; and in London, £218 10s. to £231 10s. per ton.

COPPER PRODUCERS' ASSOCIATION REPORT

The Copper Producers' Association statement for April shows an increase in production and increase in stocks on hand. The details are as follows:

	Pounds.
Stocks of marketable copper of all kinds on hand at all points in the United States, April 9, 1914	64,609,319
Production of marketable copper in the United States from all domestic and foreign sources during April	151,590,531
Deliveries for consumption, April	63,427,633
Deliveries for export, April	82,345,216
Stock of marketable copper of all kinds on hand and at all points in the U. S., May 2	70,337,001

Recent changes in surplus have been as follows, in pounds:

	Increase.	Decrease.
April 1913	28,720,162	
May	8,074,883	
June	11,569,619	
July	690,330	
August	15,280,908	
September	8,531,043	
October	2,773,288	
November	15,363,047	
December	43,599,438	
January 1914	4,142,182	
February	8,924,833	
March	13,762,533	
April	5,727,682	

Asbestos production of Ural district of Russia amounted to 1,032,003 pounds (58.6 pounds per short ton) in 1913, an increase of 25,324 pounds over 1912. The demand for this product is mainly from foreign countries, and the output is increasing.

The Stock Markets

SAN FRANCISCO STOCKS AND BONDS

(San Francisco Stock and Bond Exchange.)

May 13.

BONDS

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Associated Oil 6s.....	\$ 97½	98	Natomas Consol. 6s.....	5	—
Natomas Con.....	—	35	Pac. Port. Cement 6s.....	100	—
Unlisted.			Santa Cruz Cement 6s.....	85	88
Ass. Oil 6s.....	75	80½	Union Oil.....	86½	—
General Petroleum 6s.....	35	39			

STOCKS

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Amalgamated Oil.....	78	—	General Petroleum.....	3½	—
Associated Oil.....	38½	—	Noble Electric Steel.....	50c	—
Giant.....	85	—	Natomas Consol.....	50c	—
Pac. Ost. Borax. com.....	50	—	Pac. Port. Cement.....	90	94
Sterling O. & D.....	—	1½	Riverside Cement.....	—	63
Union Oil.....	—	71½	Santa Cruz Cement.....	4	—
West Coast. pfd.....	—	112½	Stand. Port. Cement.....	—	20

NEVADA STOCKS

(By courtesy of San Francisco Stock Exchange.)

May 14.

Atlanta.....	\$.20	Montana-Tonopah.....	\$.80
Belcher.....	.32	Nevada Hills.....	.33
Belmont.....	7.12	North Star.....	.28
Con. Virginia.....	.08	Ophir.....	.14
Florence.....	.52	Pittsburg Silver Peak.....	.29
Goldfield Con.....	1.40	Round Mountain.....	.28
Goldfield Oro.....	.11	Sierra Nevada.....	.05
Halifax.....	.75	Tonopah Extension.....	2.52
Jim Butler.....	1.00	Tonopah Merger.....	.57
Jumbo Extension.....	.24	Tonopah of Nevada.....	6.60
MacNamara.....	.03	Union.....	.08
Mexican.....	.89	Victor.....	.23
Midway.....	.52	West End.....	.87
Mizpah Extension.....	.33	Yellow Jacket.....	.19

CALIFORNIA STOCKS

(Latest Quotations.)

	Bid.	Ask.		Bid.	Ask.
Argonaut.....	\$2.50	—	Central Eureka.....	\$0.16	0.17
Brunswick Con.....	1.05	—	Mountain King.....	0.46	0.50
Bunker Hill.....	1.90	—	South Eureka.....	1.25	—

COPPER SHARES—BOSTON

(By courtesy of J. C. Wilson, Mills Building.)

May 14.

	Bid	Ask		Bid	Ask
Allouez.....	40½	41	Mohawk.....	\$ 4½	45
Ariz. Commercial.....	4½	4½	Nevada Con.....	14½	14½
Butte & Superior.....	39½	39½	North Butte.....	26½	27
Calumet & Arizona.....	65½	65½	Old Dominion.....	47½	48
Calumet & Hecla.....	420	425	Oscuela.....	75	76
Copper Range.....	37½	38	Quincy.....	59	59½
Daly West.....	—	2	Shannon.....	6½	6
East Butte.....	10½	10½	Superior & Boston.....	2½	2½
Franklin.....	4½	5½	Tamarack.....	36	36½
Granby.....	8½	8½	U. S. Smelting. com.....	33	33½
Greene Cananea.....	33½	34½	Utah Con.....	10½	11
Istle-Royale.....	20½	20½	Winona.....	34	3½
Mass Copper.....	4½	4½	Wolverine.....	42	4½

NEW YORK CURB QUOTATIONS

(By courtesy of E. F. Hutton & Co., Kohl Building.)

May 14.

	Bid.	Ask.		Bid.	Ask.
Braden Copper.....	7½	8½	La Rose.....	1¾	1½
Braden 6s.....	160	165	Masson Valley.....	2	3
B. C. Copper.....	1¾	1¾	McKinley-Dar.....	6½	66c
Con. Cop. Mines.....	1½	1¾	Mines Co. Am.....	2½	3½
Davis-Daly.....	½	¾	Nipissing.....	6	6½
Ely Con.....	2	4	Ohio Copper.....	¼	¾
First National.....	1¾	2	Stand. Oil of Cal.....	30½	—
Giroux.....	½	1	Tri Bullion.....	¼	¼
Hollinger.....	15½	17	Tuolumne.....	5½	5½
Iron Blossom.....	1½	1¾	United Cop. com.....	¼	¾
Kerr Lake.....	½	¾	Yukon Gold.....	2½	2½

NEW YORK STOCK EXCHANGE

(By courtesy of J. C. Wilson, Mills Building.)

May 14.

	Bid	Ask		Bid	Ask
Amalgamated.....	\$ 73½	73½	Miami.....	\$ 22	22½
Anaconda.....	32½	32½	Nevada Con.....	14½	14½
A. S. & R., com.....	62½	—	Quicksilver, com.....	1½	1½
Calif. Pet. com.....	21	21½	Ray Con.....	21½	22
Chino.....	42½	42½	Tenn. Copper.....	85½	85½
Guggenheim Ex.....	54½	55	U. S. Steel, pfd.....	109	109½
Inspiration.....	17	17½	U. S. Steel, com.....	61	61½
Mexican Pet., com.....	58½	—	Utah Copper.....	57½	58

ORE MILLED on the Rand in March was 2,094,098 tons averaging \$6.32, and cost \$4.14 per ton for all operations. The total profit was \$4,650,000.

Gold worth \$1,000,000 was shipped from San Francisco to the Philippines on May 5. This is the first movement of gold to this territory for several years.

OPERATIONS at the U. S. Assay Office in New York in April totaled \$2,862,086. For the first four months of the current year the business amounts to \$27,712,248, against \$34,283,992 for the whole of 1913.

Production Statistics

Final figures of mineral production of the various states in 1913 are being collected, and the U. S. Geological Survey has published the following data regarding the central states, as compiled by J. P. Dunlop:

ARKANSAS

The value of the mine output of lead and zinc in this state was \$55,120, compared with \$106,014 in 1912. None of the concentrating plants in Arkansas were in active operation during 1913, and the ore shipped was either hand-cobbed or recovered by hand firs. Nearly all the mixed sphalerite and carbonate was mined by J. Conness Shepherd at the Red Cloud, Climax, and Morning Star mines, in the Rush district, Marion county. The Morning Star mine was also the largest producer of high-grade zinc carbonate. The Frisco and Gloria mines, in the zinc district, Boone county, were worked steadily by L. L. Brown, and the output was the second largest in the state. The small lead shipments were made by the Washington Mining Co., of Washington county, J. W. Park, of Marion county, and N. B. Whitely of Newton county.

ILLINOIS

The value of the silver, lead, and zinc produced at mines in 1913 was \$336,963, compared with \$679,259 in 1912. Shipments of silver-bearing galena concentrate from the southern Illinois fluorspar region amounted to 507 tons, or 290 tons less than in 1912. The decrease in output was due chiefly to the flooding of the Rosiclare mines, the largest producers of lead concentrate in the region, though the Fairview mine also reported smaller shipments of galena in 1913. The lead concentrates yielded an average recovery of 7 oz. of silver per ton. With the exception of one mine in the Elizabeth district, which produced a small quantity of galena, the mines near Galena were the only producers in northwestern Illinois. Development work was more active than in previous years and several mines were placed on a productive basis in the latter part of the year, so that the output in 1914 will probably be much larger than in 1913.

The Vinegar Hill Zinc Co. operated the Vinegar Hill, Eadie, and Marsden Black Jack mines, but the Unity mine, a large producer in former years, was not worked. The old Marsden Black Jack was opened again, and the property was equipped with a 200-ton plant, which was in operation during the past three months of 1913. The Northwestern Zinc Co., was a large producer of both lead and zinc, and the Great Western Lead Manufacturing Co., developed a new mine on the Brown land

and moved the Calvert mill from Benton. Lead and zinc concentrates were sold by the Ten Strike, Josephine, Betsy, and Glen Ridge mines.

KANSAS

The value of the lead and zinc produced at mines in Kansas was \$1,343,432, compared with \$1,689,744 in 1912. The decrease was due to the lower price of spelter and to the decline in recoverable spelter from 10,637 tons in 1912 to 10,088 tons in 1913. Most of the mines in the Badger-Peacock district were idle, and the district produced little ore. The Lawton district was active, several new concentrating plants were erected, and the mine output was double that of 1912. The output will probably be still greater in 1914, as several new plants will be in operation. Mine developments compared favorably with those of other years, in spite of lower prices paid for zinc concentrate, and the production exceeded the sales, so that the decline in production was not nearly as large as the figures indicate. The percentage of concentrate recovered to crude ore mined increased appreciably, indicating a lower proportion of ore from the "sheet ground."

MISSOURI

The value of the mine output of silver, copper, lead, and zinc in Missouri was \$29,604,890, compared with \$34,914,761, in 1912. The decrease was due mainly to the output of sphalerite concentrate being about 19,000 tons less in quantity and \$9 per ton less in value than the output in 1912. The production of sphalerite concentrate, of which all but 33 tons was derived from the Joplin region, amounted to 225,850 tons. The output of zinc carbonate and silicate in 1913 was 21,531 tons, compared with 22,172 tons in 1912. About half of this kind of zinc ore was shipped from leases of the Granby Mining & Smelting Co. at Granby, Missouri. The recoverable spelter content of the zinc concentrate (which averaged slightly lower in 1913 than in 1912), was 124,963 tons in 1913, against 136,551 tons in 1912. The total quantity of lead concentrate produced was 255,723 tons, or 1115 tons less than in 1912. The mines operating in the district of disseminated lead in southeastern Missouri reported the production of 218,949 tons of galena concentrate, averaging 67.2% lead. The Joplin region reported the sale of 35,979 tons of galena concentrate and 323 tons of lead carbonate concentrate, a slightly smaller yield of both classes of ore than in 1912. The estimated total quantity of lead, zinc, and copper ore treated in Missouri in 1913 was 12,300,600 tons, or about 1,000,000 tons less than in 1912. The decrease was due almost wholly to the lessened activity in the "sheet ground" mines in the Joplin region. A good deal of prospecting was successful, and when prices advance many districts in the Joplin region will show an increased output. The yield of silver and copper was derived mainly from the dressing of lead concentrate from mines in southeastern Mis-

sour.¹ [Details of the production of various districts in Missouri was published in this journal of January 10, 1913.]

OKLAHOMA

Oklahoma was the only one of the central states which showed a larger output of both lead and zinc in 1913 than in 1912. The value of the silver, lead, and zinc produced at mines was \$1,855,217, compared with \$1,101,942 in 1912. The metal content of lead concentrate increased from 3388 tons, valued at \$304,920, in 1912, to 6228 tons, valued at \$548,064, in 1913, and the recoverable spelter increased from 5769 tons, valued at \$706,122, to 11,664 tons, valued at \$1,306,368. The increased yield of lead and zinc in 1913 was entirely due to operations in the Miami field, as the mines in the Quapaw and Peoria districts reported a much smaller output and there were no shipments of sphalerite from the Arbuckle Mountain region in Murray county. The relatively small output of zinc silicate came entirely from the Peoria mines. Most of the mines in the Quapaw district were idle the greater part of 1913 and the value of their product was less than half that of 1912. Drilling operations were conducted over a wide area from the immediate vicinity of the city of Miami northeast to the Kansas line and southwest across Neosho river. This drilling resulted in the discovery of some extensive bodies of mineralized ground, the sinking of new shafts, and the erection of concentrating plants, some of which were not put in operation during 1913. The water-level has been lowered to about 320 ft., and an increasing quantity of ore was hoisted from the lower levels. The most productive mines on the Commerce Mining & Royalty Co.'s lands were the Mizpah, Turkey Flat, Cactus, Sullivan, Old Chief, Midas, Lennan, King Jack, and Lost Trail. On the Emma Gordon Mining Co.'s lease the producing mines were the Carson, Thirty Acre, Emma Gordon, Prairie, and Miami (Lennan).

WISCONSIN

The value of the mine output of lead and zinc in this state was \$3,570,464. The value of the production in 1912 was \$4,793,190, the decrease in 1913 being, therefore, \$1,222,726.

The Benton district was much the largest producer of both lead and zinc concentrates, though the yield of galena declined 256 tons and that of sphalerite 4217 tons compared with 1912. Hazel Green was the next largest producer of sphalerite, with shipments of 18,499 tons, or about 1100 tons less than in 1912. The only districts in Wisconsin which showed materially increased shipments of lead and zinc concentrates were Linden and Livingston.

[Details of the production of the various districts in Wisconsin were published in this journal of January 17, 1913.]

Average market prices used by the Survey in 1913 were as follows: silver, 60.4c. per oz.; electrolytic copper, 15.5c.; lead, 4.4c.; and spelter, 5.6c. per pound.

SUMMARY OF ALL CENTRAL STATES

State.	Ore treated, short tons.	Silver, fine oz.	Copper, pounds.	Lead, short tons.	Zinc, short tons.	Total value.
Arkansas	13,000	.....	.....	18	478	\$ 55,120
Illinois	*119,200	3,541	.....	959	2,236	336,963
Iowa .....	†	.....	.....	65	.....	5,720
Kansas	590,300	.....	.....	2,427	10,088	1,343,432
Kentucky .....	‡	.....	.....	22	327	38,560
Michigan	7,016,370	295,173	135,853,409	.....	.....	21,235,561
Missouri	12,300,600	35,620	576,204	176,116	124,963	29,604,890
Oklahoma	581,100	1,300	.....	6,228	11,664	1,855,217
Wisconsin	1,406,000	.....	.....	1,866	30,413	3,570,464
Total 1913	23,026,570	335,634	136,429,613	187,701	180,169	\$58,045,927
Total 1912	27,379,456	568,622	218,579,133	186,891	191,307	\$79,675,814

*Includes only ore from northwest Illinois; tonnage of ore from southern Illinois not available.

†Production from shallow mining; galena hand cobbled.

‡Tonnage not available.

Company Reports

PIONEER TIN MINING COMPANY

This Company's property is at Bradshaw's creek, Tasmania, and the report is for the year ended December 31, 1913. Tin grit sluiced was 450,600 cu. yd., yielding 327 tons of black tin. The Pioneer property averaged 1.793 lb. per yard, at a cost of 10.51c. per yard. A dividend of 60c. per share was paid.

NEW CHUQUITAMBO GOLD MINES, LIMITED

This Company operates a gold mine in the district of Cerro de Pasco, Peru. The property has been developed by open cuts and adits and is equipped with a long tramway, 40-stamp mill, and cyanide plant. During the year ended June 30, 1913, the amount of ore treated was 23,673 tons, yielding a profit of £2370. The cyanide plant has up to the present proved ineffective, and is the cause of monthly returns not being up to anticipation.

WAIHI-PAEROA GOLD EXTRACTION COMPANY

The business of this Company is to recover tailing deposited in the Ohinemuri river by the mills of various properties at and near Waihi, New Zealand, and recover the gold contained. The tube-mill plant, described in this journal of May 10, 1913, is the largest in the world, and the capacity of the regrinding and cyanide plants is 500 tons per day. During 1913 the river was very low and interfered with dredging work. Another grab dredge is to be installed. Tailing treated amounted to 140,100 tons yielding \$202,000, with a net profit of \$24,000. Since 1912 over 255,700 tons has been treated for gold worth \$385,000.

FRONTINO AND BOLIVIA (SOUTH AMERICAN) GOLD MINING COMPANY, LIMITED

This Company's property consists of gold mines known as Silencio, Cordoba, la Salada, San Joaquin, and others, having a total area of 5000 acres in the republic of Colombia. Some of the mines are being leased and others are being worked by the Company. An electric plant is at work. During the year ended June 30, 1913, the tonnage treated in the reduction works was 32,888 tons averaging \$12.30 per ton. The revenue was \$410,000 from this ore, and \$39,000 from lessees, etc. Costs, including London expenses, were \$10.48 per ton, and the profit \$80,000. Ore reserves in three mines are estimated as 41,200 tons worth from \$5 to \$18 per ton.

AMALGAMATED ZINC (DE BAVAY'S), LIMITED

This Company's business is to purchase current and old tailing from certain mining companies at Broken Hill, New South Wales, treat the product by flotation, and ship zinc concentrate for export. The annual meeting was held in Melbourne, Victoria, on March 26. During the second half of 1913 the plant treated 253,225 tons of tailing yielding 73,947 tons of zinc concentrate, averaging 49.2% zinc, 6% lead, and .9% silver; also, 804 tons of lead concentrate averaging 52.2% lead, 35.3 oz. silver, and 18.6% zinc. This output was 7796 tons of zinc and 24 tons of lead concentrate over that of the preceding period. The revenue was \$1,277,000; working profit, \$295,000; and adding the balance from the last period, the amount available was \$680,000, of which \$297,000 was paid in dividends.

OOREGUM GOLD MINING COMPANY OF INDIA, LTD.

This is another Indian company, managed by John Taylor & Sons, of London, the property being in charge of R. H. P. Bullen. The reports for 1913 include the following information: The total number of workmen employed was 4694, of

whom 2903 natives were underground and 97 were Europeans. Development totaled 14,813 ft. In Taylor's stope of the mine good ore was opened on No. 44, 46, and 47 levels, south of the dike. In the south part of Oakley's stope rich quartz ore is being extracted on No. 51 level, the deepest in the mine. No. 42, 43, 44, and 45 levels in Bullen's stope is developing well. Ore reserves amount to 186,947 tons. The mill crushed 153,636 tons of ore, and the sand and slime plants 139,876 and 26,330 tons respectively, with a total gold production worth £360,889. All costs amounted to \$5.44 per ton. The profit was £174,332, of which £129,251 was paid in dividends. The output since 1888 is 2,402,346 tons valued at £6,639,539, and £2,214,821 in dividends.

LONELY REEF GOLD MINING COMPANY, LTD.

This Company's property is near Inyati, Rhodesia, and the report for 1913 includes the following information: Ore reserves are estimated at 172,557 tons averaging \$17.14 per ton. Recent development shows a low-grade zone at No. 10 level; but a winze below this level has been sunk from 62 ft. to 110 ft. since the beginning of the current year, and has opened better ore. The lode was strong, but unprofitable for nearly 40 ft., after which it improved to \$15.50 over 57 in. at 105 ft., and \$14 over 51 in. at 110 ft., the deepest point. It is hoped that this may indicate that the limit of the low-grade zone on No. 10 level has been reached. The mill treated 58,903 tons of ore yielding gold worth £218,520. Dividends totaling £81,302 were paid, and £53,709 spent on capital work. The balance carried forward is £13,192, against £31,214 in the previous term. Working costs were \$7.52 per ton.

GREAT BOULDER PERSEVERANCE GOLD MINING COMPANY, LIMITED

This Company's property is in the heart of the 'Golden Mile,' Kalgoorlie, Western Australia, and the report for 1913 contains the following: Development covered 8065 ft. at a cost of \$10.93 per foot. Ore reserves total 516,978 tons of positive and 321,280 tons of probable ore, averaging \$5.50 per ton. The stock of broken ore amounts to 200,178 tons. Work on the Furness and 'D' lodes has given good results. At 2050 ft., a branch of the Lake View lode, of better value than the original drift, may lead to better results at 2200 ft. The dry crushing, roasting, pan grinding, agitating, and filter-pressing plants treated 244,341 tons, yielding 59,451 oz. gold and 6865 oz. silver, worth £253,219. The recovery was 90.26% at a cost of \$2.31 per ton. Costs were: mining, \$1.70; stope filling, 1c.; treatment, \$2.31; disposal of residue, 11c.; and general expenses, 18c.; a total of \$4.31 per ton, or £220,604. After writing off development and depreciation, the net profit was £6897. The balance from 1912 was £57,747, and that for 1913 is £64,644.

NIPISSING MINES COMPANY

This Cobalt, Ontario, Company is so well known that it needs no introduction for its report for the year ended December 31, 1913. The general manager, R. B. Watson, makes the following statement on the work done: Prospecting by hydraulicking was done in 217 days, clearing an average of 3.9 ft. of overburden from 54.69 acres. The work exposed a number of stringers and some promising fissures worth further development. Diamond-drilling in six holes in the diabase area totaled 2239 ft. Results were not favorable. Underground work amounted to 13,664 ft., and 44,017 cu. yd. of stoping. Broken ore in stopes at the end of the year was 65,393 tons. Ore reserves consist of 2464 tons averaging 1897 oz. silver per ton, and 212,180 tons assaying 22.8 oz., the total silver being 9,510,014 oz. The high and low-grade mills treated 1200 and 77,240 tons of ore respectively. The refinery produced 6,530,871 oz., of which 4,844,169 oz. was from Nipissing ore. The average price received was 60.261c. per oz., and the revenue

from silver, cobalt, and nickel was \$2,929,796 net. The cost of production was \$1,096,741. Dividends amounted to \$1,800,000, and the surplus is \$1,259,061. The output to date is 32,585,418 oz. silver, yielding a net value, including cobalt, nickel, and arsenic, of \$17,569,166, of which \$11,998,297 has been paid in dividends.

BUNKER HILL & SULLIVAN MINING & CONCENTRATING COMPANY

The report of this important Idaho Company for 1913 is presented in its usual excellent form, containing 30 pages of data and three large mine plans. Operations, including the statement of the manager, Stanley A. Easton, and the accounts are best given in tabulated form:

Mine:	
Development, feet	2,203
Cost per foot	\$8.849
Ore reserves (Stemwinder, Sullivan, and Bunker Hill mines, tons)	3,842,010
Ore stoped, tons	436,060
Cost per ton:	
Stoping	\$1.396
Tramming	0.067
Holisting (315,456 tons)	0.059
Pumping	0.041
General mine expense	0.582
Underground improvements	0.067
Total mining cost, including development	\$2.225
Mill:	
Time in operation, days	355
Ore concentrated, tons	436,643
Cost per ton:	
Crushing and conveying	\$0.070
Screening	0.025
Jigging	0.062
Grinding	0.045
Concentrating	0.067
General mill expense	0.192
Improvements	0.013
Total milling cost (including north mill treating 72,392 tons of tailing)	\$0.506
Concentrate produced, tons (27.6c. cost per ton) ...	59,471
Average content of lead in ore, per cent.	10.154
Average content of silver in ore, ounces	3.971
Recovery, per cent:	
Lead	80.13
Silver	70.03
Production:	
Lead, pounds	71,860,773
Silver, ounces	1,227,076
Financial:	
Revenue from metals	\$3,890,139
Profit from operations	1,119,961
Other revenue	165,790
Total profit	\$1,285,751
Dividends paid	817,500
Balance at end of 1913, including that from 1912, and excess over book values of mine and plant. . .	2,880,203

The result of the year's work, as to production, earnings, and new ore found, compares well with that of past years. The development of new ore on No. 13 level, 800 ft. vertically below the Kellogg (mill adit) tunnel, has been satisfactory. The continuation to this level of three important ore-shoots from No. 12 level and their great value, has been already shown. The shaft is being sunk to No. 14 level, with all conditions regular and normal. More of the old upper workings of the Tyler, Bunker Hill, Stemwinder, and Sullivan mines were thrown open to tributaries, or lessees, and as royalties from this production there was collected during 1913 the sum of \$14,256.

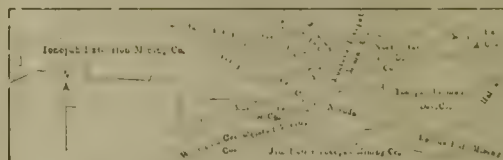
Research and experimental work to improve the mill work was continued throughout the year, and the economic extraction shows 1.7% higher than that reported in the last annual report.

Litigation with the Caledonia Mining Co. was settled. There is some doubt as to the action of the Stewart Mining Co. concerning the dismissal of its suit against the Bunker Hill & Sullivan company. About 94% of the shares of the Sierra Nevada Consolidated Mining Co. have been acquired.

TONOPAH BELMONT DEVELOPMENT COMPANY

From the treatment of 172,398 tons of ore, this well known Nevada Company marketed 131.19 short tons of silver and 1.31 short tons of gold, worth \$4,199,133, out of which \$1,650,000 was paid in dividends, during the financial year ended February 28, 1914. Any company report could be summed up in this way; but a great deal of interesting work is done to produce such excellent results, a resume of which is as follows:

The general superintendent, Frederick Bradshaw, reported that development covered 25,696 ft., nearly double that of any previous year. Each foot of development was equal to



PLAN OF IMPORTANT MINES AT TONOPAH.

6.71 tons of ore sent to the mill, at a cost of \$8.186 per foot. A fair amount of prospecting was done on the 600, 700, and 800-ft. levels. At 900 ft., cross-cuts and raises were driven on the Belmont vein, the former to look for possible parallel veins. At 1000 ft., the Occidental vein has proved profitable for 150 ft., and the Lillie Belle vein was narrow but of good grade for 200 ft. Drifts 1042, 1048, 1049, 1055, and 1056 were driven on the Shaft vein for prospecting purposes. At 1100 ft., a cross-cut opened a branch of the Mizpah Fault vein, exposing so far 150 ft. of stoping ore. North cross-cut 7 cut the Favorite vein, the east and west drifts showing 280 ft. of ore. The west drift on the Shaft vein opened another good ore-shoot. On the 1166-ft. level, drifts have developed ore for 700 ft., and the east drift on the Belmont vein has opened a rich shoot. A good deal of work was done on No. 12 level, exposing a large low-grade vein, and 2 to 3 ft. of rich ore in the Mizpah Fault vein. Rich ore was opened in a short shoot in the Mizpah Fault vein, branch 'B'. The Belmont vein developed well. At 1400 ft., an east drift on the Belmont vein has proved ore for 400 ft. east of the Belmont shaft. Since the date of the report this vein has been cut on No. 15 level. Mining costs were \$4.699, of which stoping amounted to \$2.681 per ton of ore milled. The main shaft was sunk from 1559 to 1718 ft. A Nordberg air-compressor, and Word drill sharpener were installed. An electrically driven quintuplex pump of 100 gal. capacity per minute against a head of 1750 ft. is to be placed on No. 15 level, in addition to the present 2000-gal. machine.

The mill superintendent, A. H. Jones, reported that the 60-stamp mill treated 172,398 tons of ore yielding 44,466 oz. gold and 4,251,746 oz. silver, with an average recovery of 94.45%. An average of 54.8 stamps crushed 8.66 tons per stamp day. There was no new construction of importance. The Company's custom plant at Millers, 12 miles north, treated 48,088 tons of mixed ores, sand, and slime, averaging \$18.90 per ton, with 87.39% recovery. The profit from this mill was \$38,547.

The undivided profits of the Company at the end of February, 1914, were \$2,126,763.

Monthly Copper Production

AHMEEK COPPER MINING CO., Kearsarge, Michigan. \$1,250,000 in \$25 shares; 24,796 shares owned by Calumet & Hecla; smelter mill at Hubbell; concentrate smelted by Calumet & Hecla smelter. Total in 1913, 9,100,000 pounds.

ALLOUEZ MINING CO., Allouez, Michigan. \$2,500,000 in \$25 shares; controlled by the Calumet & Hecla, which owns 43,000 shares and \$250,000 in notes of the company; ore is milled by the Lake Milling, Smelting & Refining Co., in which the Allouez owns half. Total in 1913, 4,091,129 pounds.

ANACONDA COPPER MINING CO., Butte, Montana. \$108,312,000 in \$25 shares; controlled through Amalgamated Copper Co. which owns 3,185,240 shares by Thos. F. Cole, J. D. Ryan, and Standard Oil interests; 10,000-ton concentrator and smelter at Anaconda, 5000-ton concentrator and smelter at Great Falls, Mont. also 70-ton electrolytic refining plant at Great Falls. Production figures include copper from all companies which ship custom ore to Anaconda smelters. Total in 1913, 270,301,644 lb. copper, 61,898 oz. gold, and 19,321,296 oz. silver.

Month.	Pounds.	Month.	Pounds.
January 1914.....	21,100,000	March	23,300,000
February	21,300,000	April	22,900,000

ARIZONA COPPER CO., LTD., Morenci, Arizona. £703,894, of which \$779,974 is in 58, ordinary shares, 1500,000 in 5% debentures, controlled by Edinburgh investors; mill at Morenci is being enlarged to 3000-ton capacity and a new 1200-ton smelter near Clifton has just been started.

Month.	Pounds.	Month.	Pounds.
January 1914.....	3,474,000	March	3,286,000
February	3,063,000		

BRADEN COPPER CO., La Junta, Chile. \$2,332,030 in \$10 shares and \$4,000,000 in 6% convertible bonds; entire stock held by Braden Copper Mines Co.; \$14,000,000 in \$5 shares; \$4,000,000 in 6% convertible bonds, \$3,000,000 7% bonds controlled by Guggenheim interests, two mills at La Junta; 3000-ton capacity smelter at Raquena.

Month.	Pounds.	Month.	Pounds.
January 1914.....	2,426,000	March	1,801,000
February	2,362,000	April	2,720,000

BRITISH COLUMBIA COPPER CO., LTD., Greenwood, B. C. \$2,958,545 in \$5 shares; owns 63% of the stock of the New Dominion Copper Co., controlled by Newman Erb; 600-ton sampling plant and 2500-ton smelter.

Month.	Pounds.	Month.	Pounds.
January 1914.....	697,330	March	682,867
February	572,571		

CALUMET & ARIZONA MINING CO., Warren Arizona. \$6,285,710 in \$10 shares; has absorbed the Superior & Pittsburg Copper Co. by stock exchange; controlled by Hoatson and other Lake Superior interests; 3000-ton smelter at Douglas. Total in 1913, 52,987,383 lb., 880,915 oz. silver, 18,939 oz. gold.

Month.	Pounds.	Month.	Pounds.
January 1914.....	5,798,464	March	5,870,000
February	5,948,900		

CALUMET & HECLA MINING CO., Calumet, Michigan. \$2,500,000 in \$25 shares; controls the Ahmeek, Allouez, Centennial, Isle Royale, La Salle, Osceola, Tamarack, and Superior copper mining companies, as well as a number that are non-productive; controlled by Agassiz and Shaw interests; 2 mills on Lake Linden, capacity 15,000 tons; smelter Hubbell, Mich.; electrolytic refinery and smelter at Buffalo, N. Y.; figures include output of subsidiaries. Total in 1913, 53,420,000 pounds.

CANANEA CONSOLIDATED COPPER CO. S. A., Cananea, Sonora, Mexico. Capital \$20,000 in shares of \$100; entire stock owned by Greene Consolidated Copper Co.; \$10,000,000 in \$10 shares; 945,320 shares are held by Greene Cananea Copper Co.; \$50,000,000 in \$100 shares, which is controlled by Thos. F. Cole and J. D. Ryan; 20,800 shares held by the Amalgamated Copper Co.; 2 mills and smelter at Cananea, 3000-ton capacity. Total in 1913, 27,050,574 pounds. Output does not include copper from custom ores, which amounts to about 600,000 lb. per month, exclusive of Miami.

Month.	Pounds.	Month.	Pounds.
January	2,282,000	March	3,510,000

CERRO DE PASCO MINING CO., Cerro de Pasco, Peru. \$10,000,000; entire stock held by Cerro de Pasco Copper Co.; \$60,000,000 in \$1 shares which is owned by Cerro de Pasco Investment Co., which is controlled by J. B. Haggin, and Morgan estate; 2000-ton smelter at La Fundicion; monthly production figures not given out; output in 1912 was 45,000,000 lb. copper.

CHINO COPPER CO., Santa Rita, New Mexico. 4,502,700 in \$5 shares; 121,200 shares are held by Guggenheim Exploration

Co.; controlled by Sherwood Aldrich and C. M. MacNeill; 5000-ton mill at Hurley, N. M.; concentrate smelted at El Paso.

Month.	Pounds.	Month.	Pounds.
January 1914.....	6,133,140	March	5,399,814
February	5,769,948		

CONSOLIDATED COPPER MINES CO., Ely, Nev. \$8,000,000 in \$5 shares; \$3,500,000 in 7% convertible bonds; is a recent merger of the Groux, Butte & Ely, Chairman, and Copper-mines companies, controlled by Thos. F. Cole, Wm. B. Thompson, Charles F. Rand, and Jas. Phillips, Jr.; reduction plant not yet built; production so far derived solely from Groux; ore treated at Nevada Con. smelter.

Month.	Pounds.	Month.	Pounds.
January 1914.....	148,411	March	287,980

COPPER QUEEN CONSOLIDATED MINING CO., Bisbee, Arizona. \$2,000,000 in \$10 shares; owns 100,000 shares of Greene Cananea; almost all its stock is held by Phelps, Dodge & Co., Inc.; \$4,995,000 in \$100 shares; 4000-ton smelting plant at Douglas, Ariz. Total in 1913, 85,389,630 pounds.

Month.	Pounds.	Month.	Pounds.
January 1914.....	8,099,847	March	7,122,739
February	6,448,770	April	6,922,390

COPPER RANGE CONSOLIDATED MINING CO., Palmdale, Michigan. \$39,371,000, in \$100 shares; owns 99,659 shares of Baltic M. Co., 99,699 shares Copper Range M. Co., 99,345 shares of Tri-mountain M. Co., half interest in Champion Copper Co., 16,392 shares of Copper Range R. R. Co., and \$870,000 in Copper Range R. R. bonds; controlled by Wm. A. Paine; production is derived from the Baltic, Champion, and Tri-mountain companies, each of which mills its ore; concentrate is smelted by Michigan Smelting Co., Houghton, which is owned by mining companies. Total in 1913, 24,852,026 pounds.

Month.	Pounds.	Month.	Pounds.
January 1914.....	3,276,000	March	3,834,000
February	3,518,000	April	4,428,000

DETROIT COPPER MINING CO., Morenci, Ariz. \$1,000,000 in \$25 shares; owned by Phelps, Dodge & Co.; 1300-ton mill and 350-ton smelter. Total in 1913, 22,352,299 pounds.

Month.	Pounds.	Month.	Pounds.
January 1914.....	1,590,681	March	1,973,725
February	1,814,214	April	1,790,926

EAST BUTTE COPPER MINING CO., Butte, Mont. 4,110,000 in \$10 shares; owns 83% of the stock and all bonds of the Pittsmtont Copper Co., which holds 90% of the stock and all bonds of Pittsburgh & Montana Copper Co.; controlled by Wm. A. Paine; 350-ton mill and 1000-ton custom smelter. Total in 1913, 14,401,108 pounds.

Month.	Pounds.	Month.	Pounds.
January 1914.....	1,088,862	March	1,530,717
February	1,182,063		

GRANBY CONSOLIDATED MINING, SMELTING & POWER CO., LTD., Phoenix and Hidden Creek, British Columbia. \$14,998,500 in \$100 shares; \$1,197,200 in 6% convertible bonds; controlled by General Chemical Co. interests; 4400-ton smelter at Grand Forks and 2000-ton smelter at Anyox. Total in 1913, 21,511,747 pounds.

Month.	Pounds.	Month.	Pounds.
January 1914.....	1,793,840	March	1,775,852
February	1,661,212	April	1,692,102

GREAT COBAR, LIMITED., Cobar, New South Wales. £1,000,000 in 200,000 shares of £5 each; also 6% first-mortgage debentures. Operates gold, copper, and coal mines, coke works, flotation concentration plant, blast-furnaces, and a refining plant. During past fiscal year treated 361,566 tons for 13,016,640 lb. copper, 27,136 oz. gold, and 127,542 oz. silver.

Month.	Pounds.	Month.	Pounds.
January	1,137,920	February	898,240

HAMPDEN CLONCURRY COPPER MINES, LIMITED., Cloncurry, Queensland. £400,000 in shares of £1 each; 350,000 issued. During past fiscal year treated 24,744 tons for 5,815,040 lb. copper, 818 oz. gold, and 24,457 oz. silver.

Month.	Pounds.	Month.	Pounds.
January	929,600	February	1,321,600

KYSHTIM CORPORATION, LTD., Kyshtim, Perm, Russia. £1,002,800 in £1 shares, £650,000 in 6% debentures, convertible at £2 10s. 1000-ton smelting plant at Karabash, also electrolytic plant to treat all copper produced.

Month.	Pounds.
March 12 to April 11.....	1,666,500

MASON VALLEY MINES CO., Yerington, Nev. \$770,000 in \$5 shares; \$1,000,000 in 6% convertible bonds; controlled by W. B. Thompson; 1000-ton smelter at Thompson, Nev., also smelts ore

of Nevada-Douglas Copper Co. and custom ore smelter production. Total in 1913, 14,634,000 pounds.

Month	Pounds	Month	Pounds
January 1914	3,411,595	March	3,461,100
February	1,241,000	April	862,000

MIAMI COPPER CO., Miami, Ariz. 100,000 \$5 shares issued. \$2,000,000 in bonds convertible at \$15 outstanding; controlled by General Development Co. (the Wilson interests); 5000-ton mill at Miami; concentrate smelted at Chino. Total in 1913, 37,944,700 pounds.

Month	Pounds	Month	Pounds
January 1914	3,258,950	March	3,461,100
February	3,194,700	April	3,227,600

MOCTEZUMA COPPER CO., Nacozari, Sonora, Mexico. \$2,000,000 entire stock owned by Phelps Dodge & Co.; 2000-ton mill; concentrate smelted by Copper Queen. Total in 1913, 36,694,000 pounds.

Month	Pounds	Month	Pounds
January 1914	3,024,556	March	2,882,884
February	2,642,543	April	2,654,976

MOHAWK MINING CO., Mohawk, Mich. \$2,500,000 in \$25 shares; controlled by Stanton interests; 3000-ton mill; Traverse bay; concentrate smelted by Michigan Smelting Co. Total in 1913, 8,616,000 pounds.

Month	Pounds
March	790,000

MOUNT ELLIOTT, LIMITED, Cloncurry, Queensland. 7500,000 in 150,000 shares of 50 each. During past fiscal year treated 41,680 tons for 19,273,119 lb. copper, 8757 oz. gold, and 7285 oz. silver.

Month	Pounds	Month	Pounds
January	891,520	February	875,840

MOUNT LYELL MINING & RAILWAY CO., LTD., Queenstown, Tasmania. 1,300,000 shares of 10 each. Operates an extensive copper property, two railways, blast-furnaces, converters, and three superphosphate works in Australia. During past fiscal half-year treated 142,615 tons for 5,470,980 lb. copper, 187,097 oz. silver and 4050 oz. gold.

Month	Pounds	Month	Pounds
Jan. 22 to Feb. 18	1,169,440	Mar. 19 to Apr. 15	1,042,400
Feb. 18 to Mar. 18	1,242,200		

MOUNT MORGAN GOLD MINING CO., LIMITED. Operates a large gold and copper mine near Rockhampton, Queensland, a pyrite mine, iron and limestone quarries, a coal mine, concentrating plant being built, blast-furnace plant, and controls an electrolytic refinery at Port Kembla, New South Wales. During past half-year treated 152,016 tons for 9,741,960 lb. copper and 54,992 oz. gold.

Month	Pounds	Month	Pounds
Jan. 11 to Feb. 8	1,283,520	Feb. 8 to Mar. 8	1,106,560

NEVADA CONSOLIDATED COPPER CO., Ely, Nevada, \$9,997,285 in \$5 shares; has absorbed the Cumberland-Ely Copper Co.; controlled by American Smelters Securities Co. through the Utah Copper Co., which owns half of the Nevada Con. stock; the Nevada company owns the Steptoe Valley Mining & Smelting Co., \$10,000,000; 16,000-ton mill and 1500-ton smelter at McGill, Nevada. Total in 1913, 64,972,829 pounds.

Month	Pounds	Month	Pounds
January 1914	5,791,122	March	5,218,227
February	4,588,243		

NEVADA DOUGLAS COPPER CO., Mason, Nev. \$4,614,300 in \$5 shares; \$800,000 in 6% convertible bonds; controlled by A. J. Orem, ore smelted at Mason Valley smelter.

Month	Pounds	Month	Pounds
January 1914	409,733	February	387,287

OHIO COPPER CO., Bingham, Utah, \$7,554,350 in \$1 shares, \$1,246,000 in 6% convertible bonds, 3500-ton mill at Lark, Utah; concentrate smelted at Garfield.

Month	Pounds	Month	Pounds
February	599,394	March	616,129

OLD DOMINION CO., Globe, Ariz. \$7,333,825 in \$25 shares. Controlled by Phelps Dodge & Co. Owns 155,353 of 162,000 \$25 shares of Old Dominion Copper Mining & Smelting Co., and all the \$2,500,000 stock of the United Globe Mines; 300-ton mill, 2400-ton smelter. Production figures include custom ore smelted. Total in 1913, 30,810,000 pounds.

Month	Pounds	Month	Pounds
January 1914	2,797,000	March	2,997,000
February	2,066,000	April	2,779,000

OSCEOLA CONSOLIDATED MINING CO., Osceola, Mich. \$2,403,750 in \$25 shares; owned by Calumet & Hecla; 2 mills, 4000-ton capacity, at Torch Lake. Total in 1913, 11,325,010 pounds.

PHELPS, DODGE & CO., Inc. \$44,995,000 in \$100 shares; controlled by C. H. Dodge, James Douglas, and others; owns the Copper Queen, Moctezuma, Detroit, and Burro Mountain copper

companies. Stag Canon Fuel Co. indirectly controls Old Dominion, United Globe and Commercial Copper Mining Co., members of the firm control the El Paso & Southwestern railway, and have large interests in the Rock Island and Great Northern railways. Production figures include all properties under its control and copper derived from custom ore, the latter ranging from 750,000 to 1,000,000 lb. per month. Total in 1913, 154,454,444 pounds.

Month	Pounds	Month	Pounds
January 1914	13,411,595	March	12,461,654
February	11,444,123	April	12,008,625

QUINCY MINING CO., Hancock, Mich. \$2,750,000 in \$25 shares; controlled by W. R. Todd, 4500-ton mill at Mason, 340-ton smelter at Ripley.

Month	Pounds	Month	Pounds
January 1914	1,484,000	February	1,632,000

RAY CONSOLIDATED COPPER CO., Ray, Ariz. \$15,875,000 in \$10 shares; controlled by Sherwood Aldrich and C. M. MacNeill, 8000-ton mill at Hayden, Ariz.; concentrate smelted in A. S. & R. smelter adjoining. Total in 1913, 53,745,934 pounds.

Month	Pounds	Month	Pounds
January 1914	5,705,500	March	6,223,617
February	5,600,000		

SHANNON COPPER CO., Metcalf, Ariz. \$3,000,000 in \$10 shares; controlled by N. L. Amster; 500-ton mill and 1000-ton smelter at Clifton. Total in 1913, 13,640,000 pounds.

Month	Pounds	Month	Pounds
January 1914	938,000	March	1,082,000
February	904,000	April	1,012,000

SHATUCK ARIZONA COPPER CO., Bisbee, Ariz. \$3,500,000 in \$10 shares; controlled by Duluth investors, ore smelted at Calumet & Arizona smelter. Total in 1913, 13,219,756 pounds.

Month	Pounds	Month	Pounds
January 1914	1,276,636	March	1,136,458
February	1,134,480		

SOUTH UTAH MINES & SMELTERS, Newhouse, Utah. \$1,300,000 in \$5 shares, \$1,300,000 in 6% convertible bonds; controlled by Samuel Newhouse; 1000-ton mill; concentrate smelted at Tooele, Utah. Total in 1913, 1,883,129 pounds.

Month	Pounds	Month	Pounds
February	314,200	March	406,381

TAMARACK MINING CO., Calumet, Mich. \$1,500,000 in \$25 shares; owned by Calumet & Hecla; 2 mills, 3500-ton capacity, at Torch Lake. Total in 1913, 4,142,000 pounds.

TENNESSEE COPPER CO., Copperhill, Tenn. \$5,000,000 in \$25 shares; \$1,000,000 in first mortgage 6% gold bonds; controlled by Jas. Phillips, Jr., and associates. Total in 1913, 13,493,110 pounds.

Month	Pounds	Month	Pounds
January 1914	1,474,890	March	1,262,184
February	1,232,812		

UNITED STATES SMELTING, REFINING & MINING CO. \$21,313,700 in \$50 7% cumulative preferred shares; and \$17,553,700 common \$50 shares; copper production chiefly derived from its subsidiary, the Mammoth Copper Mining Co., Kennett, California.

Month	Pounds	Month	Pounds
January 1914	1,572,817	March	1,814,200
February	1,629,902	April	1,850,000

UNITED VERDE COPPER CO., Jerome, Ariz. \$3,000,000 in \$10 shares; owned by W. A. Clark; 1000 to 1200-ton smelter at Clarkdale; monthly figures not given out, estimated at about 3,000,000 lb. Total in 1913, 37,750,000 pounds.

Month	Pounds	Month	Pounds
January 1914	2,900,000	February	2,600,000

UTAH CONSOLIDATED MINES CO., Bingham, Utah. \$1,500,000 in \$5 shares; owns the Highland Boy Gold Mining Co. and 5000 shares of International Smelting & Refining Co. stock; ore smelted at Tooele. Total in 1913, 7,710,668 pounds.

UTAH COPPER CO., Bingham, Utah. \$15,826,000 in \$10 shares; owns half of Nevada Consolidated; controlled by A. S. & R. Co., Sherwood Aldrich, C. M. MacNeill, and W. B. Thompson; 2 mills, 20,000-ton capacity, at Garfield; concentrate smelted at Garfield plant of A. S. & R. Co. Total in 1913, 113,912,834 pounds.

Month	Pounds	Month	Pounds
January 1914	10,649,000	March	12,704,200
February	9,492,898		

WOLVERINE COPPER MINING CO., Kearsarge, Mich. \$1,500,000 in \$25 shares; owns \$80,000 interest in Michigan Smelting Co.; controlled by J. R. Stanton; mill on Traverse bay treated 388,500 tons during last fiscal year. Total in 1913, 5,700,000 pounds.

Month	Pounds
March	628,000

Decisions Relating to Mining

OIL LEASE—WRITTEN AND PRINTED PROVISIONS

Where an oil lease is drawn on a printed form, provisions written in will prevail over conflicting provisions in the printed part.

Amsdell v. Cherry Gas & Oil Co. (New York) 145 New York Supplement, 825. December, 1913.

OIL AND GAS LEASE—RECOVERY OF RENTALS PAID

Where lessees attempted to recover rentals paid the lessor, under an oil and gas lease, on the ground that the lessor's title was imperfect, but were unable to show any obstructions to their taking possession or attempted eviction from the land, they have failed to show a breach of the lessor's covenant for quiet enjoyment and recovery will be denied.

Gaffney v. Stowers (West Virginia) 80 Southeastern, 581. December 16, 1913.

MINING PARTNERSHIP—CONTRIBUTION

Under a partnership agreement, one partner conducted operations on a mining claim and incurred certain indebtedness to the payment of which the other partner contributed his share. At a later date after outstanding indebtedness had been discharged he notified the working partner that he would not be responsible for any further obligations. Notwithstanding such notice the working partner continued operations and later sought to hold his partner to account in an action for his share of the expense. Held, that the agreement terminated upon the notice and defendant could not be so held.

Goldsmith v. Murray (Montana) 138 Pacific, 187. December 16, 1913.

OIL LEASE—ACCOUNTING DENIED

A common lessee of two adjoining tracts drilled an oil well near the boundary line on what he supposed was tract A, and by a large sign posted near, as was the custom, announced that he was drilling the well under lease from the owner of Tract A. After the expiration of ten years, during which time no objection was offered, the owner of tract B caused a survey to be made which determined that the well was on tract B. Held, that the lessee was not estopped from denying the title of the owner of B, as he had never claimed to operate under that lease, and that the owner of B was debarred by limitations from claiming an accounting from the lessee.

Lockwood v. Carter Oil Co. (West Virginia) 80 Southeastern, 814. February 12, 1914.

OIL LEASE—RECISSION DENIED

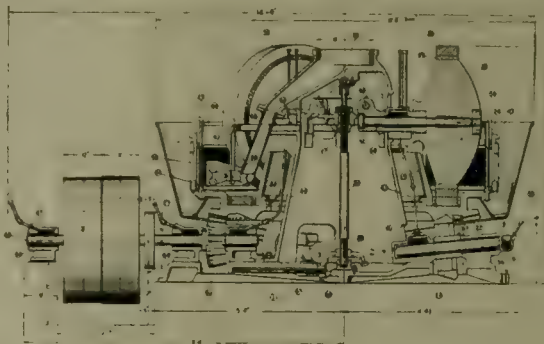
An oil lease contained the following provision: "It is expressly understood that the second party (lessee) reserves the right to abandon said premises whenever it desires to cease operations, and to remove all property placed thereon by it, at discretion." Held, that such provision destroyed the obligation placed upon the lessee, and hence the contract was without consideration when entered into. However, if the lessee proceeded to comply with the provisions of the lease, and actually drilled wells and developed the land to a certain extent, the lessor could not, merely because of a difference of opinion between it and the lessee as to further development requirements, cancel the lease on the grounds that it was without consideration, unless the lessee is restored to his *status quo* at the time the contract was made.

Caddo Oil & Mining Co. v. Producers Oil Co. (Louisiana) 64 Southern, 685. March 16, 1914.

Industrial Progress

The Elspass Mill

Chilean mills of various designs have found favor with many millmen for crushing coarse ore, up to 2-in. size, and for regrinding pulp for further concentration and treatment. In the older type of Chilean mills, the delivery of the ground product is dependent entirely upon the slushing of the pulp by the rollers against the screen. As this action brings only a small portion at any instant against the screen, the balance is retained until a greater portion is reduced



SECTION THROUGH MILL.

to slime, which may or may not be desired. The 'New Principle' Chilean mill, as designed by the Elspass Engineering & Mining Machinery Co., of Denver, Colorado, consists of a heavy, rigid, revolving bed, the bottom of which carries a heavy steel die ring, and upon this ring rest three massive stationary rolls, 6000 lb. each. Instead of these being dragged around upon the die ring by a central moving journal, as in the older style of mills, the bed below carrying the die ring is made to revolve beneath the rollers, which remain in a stationary position, and merely revolve upon their respective journals as the die ring passes beneath. The wearing surfaces are made of hammer-forged steel. The screen embraces the outer circumference of the revolving bed, and travels with it. There is at all times 36 ft. of screen surface in action. Ore up to 1-in. size gives efficient crushing results, and on quartz the capacity of a mill is from 50 to 75 tons per 24 hours, through a 30-mesh screen. The machine is said to be suitable for preparing zinc and lead ores for concentration, makes little slime, produces an even product, and extracts a high percentage of gold by amalgamation in the mill. A cross-section of the mill, furnished by the manufacturer, appears above.

THE SMITH-BOOTH-USHER Co. reports the election of the following officers: H. P. Usher, president and managing director; J. R. Hoffman, vice president; F. P. Duncklee, treasurer; J. A. Nickell, secretary; E. H. Breidenbach, general manager of sales.

THE GENERAL CHEMICAL Co. has issued a general price list of the chemicals made at the Baker & Adamson Works, which includes valuable tables showing formulas, composition, solubility, and percentage composition of the various chemicals.

R. C. COLE has joined the staff of the pneumatic tool department of the Ingersoll-Rand Co. and has been stationed at the Chicago office.

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EDITORIAL

COL. ENOS A. WALL, of Salt Lake City, has brought suit at Wilmington, Delaware, for the dissolution of the Consolidated Coppermines Company, and has asked for the appointment of a receiver. This, the latest of the Wall suits, which have come to be regarded lightly in certain localities, makes as defendants a long list of some of the most well known names connected with the copper industry. The opinion of one of the officials of the Company is that the suit was founded on misrepresentation of facts, and the counsel states that it is without merit.

School of Mines Semi-Centennial

Great schools are not collections of buildings or of books, but of great men. The Columbia School of Mines, which is celebrating in New York this week the completion of fifty years of successful work, celebrates not its growth from dark and cramped quarters in the basement of an unused building to the possession of spacious buildings and elaborate equipment, but commemorates rather the achievements of a group of great teachers and rejoices in the work of its graduates. In such teachers as Egleston, Newberry, Vinton, Chandler, Rood, Peck, and Van Amringe, the young school had the first essentials of success, and Columbia University has grown from a minor position to the leading place among the universities of the United States, and its School of Mines has not only shared in that growth, but contributed materially toward it.

To name the graduates of the School of Mines at Columbia who have risen to honor in the mining profession would require more space than is possible to accord. Nevertheless, a few must be mentioned to indicate how the history of the school is interwoven with the development of mining and metallurgy in America. In the first class, 1867, were Messrs. John A. Church and H. B. Cornwall; 1868 included F. A. Sehermerhorn, W. H. Van Arsdale, and A. H. Chester. Messrs. H. S. Munroe, W. P. Jenney, and R. D. Irving were of the class of 1869, and Elwyn Waller and T. F. Van Wagenen graduates in 1870. S. A. Goldschmidt and P. de P. Ricketts of 1871, and T. O'C. Sloan in 1872 lead up to the class of 1874, in which were Messrs. W. DeL. Benedict, A. R. Ledoux, E. E. Olcott, and F. B. Rhodes. Messrs. M. W. Iles, W. S. Noyes, C. M.

Rolker, and M. C. Ihseng were of the class of 1875; T. S. Austin, G. R. Cornwall, F. R. Hutton, and N. W. Lord of the class of 1876; Carl Barus, S. A. Reed, and Arthur Thacher, 1877; and W. B. Devereux, B. B. Lawrence, and Bailey Willis, 1878. George C. Stone of 1879, Herman Garlichs, W. B. Kunhardt, and Frank Klepetko of 1880, and V. M. Braschi, A. L. Colby, and H. Van F. Furman of 1881 are only a few of those whose names deserve mention. John B. Porter and E. L. Young, 1882; J. P. Channing, Robert Peele, and A. L. Walker, 1883; J. F. Kemp and William Newbrough were of 1884; while A. S. Dwight, E. N. Engelhardt, George B. Lee, F. J. H. Merrill, Richard Moldenke, R. Van A. Norris, W. E. Sanders, and Joseph Struthers were of the banner class of 1885. J. H. Janeway and E. L. Newhouse of 1886, W. H. Aldridge, Jennings S. Cox, and F. M. Stanton of 1887, Edwin Gould and C. H. Smyth of 1888; R. Gilman Brown, F. W. Denton, Karl Eilers, and F. M. Smith of 1889 are but a few of the men of those years who have left an indelible mark in their profession. To name the prominent graduates of the years since 1890 would almost sound like calling the roll of the active younger men of the mining profession. The School of Mines may well be proud of her sons. To them and their school we wish Godspeed, continued success and honor, with a faithful adherence to the noblest ideals of an honorable profession.

Potash Production and Borax Prices

In connection with the impending advent of the American Trona Corporation into the market for potash, there is more than a hint of trouble for borax producers. It will be recalled that Borax Consolidated Ltd. when formed in 1899, acquired the physical properties of the Pacific Coast Borax Company at the same time that properties in Chile, leases in Turkey, and other sources of raw material around the world, were purchased. At the same time the Pacific Coast Borax Company of California was formed by Mr. F. M. Smith and his associates. This new concern received 364,710 of the deferred ordinary shares of Borax Consolidated in payment for the properties transferred, and, having purchased 135,290 additional shares, now holds 500,000 of the 900,000 shares which have voting control of Borax Consolidated. The Pacific Coast Borax Company of California is dominated by Mr. Smith. He, with Messrs. L. H. de Friese, J. Gerstley, and R. C. Baker, are managing directors of the Borax 'trust'. Borax Consolidated has prospered. The net profits have increased steadily and for the year that ended September 30 last were nearly £362,000. There is an amazing tangle of deferred and preferred and ordinary shares, but after deducting for income tax, depreciation, sinking fund, general reserve, investment reserve, and other minor items, the following payments were made: debenture interest, £74,164; preferred dividend, £44,000; preferred ordinary dividend, £27,000; deferred

ordinary dividend, £135,000; carried forward, £45,397. The rate of payment on the deferred ordinary dividend in the last four years has been at 12 $\frac{1}{2}$ %, 13 $\frac{3}{4}$ %, and 15 per cent. The shares have a par value of £1 and have naturally sold at a premium. Mr. Smith, having become involved in real estate speculations at Oakland, California, and in railway and traction ventures that were not altogether profitable, placed his interests in the hands of trustees some months ago as we noted at the time. Some of his properties already have been sold. So far his Borax shares have not changed hands though there have been negotiations with several parties and various rumors of sale. It is to be noted that their transfer, or even the sale of a part of them, might mean a change in control of Borax Consolidated. Naturally the matter has brought up the question of the value of the shares. So far they have been sold mainly on the basis of the dividend record, though the question whether the richer parts of the colemanite deposits were not being exhausted unduly, has been occasionally brought up. There is no fear as to the total amount of borax available but merely a question whether future costs will not be higher. Another danger to the Company is in connection with the Tonopah & Tidewater railroad. This line was built to provide transportation from the mines to the Santa Fe railroad and in the flush of enthusiasm over southern Nevada, following the discovery of Goldfield, it was extended until now 170 miles of line is operated. Unfortunately the railway does not pay. While the yearly deficit has not been large there is no great encouragement to believe that it can be permanently decreased. The country traversed is desert and there seems little possibility of building up a permanent traffic. The main business at present is with the mines of the Borax company, and if for any reason these should be closed, there would be little left. It does not seem to be generally appreciated that the bonds of this road are guaranteed both as to principal and interest by Borax Consolidated Ltd. There is £500,000 in 4 $\frac{1}{2}$ per cent bonds issued in 1905 and £175,000 in 5 per cent issued in 1907 out of £250,000 authorized at this time. If for any reason Borax Consolidated should find it necessary to transfer its main activities to another field, there would be here a heavy loss to face.

Competition in borax production has so far been unimportant though there are independent producers. There is now, however, the threat of competition that may put another face on matters. The American Trona Corporation, as already noted in our news columns, has completed a railroad to its works and is rapidly building a plant designed to manufacture soda ash, borax, and potassium chloride, from the brine of Searles lake. Interesting details of this enterprise were printed in the *Mining and Scientific Press*, June 14, 1913, and since then rapid progress in construction has been made. The various salts have already been manufactured on a working scale and before January it is expected that regular production will be under way.

The plant now being built is small though each piece of machinery is of standard size. It is designed with a view to experimental work directed to obtaining the maximum efficiency in the larger works to follow. The process used was worked out by Mr. John W. Hornsey and after being tested in the laboratory was applied on a larger scale in the old works of the Pacific Coast Borax Company, now under lease to the Trona company. It consists, essentially, of evaporation and fractional precipitation of the soda ash, salt, sodium sulphate, borax, and potassium chloride. The material is derived from brine pumped from the interstices of a crystal body covering several square miles and extending to 60 or 70 feet in depth. The quantity available is undoubtedly adequate and the process to be used has been tested sufficiently to assure its success and economy, though exact statement of costs must wait actual operation on a large scale. The plant will be built in four units and when all are working is to produce daily 500 tons of soda ash, 490 potassium chloride, 225 borax, 1500 salt, and 590 sulphate of soda. There is no adequate market available for the salt and sulphate so the Trona Corporation must derive its revenue from the sale of the other salts. The amount of potassium chloride contemplated is less than that at present annually imported into the United States, and would in any event be absorbed by the normal growth of the American market in five years. As the raw material is obtained by pumping as against mining under peculiar and expensive conditions in Germany, little fear is felt as to the market for this material. The amount of soda ash to be produced is equivalent to about 5 per cent of the present world's consumption and as freight to deep water at San Pedro will be not more than \$1.50 per ton, it is felt that a ready market, probably in the Orient, will be found for all that it is now proposed to manufacture. The critical factor is the borax. It is evidently a matter of book-keeping so far as the Trona Corporation is concerned, as to what the borax costs. It must be taken out of the brine in order to bring down the potassium chloride. It can therefore be sold for anything over freight and handling charges better than thrown on the dump as the salt and sulphate must be at present. The amount to be made is about equal to the present world's consumption, and if it be marketed, borax mines must close elsewhere, at least temporarily.

Borax Consolidated has succeeded in materially expanding the market for its products. The United States output has increased from 5959 tons in 1895 to about 43,000 tons in 1913. Since 1870 the price has fallen from 35 to 4 cents per pound. Probably a still lower price would increase the use of borax, especially in the dyeing, enameling, and glass trades, but there is no evidence that the world's markets will absorb double the present output in even a few years, without a very material decrease in price. It is one of the curious chances of time that the Trona company is now operating in works originally built by Searles, and

which were one of the pioneer plants of the Pacific Coast Borax Company, whose prosperity is threatened by the new development. The San Bernardino Borax Company, a subsidiary of the Pacific Coast, owns the land and the works. The land covers the mud flats but does not extend into the crystal body originally located by the California Trona Company with a view to manufacture of soda. This Company leased the old borax works and to guard against any possible competition it was stipulated that during the life of the lease, which has still four years to run, the Borax company should have an option to purchase at 1 cent per pound all borax that might be produced by the Trona company, and the latter should have a reciprocal option at 1 1/5 cent per pound on all soda made by the Borax company. At that time potash was known but its value was not appreciated. The California Trona Company borrowed money from the Foreign Mines Development Company and for various reasons came to grief. The Consolidated Gold Fields people, who were backing the Foreign Mines Development Company, bought control of the Trona company and eventually organized the American Trona Corporation, to build and operate the works. The value of the potassium was discovered by one of the engineers of F. S. Pearson who at one time held an option from the California Trona Company, and the discovery was exploited by the United States Geological Survey. When first Trona company began work there was no intention of producing borax but with the development of the process for making potash salts a new situation arose. Borax Consolidated still holds the option on the borax output of the plant but can not take the amount offered without interfering with its regular business. On the other hand, Borax Consolidated undoubtedly has a firm hold on the market and a newcomer will have to fight to get in. The big customers, however, are those who would buy on specifications and price; and, within rather wide limits, the latter is unimportant to the Trona Corporation. The situation is one of much interest. The Borax company did have one club over the Trona Corporation until recently in that it owned the only suitable patented land for the erection of a plant. Following the announcement of the Geological Survey, of the presence of potash in the brine, all the lands around the lake were withdrawn from entry in 1912. This does not affect the locations on mineral land, including the crystal body, which the Trona company owns and which were made prior to the President's proclamation; but it did prevent acquirement of land for the necessary mill and townsite. After proper showing of the non-mineral character of the land and a long and annoying delay, a sufficient area was recently released and has been purchased by the Trona Corporation. The latter accordingly no longer has to have the Borax property, though it would be convenient to own the land, and interested observers anticipate that in the end some amicable adjustment will be made between the two Companies.



DAVY MILL OF THE AMERICAN ZINC COMPANY.

Mining and Milling at the American Zinc Property, Joplin

By E. H. LESLIE

The southwest Missouri zinc and lead mines are divided into three main classes of which the 'sheet ground' properties are by far the most important and have produced the greater part of the zinc concentrate of the district. The 'sheet ground' lies at a variable depth of from 100 to 250 ft. below the surface and is covered with a limestone formation which, in the conduct of mining operations, is supported by pillars of from 20 to 40 ft. in diameter. Another class of deposits is known as the hard disseminated orebodies which are similar and sometimes classed with the 'sheet ground' deposits. The mining methods are similar with the exception that in hard disseminated ground less ore is left under ground as pillars and rooms are often left which are from 30 to 40 ft. wide, 50 to 100 ft. long, and 20 to 100 ft. high. The other class of deposit is locally known as the 'soft ground' deposit and in mining this type of ground timber sets, stulls, and spiling, with lagging is usually necessary.

The property of the American Zinc, Lead & Smelting Co., which is one of the largest producers of concentrate in this district, belongs to the 'sheet ground' class. The mining and milling operations as conducted here represent the most efficient and modern practice in the working of this type of orebody and as representative of zinc mining and modern milling practice in the Joplin district, a brief summary may be of interest.

The deposit was opened by vertical shafts and mining operations commenced as soon as the orebody was reached. In the beginning of mining operations a slice 7 ft. thick is taken from the top of the deposit,

adjacent to the shaft and when 18 or 20 ft. of bench has been uncovered, long lifters or stope holes are drilled and the bottoms are chambered and then heavily loaded and fired, the amount of dynamite used depending upon the depth of the stope holes and burden. Forty per cent dynamite is the usual grade used in mining operations. Drilling is done with the 3¼-in. Ingersoll piston drill which is handled by two men and will break about 46 tons per shift at this particular property. The machines are operated by air at 90-lb. pressure. The 'one-man' drill has not as yet found a place in Joplin mines due, as contended by the operators, to the fact that it has not sufficient 'pull back' for drilling fissured holes. In stoping operations, pillars are usually left at intervals of from 30 to 50 ft. depending upon the nature of the ground. 'Slicing' is employed where the thickness of the orebody permits and underhand stoping is the regular procedure. The pillars vary from 20 to 40 ft. diameter. At this property the tonnage broken per man, including the entire force, both surface and underground, is 5.7 tons and the tonnage broken per man for the entire underground force is 7.41 tons. This method of breaking ground is most economical, the average mining cost being 35c. per ton which is cheap when it is considered that the ground is hard and difficult to drill.

The broken ore is loaded into large buckets of from 800 to 1200 lb. capacity which are placed on small flat cars and trammed by hand out of the stopes to the main haulageway. Here trains are made up of from 15 to 25 cars and hauled to the shaft by gasoline locomotives. Three engines are used for this purpose

which were made by the Milwaukee Locomotive Company. This method of handling ore underground has proved most efficient and is a decided improvement over the time honored mule and 'mule skinner'. In shoveling the regular 'D' handle No. 2 scoup shovel is used and many shovelers will load as many as 25 tons per 8-hr. shift. The loading is done on contract at prices ranging from 6 to 8c. per bucket according to the size of the bucket.

The buckets are hoisted to the surface with small geared hoists mounted in the top of the head-frame, a particular type of which has been developed in the Joplin district. A side elevation of the new head-frame at the American property which is one of the most modern in the district is shown in the accompanying drawing (Fig. 1). The head-frame and ore-bins, which

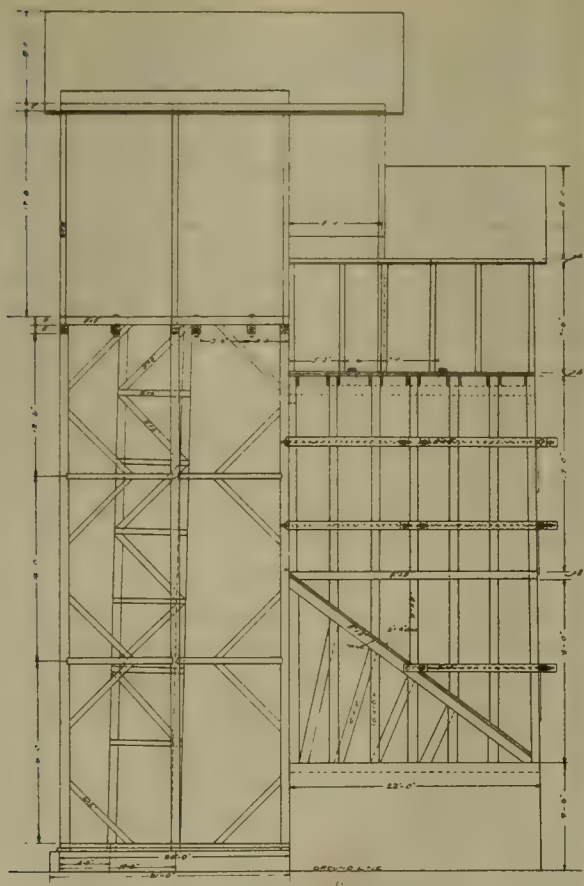


FIG. 1. SIDE ELEVATION, SHOWING METHOD OF FRAMING.

are a part of the structure, are supported on heavy concrete foundations and are of heavy timber as indicated in the drawing. The hoistman dumps the buckets directly into the mill bins. There are no guides in the shaft and a $5/8$ -in. non-spinning steel cable is used for hoisting. Electric hoists are replacing the steam equipment throughout the district and one hoist will frequently raise as many as six hundred 1200-lb. buckets in an 8-hr. shift, besides raising and lowering the men.

No signals are used for hoisting ore, as the hoistman knows from experience when the 'hooker' at the bottom of the shaft has detached the empty bucket and hooked on the load. Two electric hoists, both mounted in the same head frame which is shown in the drawing and half-tone, are employed at the Davy No. 3 shaft. Fig. 2. Each hoist is operated by a 75-hp. West-



FIG. 2. HEAD-FRAME AND ORE-BINS.

inghouse motor and the combined hoists have a daily capacity of about 1200 tons.

The American mine is equipped with an underground machine shop for making minor repairs on the drills, cars, and gasoline locomotives. Also there is a forge and Leyner drill sharpening machine. Ventilation for the forge is secured by a churn-drill hole which serves as a stack to the surface.

Milling Operations

Milling operations may be characterized as simple, cheap, and efficient. In the 1200-ton mill at this property, a general view of which is shown in Fig. 3, the ore is drawn from the hoppers into two 12 by 18 in. Blake crushers and the crushed ore lifted by bucket elevators to two trommel screens. The undersize from these screens which is through $1/2$ -in. goes directly to two 'rougner' jigs while the oversize is reground in four sets of 36-in. rolls, two others being held in reserve. These rolls discharge into the boot of the bucket elevators previously mentioned, and the reground material is returned to the trommels.

The two 'rougner' jigs are made with six compart-



FIG. 4 AND 5. EXTERIOR AND INTERIOR VIEW OF SLIME PLANT.

ments each and produce a middling product, which is reground in 30-in. rolls, and a rough concentrate. The tailing is lifted by means of bucket elevators to the stackers which removes it to the tailing piles. The concentrate from the rougher jigs is raised by a bucket elevator and discharged through a launder to the cleaner or finishing jig. The zinc concentrate and lead concentrate are taken from the first two and last two compartments of the cleaner jig to the concentrate bins. The middling product which consists of a mixture of sphalerite and galena is returned to the boot of the concentrate elevator where it joins the concentrate from the rougher jigs and again passes through the cleaner jig.

The middling, or what is locally known as the 'chats'. From the rougher jig is lifted in the 'chat' elevator and discharged into a 3-mm. trommel. The oversize from this trommel is re-crushed in a pair of 30-in. 'chat' rolls and returned by the elevator to the trommel. The undersize from the trommel goes to a cone classifier, the overflow of which is laundered to settling tanks in the 'sludge' mill while the underflow is returned to the elevators and rougher jigs.

The fine sand from the rougher jigs tailing is separated by a hydraulic classifier on the end of the jig through which the tailing flows and is sent to the table room. The classifier as used on the end of the rougher jig, is a local device, which has been found most effective in the recovery of the fine sands in which most of the losses formerly occurred. The tailing in passing from the jig flows over a series of three classifier boxes. These boxes are wedge shaped with a long pipe and water jets in the bottom. The fine material which is held in suspension by the rising current is thus separated and flows through launders to the table room. From the rougher jigs an immense amount of barren rock is quickly eliminated from the mill. Power for the mill is furnished by a 150-hp. General Electric motor. The tailing from the cleaner jig locally called the 'sand' is laundered to settling tanks and a drag classifier.

Not a great many years ago the concentration of Joplin ores was done entirely by jigs and a 'rougher'

and 'finishing' jig, with the accessory equipment, constituted the standard practice. The advent of tables marked a new era in the milling practice and the combination of jigs and tables with a more careful classification has been generally adapted throughout the district. The zinc and lead concentrates from the finishing jig have been augmented by the concentrates from the 'sludge' or sand plant, and at this particular property a slime plant has been profitably added and a still further saving affected. The material which passes from the jig room to the 'sludge' or table room consists, as stated, of the sand which is removed from the tailing of the rougher jigs, the fine material from the classified reground middling product of the rougher jigs, and the tailing product of the finishing jig. All of this material is conducted by launders to the settling tanks and drag classifier where the slime is separated for the slime-plant and the sand for the 'sludge' room concentration.

Sludge Room

The sand is raised in a bucket elevator and discharged into a cone classifier which marks the initial classification in the 'sludge' room or sand concentration. The overflow of the classifier is returned to the settling tanks while the underflow goes to a 1½-mm. trommel. The oversize from this trommel is returned to the 'chat' rolls in the jig room while the undersize goes to a system of classifiers which feed the first set of 'sludge' tables. Wilfley and Arbutnot tables are used for this purpose. The lead and zinc concentrates from these tables goes to the concentrate bins. The overflow from the first set of classifiers which feed the first system of tables is re-classified in hydraulic classifiers, and treated on a second set of tables. The slime from this second classification goes to the settling tanks and slime plant. The lead and zinc concentrates from these tables goes to the concentrate bins while the middling is returned by bucket elevator to a 1½-mm. trommel. The oversize from the trommels is returned to the 'chat' rolls in the jig room while the undersize is again classified in a cone classifier, the overflow going

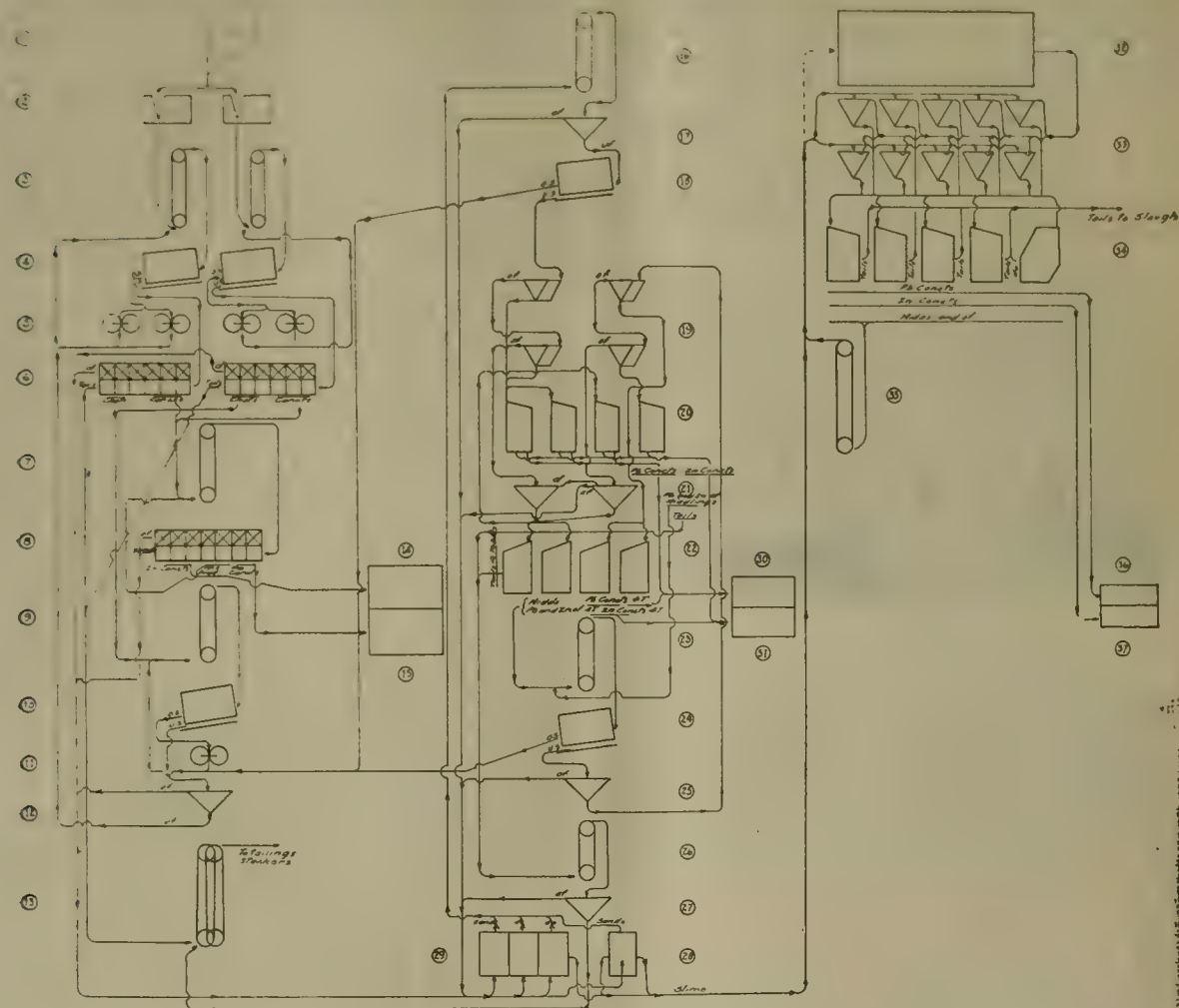
to the settling tanks and slime plant, while the underflow is returned to the first set of classifiers and tables. The system of classification appears rather complicated from a record of flow through the sand plant, but reference to the flow-sheet, herewith presented, shows the system of classification to be by no means complicated. The method adopted amounts to the separation of three products, a coarse and fine sand which are treated on two sets of tables and the slime which is passed to the settling tanks or drag classifier and from there to the slime plant.

The tailing from both sets of tables is raised in

a bucket tailing elevator and classified in a cone classifier. The overflow from the classifier goes to the settling tanks while the underflow is sent to the tailing elevators and thence to the tailing piles.

Slime Plant

The slime-plant, of which an exterior and interior view are shown in Fig. 4 and 5, is a feature of the mill, being at present the only one in the district, and owes its existence to the recent manager, J. N. Houser. The performance of the plant during the past year which it has been in operation has proved this depart-



FLOW-SHEET

- | | | | |
|-----------------------|-----------------------------------|-------------------------|----------------------------|
| 1. Ore-bin. | 11. 30-in. middling rolls. | 19. Classifiers. | 28. Drag classifier. |
| 2. Crushers. | 12. Classifier. | 20. Sand tables. | 29. Settling tanks. |
| 3. Ore elevators. | 13. Double elevators for tailing. | 21. Cone classifiers. | 30. Lead concentrate bins. |
| 4. Trommels. | 14. Zinc concentrate bins. | 22. Sand tables. | 31. Zinc concentrate bins. |
| 5. 36-in. rolls. | 15. Lead concentrate bins. | 23. Return elevator. | 32. Pond. |
| 6. Rougher jigs. | 16. Sand elevator. | 24. 11 1/2-in. trommel. | 33. Cone classifier. |
| 7. Elevator. | 17. Classifier. | 25. Classifier. | 34. Slime tables. |
| 8. Cleaner jig. | 18. 1 1/2-in. trommel. | 26. Tailing elevator. | 35. Middling elevator. |
| 9. Middling elevator. | | 27. Classifier. | 36. Lead concentrate bins. |
| 10. 3-mm. trommel. | | | 37. Zinc concentrate bins. |

ment to be a valuable addition to the existing milling practice in Joplin district where a sufficient amount of slime is produced to warrant such an installation.

The slime as formerly removed from the sludge room went directly to the pond. The slime now passes to a system of ten cone classifiers which will be seen in the halftone to the left of the slime-plant. The overflow from these classifiers which contains but a very small per cent of solids, the cones acting as a dewatering device rather than classifiers, goes to the pond while the underflow is treated on five slime tables, four of which are James tables and one a Wiltley. Lead and zinc concentrate are obtained from these tables and the middling is elevated and returned to the classifiers. The tailing is laundered to the slough. The material treated in the slime plant is finer than 200 mesh and carries about 5 1/2% zinc. The tailing contains about 1 1/2% zinc. The total mill recovery is between 68 and 69%, and the average cost about 18c. per ton.

The method of mill tailing disposal is by bucket elevators and a launder distribution system. This method



FIG. 6. METHOD OF TAILING DISPOSAL.

is used throughout the district, the topography being almost universally level with no depressions which will permit of a gravity disposal. As the tailing piles increase in size and height a limit is finally reached and it becomes necessary to re-elevate the tailing to permit of a higher pile and broader distribution. At this property it has been found necessary to elevate the tailing three times as shown in Fig. 6. The elevation and disposal of tailing at this plant is effected at a cost of 23 1/4c. per ton.

The boiler plant consists of eight 150-hp. boilers, which are fitted for burning gas, coal, or oil. The Hammel oil burning system is used. As a result of the fuel equipment, a shortage in the gas supply occasions but a short delay in putting the oil system into operation. The oil storage is sufficient to run the plant through any ordinary gas failure. In the event of a shortage of both gas and oil, coal is fired under the boilers. The boiler plant supplies steam for three compressors, a 3000-ft. piston inlet Ingersoll-Rand cross compound, a 2000-ft. Laidlaw-Dunn-Gordon compound, and a 2000-ft. Rand compressor. All compressors run condensing. Electricity is used for all power pur-

poses, excepting the compressors, and is supplied by the Empire District Electric Company.

The machine shop equipment is elaborate for a property of this size and in addition to handling all of the repair work about the mine and mill, manufactures elevator buckets and machine spares for this and other properties of the Company. The equipment includes two lathes, shaper, planer, radial drill press, two pipe machines, power hammer, plate bending rolls for trommel screens, three power saws, and oxy-acetylene welding outfit. The machinery is driven by a 40-hp. General Electric motor. The store room contains a \$40,000 stock of all kinds of supplies for mine and mill use.

While the methods herein described of both mining and milling will undoubtedly appear as rather primitive to miners and millmen in other parts of the world who are accustomed to the more elaborate and costly equipment, nevertheless the results which are being obtained at total cost of mining, milling, depreciation, amortization and general expenses of less than a dollar per ton is ample evidence that the Joplin practice is most efficient and well adapted to the local conditions.

The work done in producing a given deformation of any body, within the elastic limit of the substance, varies as the volume of the body deformed, according to Arthur F. Taggart in the *Bulletin* of the American Institute of Mining Engineers. For a highly elastic substance this principle may be extended beyond the elastic limit, by the assumption that the force-deformation curve beyond the elastic limit is closely represented by a continuation of the straight line, which represents the behavior of the body within the elastic limit. For rock, which is almost perfectly elastic, this assumption is correct within the limits of experimental error. The work of crushing rock is proportional to the volumes of the particles crushed, and to the volumes of the resulting particles. Attempts to prove the work of crushing proportional to the reduction in diameter err in one of the following ways: (1) by neglecting the distance quantity in the work formula; (2) by assuming that particles in a crushing machine are acted upon in such a way as to produce simple shearing stresses; (3) by assuming that the force exerted is a constant; and (4) by confusing force and work. The difference in the results obtained according to the two assumptions is small throughout a considerable range of sizes. The difference is marked in the fine sizes, where the greatest amount of power is wasted.

Wages paid to white employees of mining companies in the Union of South Africa in 1913 totaled £9,913,490, of which the Transvaal was responsible for £8,551,921; Cape Colony, £868,982; Orange Free State, £337,081; and Natal, £155,506. Native, Asiatic, and other colored peoples were paid £8,027,541. the Transvaal accounting for £6,595,657. Total mine employees in the Union in February, 1914, were 28,750 whites and 243,531 natives, against 32,159 and 302,337 respectively in March, 1913.

A New Safety Detonator at Cornwall

By EDWARD BROWNING

Bench blasting by means of deep well drill-holes has come into general use in nearly all large open-cut mining and quarrying operations because of the greater economy found in breaking down with a primary blast masses of material, which saves the immense amount of labor formally used in bench cleaning and which gives assurance that plenty of material is on hand prepared for the shovel and for other reasons.

Always the great trouble experienced in blasting is

Probably in all large shots the more holes that are fired at one time and the deeper they are, the more the efficiency that can be procured, due to one hole helping out another, and because there are relatively less end holes. Now it is a well proved fact that the powder in a hole gives best results around the exploder. This can be seen at any time by examining the face of a bank after a shot. The powder farthest away from the exploder has decidedly less disrupting

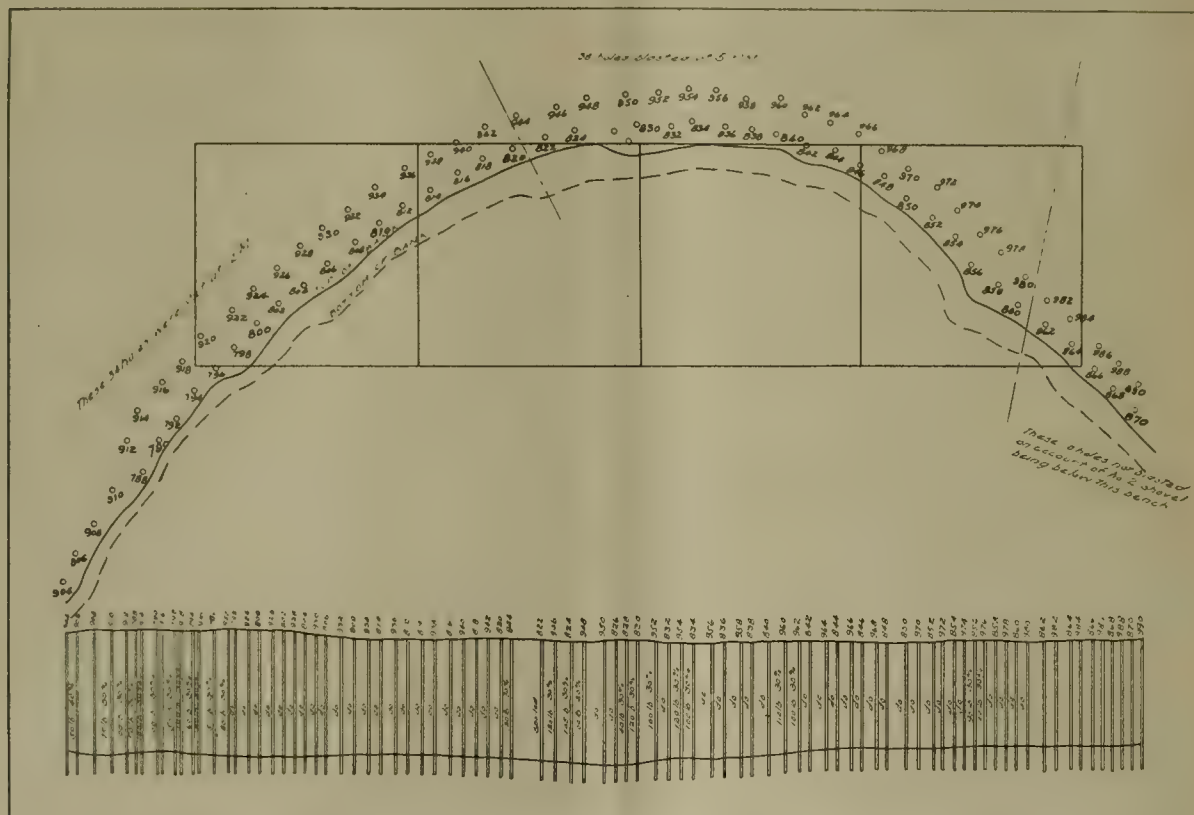


DIAGRAM SHOWING ARRANGEMENT OF HOLES AND AMOUNT OF EXPLOSIVE CHARGES IN BENCH BLASTING AT CORNWALL.

imperfect detonation of all the holes. The charge of powder or dynamite is necessarily large on account of the amount of burden to be moved. Unless a live wire is used to set off the blast, comparatively few holes can be shot at one time, as the ordinary blasting machine is only capable of shooting a few of the long exploders, with any certainty; also by either of these methods there is always the danger of a short circuit spoiling some or all of the holes and there is the added danger of the wires being charged accidentally by lightning. The up-keep of the live-wire circuit and the leader wire is also considerable

power. The usual 4 by 8-in. stick of dynamite will fill about 1 ft. of hole ($5\frac{5}{8}$ in.) for every 15 lb. if uncut, or 33 lb. can be tamped in a hole if the dynamite is taken out of the paper. This means that if a hole is not chambered a couple of hundred pounds will fill several feet and in order to get good efficiency, two exploders are used, one near the top of the charge and one near the bottom. This insures greater safety in case one exploder is defective or the wire is broken. Also it increases the danger in loading a charge and increases the number of detonators to be exploded. In very deep holes it would at times pay to load the dynamite in

several separate charges in order to break up the rock better, but the number of wires to be handled in this case is almost prohibitive. A perfect exploder would be one that would be safe and easy to handle, that would be waterproof, would explode a charge of powder throughout its entire length, and in any number of places instantaneously.

Very recently a large powder concern brought to our notice a new exploder called 'cordeau' which answers all of the above requirements. It consists of a lead tube 5 or 6 mm. in diameter, filled with a safety explosive. This tube comes wound on reels or spools, in convenient lengths for handling. The operation of loading a hole is very simple. First the hole is pumped out if possible, then a stick of powder is tied to one end of the exploder tube and lowered down the hole. The object of the powder on the end is to give weight to the tube to facilitate lowering and to keep it taut. After the tube is all the way down, the hole is charged in the usual manner, no special precaution above the ordinary being necessary, and tamped up. After the hole is finished the cordeau is broken off, leaving about 1 ft. extending above the top and the next holes loaded and so on until all are finished.

After loading the holes the ends of the cordeau sticking out are split with a knife for about five inches and a leader, consisting of the same cordeau, is run along the top and the split ends of the separate holes are carefully wrapped around this leader. If several rows of holes are to be shot at the same time, it is necessary to either leave enough cordeau sticking out of the back holes to extend to the leader over the top of the front holes or to run a second stringer across them also and loop the two leaders together at one end by means of a little brass sleeve. In order to shoot, all that is then necessary is to place an ordinary blasting cap with fuse at one end of the leader and the whole shot goes off instantaneously.

At the mines of the Cornwall Ore Bank Co. we have been using the cordeau two months, being as yet the only users of it in this country, although in France, where it is manufactured, they have used it for several years. We have made a dozen big shots. Before attempting to use it, however, we tried it out in the open. It is surprising what a terrific explosion a short piece will make when detonated. A two-foot piece laid on top of a powder box will blow it all to splinters; however, letting a locomotive run over it repeatedly has no other effect than to flatten it out, and applying a match to some of the cordeau powder gives no results but to make a black smudge which immediately goes out of itself. Our first shot consisted of five 40-ft. holes. The second of twenty-seven 40-ft. holes. The last one consisted of seventy-two 30-ft. holes by which 30,000 tons of heavy magnetic iron ore was displaced.

The makers claim that the rate of travel of explosion in the lead tube is 17,716 ft. per second, faster than that of 40% dynamite itself. By the use of this exploder we get greater efficiency from our dynamite,

mostly due to the fact that the powder is detonated throughout its entire length and we have therefore cut down the amount of powder used 10% and have not yet reached the limit. The lead tube makes the explosive absolutely water-proof. The handling of the same when loading is very much simpler than is the case with exploder wires and does not require the supervision the latter do. Also, because there are no wires to worry about, the loading and tamping are much expedited.

Finally, the remarkable fact of cordeau is that it not only promotes the 'safety first' idea by eliminating the real danger in blasting (the mercury cap), but it also is much simpler to handle, cheaper, and more efficacious.

Reviving Oil Wells

The use of nitroglycerine to increase the flow from oil wells has been so long known that it is common practice. A more recent development which promises to be of great importance is the use of compressed air for increasing the flow. The theory upon which it is based is that if the original rock pressure is put back upon the rock the flow of oil through it will be greatly accelerated. In actual practice the method followed is to cap a well in the usual way and connect it with an air-compressor. The compressor is run at full speed until the most satisfactory degree of pressure is reached, and then it is only operated to the extent necessary to keep the pressure uniform. The flow of oil from the surrounding wells is thus greatly increased, and in one case a group of wells was raised from an output of about 40 bbl. per day to over 40 bbl. per day. The degree of pressure needed has to be determined by experiment, and when the point is found at which the greatest flow is attained, the pressure is maintained at this point. In practice it has been found, for example, that a 14 by 20-in. compressor will serve to properly stimulate the flow of a group of 40 wells. The air is only used on certain of these, and the pumps are operated upon the remainder in the usual way. Patents covering the use of air for this purpose have been obtained by Smith & Dunn, of Chicago, and the process is being applied to over 1000 wells in various places between Pennsylvania and Texas with results that are reported to be uniformly encouraging. In some cases wells which have not yielded oil for many years have been caused to produce again. There is some question as to the validity of the patents and many other operators are also using the method for stimulating the flow of their own wells.

The production of crude barite in the United States in 1913 was 45,298 short tons, valued at \$3.45 per ton, according to the U. S. Geological Survey. The imports of crude barite entered for consumption amounted to 35,840 short tons, valued at \$1.71 per ton. Of these imports 82 short tons were entered at San Francisco.

Economical Sliming by Grinding Pans

By M. G. F. SÖHNLEIN

In Mr. Alfred James' review of progress in gold ore treatment during 1913, which appeared in the *Mining and Scientific Press* of January 3, 1914, the author refers to my article in *The Engineering and Mining Journal* of September 27, 1913, describing the evolution of the present grinding-pan practice at our mill. Since Mr. James believes that my grinding-pan resins deserve the attention of the industry, I feel myself obliged to explain everything that may have left some doubt as to the actual performance of these pans. In this, as in the previous paper, only the metric ton of 1000 kilograms has been used.

Character and Quantity of Feed

At the time when I wrote the paper mentioned (May 1913) the pan had been running for two months in the way I described. The quantity of tailing from the old mill was computed as follows: In one unit of the plant I was treating 50 tons of pyritic ore per day, which after roasting was reduced to 40 tons, and in the other unit a maximum of 22 tons of oxidized ore from the upper levels of the mines. Preliminary grinding of both kinds of ore was done in No. 5 Krupp ball-mills, and certain middling-products from the concentrating machinery were reground in Huntington mills to about 40 mesh. After taking out a maximum of 10 tons of concentrate and rich middling for roasting and re-dressing, the balance of 52 tons was sent to the tailing-mill, of which I described the regrinding and sand-concentrating department. In the tailing-plant about two tons of concentrate was recovered from the Overstrom tables and the slime-plant, so that the final tailing amounted to at least 50 tons. I am absolutely certain about the grading analysis of this material, because the tables in the tailing-mill were working some time before the pan was started, and after being treated on these tables the pulp overflow from classifiers and cones was made to pass an automatic sampler, which takes a cut across the whole stream every 70 seconds, traveling at right angles to it and at an even velocity. Therefore I had a perfect control on the performance of the pan: knowing how much the average quantity of -200-mesh product was in the daily sample, any increase of this material was due to grinding of sand by the pan.

The quantity of pyritic ore treated was exactly known, because the ore is delivered at the plant in railroad cars which are weighed on platform scales when arriving. From daily laboratory tests on a sample of the ore ground during the past 24 hours, the loss in weight through roasting is known to average 20 per cent.

That part of the mill which treated oxidized ore was not run all the time. The ore supply was irregular on

account of the work in the mines being confined to development at that time. This department could only be run when there was ore, and then a quantity of 50 trucks of 440 kg. each was treated in 24 hours. The gangue of this ore contains slate, quartz, limonite, and other iron oxides, more or less decomposed feldspars, and a little pyrite. I may give an idea of its hardness by stating that it is at present being crushed in a 10-stamp battery, of which the output is 3.25 tons per hour when discharging through a 1.18-mm. screen. The stamps drop 98 times per minute, the height of drop being $6\frac{1}{2}$ in., height of discharge 4 in., and weight of stamps 1050 pounds.

All my figures and screen tests refer only to those days when both parts of the old mill were running. If finally no +60 product was found in the daily tailing sample, it is obvious that the pan must have reduced all the sand to pass a 60-mesh screen, and about 30 tons of it to -200 mesh, as shown below:

SCREEN TEST ON MILL TAILING SAMPLES

Quantity of tailing, 50 tons per 24 hours.

Screen.	Before installation	After installation
	of pan, %.	of pan, %.
+200	81.5	21.2
-200	18.5	78.2
	100.0	99.4

The increase in -200-mesh product, due to grinding done by pan was $(0.782 - 0.185) \times 50 \text{ tons} = 29.85 \text{ tons}$. I hope it will now be well understood that the pan really slimes 29.85 tons, and not only one-third of it, as Mr. James infers in his paper. I have dwelt rather long on this subject, but my only reason has been to prove that there is no guesswork about the quantity of material treated in our plants, and the grading analyses given in the previous paper.

At present the pan does not grind the same quantity, because since October of last year that part of the mill for the treatment of oxidized ore has been closed down, and this ore is now treated in much larger quantities in a new installation with its separate grinding pan and slime plant. At present 40 tons of roasted ore is being treated in the tailing mill, of which the pan grinds 20 tons to -200 mesh. I have given up sliming all the sand, because it was found that the poorest sand-tailing from the Overstrom tables always contains less tin than the final tailing from the slime-plant. Therefore it is useless to grind this material, and by running about five tons of the poorest sand to waste, the extraction of tin has been improved.

I must admit that I was working with favorable material when sliming about 30 tons per day in the pan. Roasted ore is always easy to grind, and the oxidized ore is not hard. But at many Australian mills

the pans are likewise handling roasted ore, and their results are not as good as those obtained here. As I said in my previous paper, there are reasons to believe that I had not reached the maximum capacity of the pan when sliming 30 tons; less water in the feed, heavier shoes, a larger grinding surface, and greater muller speed would probably have improved the grinding work. Further, it must be borne in mind that this pan is a rebuilt amalgamating machine, changed into a fine-grinder by crude make-shift means, and if a pan were specially designed along the lines of my indications, it would doubtless be more efficient.

When operating the pan without any special feed device it was impossible to slime more than $2\frac{1}{2}$ tons per 24 hours. I did everything possible; thickened the feed pulp to 80% moisture by discharging the spigots of the dewaterer intermittently, run the muller at seven different speeds varying between 26 and 70 r.p.m., tried several heights of discharge, and changed the position of the baffles, none of which gave satisfactory results, and the pan was about to be sent to the scrap pile, when I noticed a cut of a Colorado Iron Works pan in Richards' 'Ore Dressing,' showing the central feed pipes. When these had been put in, the pan became serviceable, but its performance was not yet satisfactory.

I noticed with some satisfaction, when reading A. W. Allen's experience with an amalgamating-pan as a fine-grinder ('Cyanide Practice, 1910 to 1913,' page 189) that I do not stand alone with my failure to make such a machine grind. Mr. Allen says: "Personally I have done everything in an endeavor to coax even a moderate duty out of this type of pan, but all to no purpose. * * * The maximum output I could get on ordinary quartz ore and with the pan fitted with new shoes and dies and a Wheeler discharge was about three tons slimed per 24 hours from 20 mesh." This figure agrees remarkably well with mine of $2\frac{1}{2}$ tons.

Quantity of Sand in Circulation

I said in my previous paper, "the quantity of sand separated by the Dorr classifier is 38 tons, without considering the sand returned from the pan." My paper was not silent on the question of the returns, as Mr. James observes. To compute the total quantity of sand which passes during 24 hours from the tables to the pan, I must refer to the screen tests on feed and discharge, which, of course, were made under normal working conditions, that is, when the equilibrium to which Mr. James refers had been established.

Screen, mesh.	Feed to pan.	Discharge from pan.
On 20.....	9.0	0.0
40.....	11.0	1.0
60.....	21.5	12.5
80.....	24.0	22.5
100.....	9.5	9.5
150.....	13.0	11.0
200.....	7.5	11.5
Through 200.....	4.5	32.0
	100.0	100.0

If the overflow of the Dorr classifier consisted exclusively of -200-mesh material, $32.0 - 4.5 = 27.5\%$ of the discharge from the pan would be discarded at one passage. But the overflow has only 78.2% -200 mesh, and consequently $21.8\% + 200$ -mesh product. Therefore an additional amount of $\frac{21.8}{78.2} \times 27.5 = 7.6\%$ of the pan discharge flows over as fine sand. This makes a total of 35.1% of the pulp ground fine enough at one passage to be eliminated from the circuit, and consequently, 64.9% is returned. Of this returned sand, another 35.1% flows over after the next passage, and 64.9% goes back to the pan, and so on. If the original feed to the pan is 38 tons, the total feed during 24 hours, including the returns, must be:

$$38 + 0.649 \times 38 + 0.649 \times 0.649 \times 38 + \dots \dots \dots 0.649^n \times 38$$

$$= \frac{38(0.649^n - 1)}{0.649 - 1} = \frac{38}{0.351} = 108.2 \text{ tons.}$$

Before the pan was used, one large-size Overstrom table could easily handle all the sand, but when the quantity had been so considerably increased by the returns from the pan, it was found necessary to use both tables, which then received about all they could treat.

It never occurred to me to check the total quantity of sand fed to the pan by a direct test, but have recently determined by timing the filling of a 15-litre bucket that it is equal to 73 tons under the present conditions, when sliming only 20 tons and discarding 5 tons without grinding.

Mr. James observes that it is difficult to realize how, if at one passage only 30% is slimed, the other 70% is to be slimed as well, and at the same time the new ore from the mill is crushed. I believe that this may be explained as follows: by discharging the pulp directly after it has once passed underneath the muller, instead of returning it by baffle-plates, so much time is gained that this accounts for the greater capacity. Be this as it may, it is possible, because I have done it for over six months, and am doing it today with two pans, though grinding smaller quantities. I shall refer again to this question further on.

Comparison of Screen Analyses

In comparing the screen test tables, one sees immediately that the increase of -200-mesh product in the discharged pulp is principally gained at the expense of the +20, +40, and +60-mesh sand. This is easy to understand, because if a pan muller squeezes a grain of say 0.3 mm. (40 mesh) between shoes and dies, it is almost certain that this grain will be disintegrated into almost impalpable powder. The finer sand more easily escapes the grinding action, because when the muller is engaged in crushing the coarser grains, it will probably be lifted a very small distance from the dies on which it should be resting, and thereby gives the fine sand a chance to reach the periphery without being touched. Then again, if fine grains get under the shoes, they will have a tendency to be broken into a few smaller particles instead of being pulverized like the

larger ones. It is fully corroborated by screen tests that the fine sand between +80 and +200 mesh accumulates in the pan-feed. Before the pan was used, the grading analyses on the products from the Dorr classifier were:

Screen, mesh.	Sand, 38 tons.	Slime, 12 tons.
On 20.....	11.5	0.0
40.....	14.5	0.0
60.....	29.0	0.0
80.....	19.5	0.5
100.....	12.0	3.0
150.....	7.5	6.5
200.....	4.0	9.0
Through 200.....	2.0	81.0
	100.0	100.0

The grains between the limits of -60 and +200 con-

back to its proper pan. Every pan could be so built as to be most efficient for the size of sand it should comminute. The pan grinding the coarsest sand would probably have more capacity than the others, therefore to work under the most economical conditions it might be necessary to have three or four pans for the finer sizes instead of two, this detail being different for each kind of ore and also depending on the preliminary crushing.

Referring again to the question of grinding the returned sand in the same pan, I should like to make a comparison with a tube-mill working in closed circuit with a classifier. It is generally acknowledged that no separate tube-mill is needed to slime the oversize in the discharge from the first one, although in exceptional cases the latter practice has been adopted. I have no

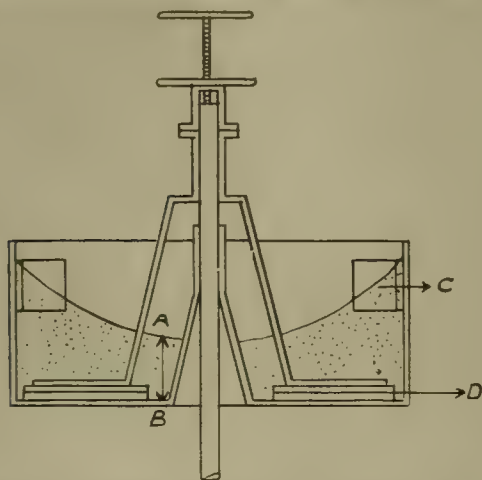


FIG. 1. SECTIONAL ELEVATION OF GRINDING-PAN FED IN ORDINARY WAY.

Centre of pan around central cone is full of pulp. Grains of sand directed by the baffles to A have to settle the distance AB in the liquid to arrive at the grinding surface. C. Baffle plate. D. Grinding surface.

stitute 43% of the sand product of the classifier, and after mixing it with the returns of the pan, the quantity of this fine sand is as much as 54%, as shown in the screen test table on feed and discharge of the pan.

The Australian practice of using different pans for coarse grinding and sliming seems reasonable, because each pan can be so adjusted to suit the material it is grinding. This principle is very good, but it should be more elaborate to give real economy. For a large installation, I believe the following arrangement would prove very effective: a different pan should be used for every size, namely, one to reduce only +40-mesh sand, another -40 to +80, and perhaps a third one to grind only -80 to +200-mesh material. The product from these grinding machines should then be returned to the sizing and classifying system, which could be simply and efficiently made of two Callow screens and one mechanical classifier, and the oversize from each screen and the classifier should be brought

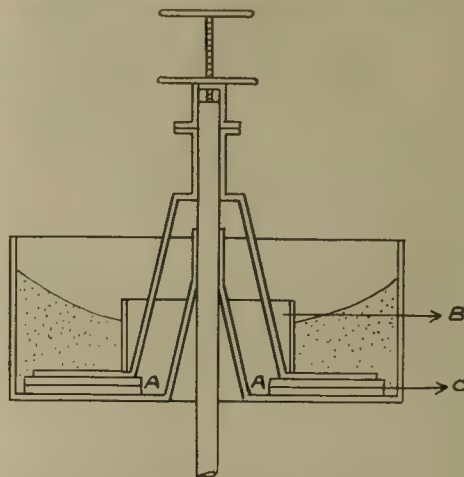


FIG. 2. SECTIONAL ELEVATION OF GRINDING-PAN WITH CENTRAL FEED CYLINDER.

Bottom of pan around central cone inside cylinder is dry. Grains of sand fed in the cylinder fall directly to A, where they arrive at the grinding surface without delay. B. Central feed cylinder. C. Grinding surface.

grading tests to publish from personal experience with tube-mills, and have compiled a small list of screen analyses on feed and discharge from tube-mill practice in different parts of the world, which show the increase of the quantity of finest product obtained at one passage through the mill.

(1) *Dos Estrellas, Michoacan, Mexico.*

Mill No. 1, tube-mill No. 1.	+200	-200
Feed	70.5	29.5
Discharge	31.5	68.5
Slimed at one passage 39% of total feed.		
Mill No. 2, tube-mill No. 2.		
Feed	72.5	27.5
Discharge	53.5	46.5
Slimed at one passage 19.6%.		

(2) *Guerrero Mill, Pachuca, Mexico.*

Average of 4 tube-mills working parallel on the same feed:		
	+200	-200
Feed	85.5	14.5
Discharge	71.4	28.6
Slimed at one passage 14.1%.		

(3) *Simmer & Jack Mill, Transvaal.*

	+90	-90
Feed	82.9	17.1
Discharge	49.2	50.8
Ground to -90 at one passage 33.7%.		

(4) *Hannan's Star Mill, Kalgoorlie, Western Australia.*

	+150	-150
Feed	52.9	47.1
Discharge	37.2	62.8
Ground through 150 mesh at one passage 15.7%.		

(5) *Treadwell Mill, Alaska.*

	+200	-200
Feed	90.2	9.8
Discharge	36.5	63.5
Slimed at one passage 53.7%.		

(6) *Polaris Mill, Arizona.*

	+120	-120
Feed	60.8	39.2
Discharge	36.4	63.6
Ground through 120 mesh at one passage 24.4%.		

(7) *Tonopah Extension Mill, Nevada.*

	+200	-200
Feed	84.91	15.09
Discharge	54.00	46.00
Slimed at one passage 30.91%.		

(8) *Homestake Mill, South Dakota.*

	+200	-200
Feed	96.0	4.0
Discharge	58.0	42.0
Slimed at one passage 38%.		

(1) McCann, 'Cyanide Practice in Mexico.'

(2) McCann, *op. cit.*

(3) 'A Text-book of Rand Metallurgical Practice,' Vol. I.

(4) Richards, 'Ore Dressing,' Vol. III.

(5) *Bull. Amer. Inst. Min. Eng.*, February 1912.

(6) 'Cyanide Practice 1910 to 1913.'

(7) *Eng. & Min. Jour.*, March 1, 1913.(8) *Trans. Inst. Min. Met.*, 1912.

In compiling these data I have tried to be entirely indiscriminating regarding the performance of the tube-mills: my only purpose has been to obtain figures from many various districts. The average of the eight examples gives 29.8% of the feed slimed at one passage through the grinder, against 27.5% by my grinding pan. Example No. 2 is very instructive. The tube-mills in question receive a feed, of which only 7% is coarser than 60 mesh, and due to this have an abnormal small duty. This proves that whether the pan or tube-mill is used, the main difficulty in fine-grinding consists in reducing the -60 to +200-mesh sand to slime. To compare the quality of grinding of pan and tube-mill, regardless of power and material consumption, I should like to know if in the tube-mill feed the same accumulation of the fine sand is noticed as with the pan. Although not having data at hand from which I can make a definite conclusion, I have a strong conviction that this really is the case, based chiefly on the reduced output of tube-mills working on fine sand only. Now, if the quality of grinding work of tube-mill and pan is so similar, why should one machine have more difficulty in handling the returns than the other? Besides, I believe to have proved by my pan-results that the difficulty does not exist.

I can give a satisfactory explanation to Mr. James' observation, that although there is more +100-mesh product in my pan discharge, my results seem to be better than in Australian practice. As I understand, the pan in vogue in Australia has its return classifier connected with it, while I use a separate classifier outside the pan. The coarse sand which needs further comminution remains inside the Australian pan, until it is ground fine enough to flow over in the discharge lip, whereas I discharge this material with the fines to elevate it to the Dorr classifier.

Central Feed

I must confess that I think very little of the argument from Australia that "the centrifugal motion was such that the feed was found to be sent from the centre between the shoes and dies to the periphery anyhow." The only natural movement of the pulp in the pan is from centre to periphery, and it is just this movement which should be fully utilized to make the pan grind properly. During the passage from centre to periphery on the grinding surface the pulp stands the best chance to be caught by the entire width of the shoe. Now let us see how a pan grinds which is not centre fed. The pulp is introduced opposite to the discharge lip, rises to the baffle-plates, which subsequently direct it to the centre.* From there it is supposed to pass between shoes and dies to the periphery to be discharged. This is nothing but centre feed in disguise. If the pulp is not directed to the centre by the baffles, no grinding will result. Now, it is certainly not correct to first make a mistake and to afterward use baffles as a remedy; it causes loss of time by keeping pulp in circulation before it comes to the grinding surface at the contact of shoes and dies, and here 'time is capacity.'

In a pan with central feed the bottom inside the central cylinder is entirely dry, one sees the pulp falling between the projecting points of the shoes and dies, from which it is directly drawn away by the suction from the revolving muller. But during this rapid passage to the periphery the grains are sure to meet the shoes, because they cannot pass above the muller, every communication between the centre and the pan body being closed. On the other hand, if the centre of the pan is open, the level of the pulp at this point stands above the muller. The feed, be it brought to the centre by baffles or pipes, does not come directly to the clean grinding-surface, as with the centre-fed pan, but falls into a liquid where the coarse grains must first settle before they can come on the dies. This settling is a delicate question: first, the specific gravity of the pulp in which the settling must take place is high; and, second, the grains are directly submitted to the action of the centrifugal force caused by the revolving muller, which will draw some of them, and I believe the greater part, over the shoes

*'Grinding-Pan Practice at Kalgoorlie,' by M. W. von Bernwitz, *Mining and Scientific Press*, May 17, 1913.

instead of through the open segments between them, where the only possibility of grinding exists. The accompanying sketches elucidate this. I believe I have sufficiently proved, first by the results of my grinding-pan, and further by argument, that a forced central-feed arrangement is an essential feature for real economical work with pans.

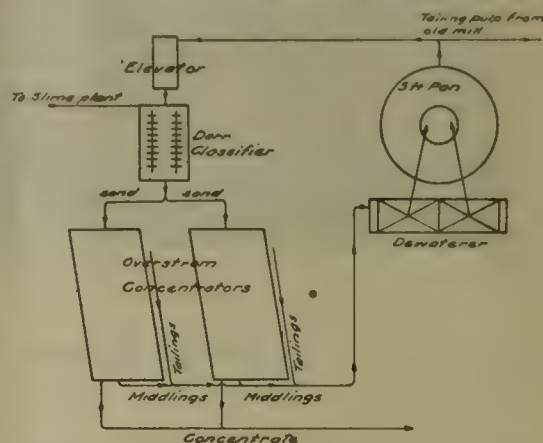
Finally, I will use this opportunity to make a few observations on the reply of Mr. von Bernewitz to my letter in the *Mining and Scientific Press* of December 6, 1913. I saw in his sketch that the coarse sand from the return-classifier is supposed to be drawn in by the muller. It is not drawn in, but settles by gravity, because it cannot flow over in the classifier. Then it is kept in circulation at the periphery of the pan until it has sufficiently risen to reach the baffles, and only then it comes back to the centre where it can come to the shoes and dies. The grinding pan can be compared with a centrifugal pump: with both, the maximum suction exists in the centre, and at the periphery, where the discharge should be, there exists only a repellant action. Therefore, it is impossible that the revolving muller can in any way be an agent for sucking the coarse sand back to the grinding surface in the pan.

As to the paraboloidal shape of the pulp surface, a look into a text-book of theoretical mechanics will prove that any liquid, contained in a cylindrical vessel in which a stirring motion parallel to the circumference is acting, must assume this shape. Of course, baffle-plates interfere with the regularity, but a depression in the centre always exists, and the pulp cannot keep level, as Mr. von Bernewitz believes. There is no reason whatsoever for the pulp in a sliming pan to behave differently in this respect from the pulp in the stage-crushing pan. I have noticed the central depression with every pan I have seen working.

Synopsis of article, 'Economical Fine Grinding in Pans,' discussed by Alfred James in 'Progress of Gold and Silver Ore Treatment During 1913':

In a new plant for concentrating tailing from tin ores, erected in 1912 at the reduction works of the Compañia Minera de Oruro, at Machacamarea, Bolivia, a mill was needed for grinding the sand in the tailing to -200 mesh. On account of the small quantity to be handled, a tube-mill was out of the question, and it was decided to install a pan. The pan in question was a 5-ft. standard amalgamating-pan, and when tried as it came from the factory, the maximum capacity which could be obtained was $2\frac{1}{2}$ tons of sand slimed per 24 hr. After a feed device with pipes which delivered the pulp in the path of the mullers had been fitted to the pan, the duty was raised to 7 tons slimed per 24 hr. When a sheet iron cylinder was fixed on the muller plate, all openings in this plate were closed, and the feed introduced inside the central cylinder, the grinding improved to

such an extent that the pan reduced 30 tons of sand to -200 mesh, with a power consumption of 6.26 hp., and the muller made 60 r.p.m.; 0.67 lb. of iron was used for shoes and dies for comminuting one ton of sand to -200-mesh product. A cost of \$0.30 per ton slimed was calculated after two months' running.



FLOW SHEET OF REGRINDING PLANT

Capacity, quantity of moisture in the feed, and number of revolutions of muller are closely related, and for every feed a critical speed of highest efficiency exists. The material ground was not hard, the greater part of the sand came from roasted pyritic ore, and the balance from soft oxide ore. The tailing-pulp was delivered by an elevator to a Dorr classifier, which sent its overflow to the slime plant and the sand to two Overstrom tables, which recovered a small quantity of concentrate. All middling and tailing from these tables went to the pan after being devoluted in a small spitzkasten to 48% solids. The discharge from the pan went back to the same elevator, and the sand which had not been ground fine enough at one passage through the pan was returned to the tables by the Dorr classifier, and subsequently to the pan, until all had been ground so fine that it could flow over into the classifier.

The diamond is the most impenetrable of all known substances, and will scratch any other stone or the hardest steel. During his lecture at Kimberley, before the British Association, Sir William Crookes squeezed a diamond between two blocks of steel until they touched, without the slightest injury to the stone, although the pressure is said to have been 170 tons per square inch. Gardner F. Williams, late of the De Beers mines, witnessed the experiment, which thoroughly illustrated the impenetrability of a rounded diamond. No doubt, however, an octahedron formed stone would not have stood the test.

The De Beers diamond mines contribute \$3,600,000 per annum to the revenue of the Union of South Africa. At the present rate of production, the mines will last for 50 years or more.



COLUMBIA SCHOOLS OF APPLIED SCIENCE IN 1914 AND 1884.

Columbia School of Mines, 1864-1914

Columbia University, or Kings College, as it was then known, was founded in 1754. The few buildings in which the College was housed stood just west of the present Woolworth building, and in the midst of what were then broad meadows on the outskirts of the city of New York. During the Revolution, the buildings were used by both American and British troops as barracks and for hospital purposes, and it was not until 1784 that they were restored to college uses. For some reason the institution did not flourish greatly on this site and in 1857 it was removed to Forty-ninth street, not far north of the present station of the New York Central railroad. The wisdom of the change was at once demonstrated, for the College that for nearly one hundred years had seldom had more than 125 students in attendance, a few years later had nearly ten times as many.

Establishment of School of Mines

The establishment of the School of Mines was the result of the efforts of Thomas Egleston, who had studied at the Ecole de Mines in Paris, and on returning to this country was full of enthusiasm for the establishment of a school of mines in New York. In March 1863 he published a plan for a school of mines and metallurgy embodying a three year course of instruction, both theoretical and practical, in the subjects relating to mining and metallurgy. Some of the trustees of Columbia College became interested in the plan and a committee consisting of John Torrey, William Betts, and George T. Strong was appointed to consider the matter. The committee made its final report on December 21, 1863, and the trustees adopted resolutions establishing the school, appointing Thomas Egleston professor of mineralogy and metallurgy, and entrusting him with the work of organizing the school.

The School grew so rapidly that new quarters had to

be provided for the second year, and a vacant wall paper factory nearby was secured and equipped. Accommodations were provided for 72 students and 89 were in attendance during the second year. The third year the trustees of the College were sufficiently convinced of the success of the new School to authorize the construction of a special building, and John M. Newberry was appointed professor of geology. It was not long before a fourth year was added to the curriculum, but as a fourth year course was thought too long, this was designated a 'preparatory course' in order not to appall the students.

The School entered into a new period of development when the University was moved to its present site on Morningside Heights in 1897 and mechanical limitations of cramped quarters were removed, the development of the School then becoming even more rapid. The work of the School found ready support, and funds became available for laboratory equipment that had long been needed. Laboratory instruction in ore dressing, for example, was first possible on a large scale in the more spacious quarters available on the new site. A few years later, through the generosity of the Lewisohn family, funds were provided for the construction of a special building to house the departments of mining and metallurgy.

The growth of the other engineering schools has been so great in the past 25 years that in 1896 the form of organization was changed and the schools of engineering and chemistry were set off from the School of Mines, the three, however, remaining under the jurisdiction of a single faculty now called the Faculty of Applied Science. The present organization therefore consists of:

1. School of Mines, with courses leading to the degrees of Engineer of Mines, and Metallurgical Engineer.

2. The School of Engineering, with courses in civil engineering, sanitary engineering, electrical engineering, and mechanical engineering, leading to the degrees of Civil Engineer, Electrical Engineer, and Mechanical Engineer, respectively.

3. The School of Chemistry, with courses leading to the degree of Chemist and Chemical Engineer.

The buildings of the university proper number over twenty, and of these the following are particularly devoted to instruction in the courses taught in connection with the School of Mines.

New Building

The School of Mines building, erected in 1904, is 145 by 57 by 100 ft. in size. The entire building, with the exception of three rooms, is occupied by the departments of mining and metallurgy. On the left of the entrance is the mining museum; on the right, the museum of metallurgy. The museums contain models of mines, mine plants, smelting furnaces, and metallurgical appliances, together with a collection of metallurgical products. On the two basement floors are the ore-dressing laboratories, provided with appliances for concentrating and testing ores on a small scale, and for crushing ores preparatory to treatment in the con-

centrating plant. These laboratories also contain a number of full-size concentrating machines, which are examples of the principal types of apparatus used in modern concentration works. On the second floor is a drafting room, the reference library of the department of mining, the non-ferrous and electro-metallurgical laboratory, containing roasting and crucible furnaces and amalgamating and bleaching apparatus for dry and wet metallurgy, and the library of the department of metallurgy. The third floor is occupied entirely by the department of metallurgy: the iron and steel laboratory, provided with electric and gas furnaces, pyrometers, and other apparatus, for experimental work and the heat treatment of iron and steel; several rooms devoted to metallographic work; an analytical laboratory, dark-rooms for photography, and officers' studies. On the fourth floor are the assay laboratories; also, separate rooms for crucible furnaces and western coal-fired mufles, a room for the preparation of assay charges, and a weighing room provided with a number of balances.

The School of Engineering building, erected in 1896, is 150 by 57 by 100 ft. In the sub-basement are the bituminous materials' research laboratory and road materials' testing laboratory of the highway engineering



VIEWS OF ASSAY, CHEMISTRY, ORE TESTING, AND STRENGTH OF MATERIALS LABORATORIES.

department; also the storage battery room and the supply room of the department of electrical engineering, as well as the gas engine room and stock supply room of the department of mechanical engineering. In the basement are the machine laboratories (direct and alternating current) of the electrical and mechanical engineering departments. On the main floor are the reference library of the departments of civil, electrical, and mechanical engineering; the electrical engineering museum and lecture rooms, the museum of the civil and mechanical engineering departments, and the testing materials laboratory of the department of civil engineering. On the second floor are the drafting rooms of the department of civil engineering, a library, and a large lecture-room. On the third floor are the instrument laboratory, the drafting rooms of the department of electrical engineering, and a reference library. The fourth floor is devoted entirely to the department of engineering drafting. In the attic is a blueprint-room with large rolling frame and tank.

Havemeyer Hall

Havemeyer hall, erected in 1896, is 205 by 80 by 100 ft. The entire east wing of the first floor is occupied by the Chandler Chemical Museum, showing in specimen form the evolution, not only of the science of chemistry, but of the chemical and allied industries. The rest of the large building is taken up by the laboratories, administrative offices, lecture-rooms, the science seminar, and a library of books and journals devoted to pure and applied chemistry.

Fayerweather hall, erected in 1896, is 150 by 57 by 100 ft. The building is occupied by the departments of physics and astronomy.

Schermerhorn hall, erected in 1896, is 205 by 80 by 100 ft. It is occupied by the departments of geology, mineralogy, botany, and zoölogy. At the left of the entrance hall is the museum of economic and physical geology, at the right the Egleston museum of mineralogy. Two lower floors are occupied by museums, laboratories, and special research-rooms for invertebrate paleontology, stratigraphic geology, mineralogy, and blow-pipe analysis. The second floor contains the general laboratory of inorganic geology and petrography, special laboratories, the lecture-room, and the library of the department. The third floor is mainly occupied by the department of botany. The upper floor is devoted to the department of zoölogy.

The field work of the School of Mines consists of summer courses in surveying and in mining and mine surveying. Camp Columbia, the summer school of field work and surveying, is situated in the Berkshire hills about seven miles from Litchfield, Connecticut. It comprises a tract of 500 acres of land and a group of buildings sufficient to house ten or twelve instructors and 180 students. An administration building, an observatory, a fireproof instrument house, three dormitories, a mess hall, a Y. M. C. A. building, and a building containing laboratories and baths are provided.

Instruction is given for a period of about fifteen weeks each summer, between June 1 and September 15, in surveying practice, hydrographic surveying, railroad surveying, office work, and map-making.

Not far away, near Roxbury Station, is Mine Columbia. This was first opened nearly 200 years ago, being first worked as a silver-lead mine and later as an iron mine. It has three adits and ten shafts and winzes, the lowest level being 1100 ft. long. The vein is nearly vertical, and the workings are well adapted to the study of problems in mine surveying.

The trustees of Columbia University, in accordance with the unanimous recommendation of the Faculty of Applied Science, have recently determined to raise the requirements of admission to the Schools of Mines, of Engineering, and of Chemistry, and generally to elevate and strengthen the course of engineering and technical study, from and after July 1, 1914. These schools will then become advanced or graduate schools to which students of any branch of engineering, who have had a suitable preliminary training in scientific school or college, may come for the highest type of professional instruction and for training in methods of research.

After July 1, 1915, candidates for admission to these schools will be required to present evidence of such preliminary general education as can ordinarily be had only by taking at least three years of study in a college or scientific school of high rank. During 1914-15 candidates for engineering degrees will be admitted to the second year of the present course upon presenting evidence that they have completed the work of the present first year in addition to the existing entrance requirements. The Schools of Mines, of Engineering, and of Chemistry will, therefore, be placed upon the same academic plane as the present Schools of Law and of Medicine in Columbia University.

Revised Course of Study

The revised and improved program of studies to be offered in the Schools of Mines, of Engineering, and of Chemistry will be strictly professional and specialized for students who are candidates for any one of the several degrees offered in Mines, Engineering, and Chemistry. The college or scientific school course, completion of which will be required for admission to these schools, will be one including thorough instruction in mathematics, physics, and chemistry, as well as certain designated work in drafting, shop work, surveying, and mineralogy, together with courses of college grade and type in English, history, economics, philosophy, and in either French, German, or Spanish.

The purpose of this important change is to offer better and broader training for students of engineering, and to place the instruction in these professional subjects upon the same university plane as the instruction in law and in medicine. The recent rapid development of engineering practice, the wider social and public recognition now given to the engineering pro-

fession, and the frequent demands that men in executive and administrative posts shall have had an engineering education, make it imperative that the engineer of the future shall be a broadly educated professional man and not merely a technical expert. In order to insure this, it is necessary that the future engineer shall widen his intellectual outlook by continuing his general education considerably beyond the limits of the ordinary high school course. At the present time, even before the proposed new system is in operation, about half of the new students entering the Schools of Mines, of Engineering, and of Chemistry come from other colleges and universities, many of them with a bachelor's degree, and nearly one hundred students in Columbia University are already taking advantage of the existing opportunity to combine a college and engineering course covering six years of study.

The following is the program which has been announced for the fiftieth anniversary celebration:

Wednesday, May 27—Smoker at Columbia University Club, 18 Gramercy Park.

Thursday, May 28—12 m., Registration in Earl hall. 9 p.m., Reception in the University gymnasium; dancing.

Friday, May 29—10 a.m., Academic procession (alumni to assemble in Earl hall). 10:30 a.m., Convocation in the gymnasium with commemorative and scientific addresses, and the conferring of honorary degrees upon distinguished alumni. 1 p.m., Alumni luncheon in the University commons. 3 p.m., Inauguration of Chandler lectureship, H. L. Baekeland, lecturer, and award of Chandler medal. 4 p.m., Faculty teas in the several departments. 7:30 p.m., Anniversary dinner at the Waldorf-Astoria hotel, Fifth avenue and 34th street.

The foregoing program concludes the actual anniversary celebration, but all alumni are invited to the following events in commencement week:

The anniversary headquarters in Earl hall will provide opportunity for the arrangement of side trips and group meetings for Saturday.

Saturday, May 30—10 a.m., Meeting of electrical engineers. 3 p.m., Baseball game, South field.

Sunday, May 31—Baccalaureate service.

Monday, June 1—Class day and Senior dance.

Tuesday, June 2—Campus night.

Wednesday, June 3—Commencement day; conferring of degrees; alumni luncheon; costume parade; baseball game; beefsteak dinner; decennial celebration; singing on South court.

Imports of gold and silver coin and bullion and of the baser coins into France in 1913 were valued at \$203,417,000, against \$102,531,000 in 1912, and the exports \$84,050,000 and \$62,681,000, respectively. Imports of gold coin and bullion increased from \$49,244,000 in 1912 to \$128,296,000 in 1913. Exports for the two years were \$6,851,500 and \$14,453,384, respectively, so that in 1913, \$113,843,000 in gold remained in the country. Imports and exports of silver coin and bullion in 1913 were more nearly balanced, the figures being \$75,113,000 and \$69,505,000, respectively. The trade of the country was \$1,642,117,000 in imports, and \$1,326,950,000 in exports, the balance against the republic being \$315,167,000.

Zinc Smelting in West Virginia

The importance which West Virginia has attained as a zinc smelting state during recent years has not been generally realized. The only place in which zinc smelting is carried on is at Clarksburg, near the northern boundary of the state at about the central part. The town may at first sight appear to be in a peculiar situation as a zinc smelting centre since the ore deposits in Tennessee and Virginia are so situated with respect to the Alleghany Mountains that they are even less accessible than the regions of the Middle West. The town, however, has two great advantages as a zinc smelting centre. The first of these is that it is only a comparatively short distance from Pittsburgh, where



GRASSELLI SMELTER.

there is a large market for spelter in connection with the galvanizing industry. A second and even more important feature is that there is an abundant and cheap supply of natural gas. The three plants now in operation in Clarksburg each own gas properties but have not yet developed them as an abundant supply of gas is available at about 3 1/2 c. per thousand feet, at which price it is as economical to purchase it as it is for a company to develop a supply. Gas was discovered in the Clarksburg district about 20 years ago but it is only within the past decade that development has been rapid. Since that time the growth of the town has been remarkable and a number of important industries have been developed.

Two of the zinc smelting plants at Clarksburg are owned by the Grasselee Chemical company. One of these plants is a short distance south of the town, where 5760 retorts are now in use. Another and larger plant is at Meadowbrook, ten miles north of Clarksburg, where 6912 retorts are in use. These plants are in charge of Richard Ziesing. These plants are operated on ore from the Grasselee properties. The plant of the Perlman company, which employs 2736 retorts, is not of so much interest since it treats only scrap from galvanizing works. Details as to the metallurgical practice in these plants are not available for publication, since these companies have not seen fit to fall in line with the general practice among metallurgists of making public the processes employed. The general features of the Clarksburg plant of the Grasselee company can be seen from the accompanying photograph.

The Rush to the Hoco-Poco Diamond Fields

Although tales of the rushes of 'forty-niners' and of the Alaska stampedes are still fresh in the minds of all interested in mining, it is doubtful if any of them encompassed more vivid experiences than those of various Asiatic prospectors in the race to the Hoco-Poco Diamond Fields in 189—. Mr. C. L. Larson has been good enough to attempt to reproduce the tale of one of these Oriental stampedeers, practically as related to him by Mr. McK—, one of Asia's oldest and best known wanderers. The tale has all the earmarks of authenticity that usually characterize the stories of old but unsuccessful prospectors. It follows:

"Jerry Whaley, Jim Ferguson, and myself had been prospecting alluvials for some time, in the valley of Coptiko Copokus, in the Roos Coast range near the Bay of Bengal, when news came to us of diamond discoveries near Hoco-Poco bay. Although this field was some 1800 miles from us, we were well acquainted with its locality, it being close to the Straits of Malakal. As our placers had not proved up as well as might have been desired, we all decided to pull stakes and head for the scene of the new discoveries.

Rapid Transit in the Orient

"Ferguson voted for an overland journey, while Jerry and I determined on a water route and at once began the construction of two 'katamurangs.' These were practically simple rafts made of logs from banana trees. Two runners, as it pleased me to call them, were cut about 10 ft. long and curved upward slightly at the front. These were joined by three cross-pieces, the joints being lashed together by means of monkey tails. Bamboo slats provided a suitable floor, and a bamboo pole served as a mast, tiger skins being sewed together for sails. We then prepared a stock of provisions, and were about ready to start when Ferguson reappeared from a jaunt into the forests, leading a lively specimen of a giraffe, on which he declared he would make the journey. After rigging up saddlebags of monkey skins and stocking these with food, Jerry boarded his unwilling land yacht and smiled at us a good-bye as the wind took his sails and rushed him crashingly into the underbrush.

"After a final meal ashore, Jerry and I boarded our miniature ocean greyhounds and started out to sea 'neath fair skies and in a steady and strong wind. Things went well until three bells the next morning, when we were overtaken by a screeching southwester. Our barometer jumped from 37 knots instantly to 60, and by daylight we were shooting along at 68. About 10 a.m. we narrowly escaped cutting the P. & O. liner *Baltic* in two, she barely swerving enough at the last instant to clear our course.

"Late in the afternoon the sea calmed down and we kept ourselves busy for a few hours in consuming

food and sleep. About midnight we ran into a second storm, a genuine Australian 'willy-nilly' which slammed directly across our battered 'katamurangs.' The next twelve hours were critical ones as we raced through leagues and leagues of seas torp up by the 'willy-nilly' and strewn with wreckage. Luckily the seas were covered with phosphorus which greatly helped us to steer safely through the maze of dangers. Many times we were awed at finding our compass needles whirling around and around, and only when we noted large floating masses of magnetite were we able to subdue our fears of having wandered into haunted seas.

"The climax of danger came with a narrow escape from colliding with a German mail line steamer, the *Prinz Isaac* (I think), which, however, we passed with no more serious damage than the shaving off of her rudder. In the instant of passing her we had barely sufficient time to shout to her that we were bound for Hoco-Poco bay and would receive the claim for damages at that port.

"Shortly after this occurrence the 'willy-nilly' left us and we again enjoyed peaceful progress. As we neared the entrance to Hoco-Poco bay the next afternoon we thought our troubles were over, but on entering the harbor were attacked by a huge number of sharks and alligators. I at once turned my steed toward the deeper waters, but Jerry uncorked a bottle of a chemical which he had discovered on a trip of ours up in the Himalayas, and poured it out upon the waters. The seas instantly turned an indigo blue from the reaction of their sodium chloride on that precious solution; the sharks and alligators alike, promptly succumbed and their lifeless bodies were soon floating, bottoms up, out into the deep. This phenomenon, witnessed by so many natives, at once proved to them that we merited their respect and services, and they greeted us on landing in the manner desired by kings and queens. We had no sooner landed than we heard the crashing of trees and bushes afar off, the noise rapidly approaching us. To our surprise it proved to be none other than Ferguson on his giraffe, tired, bruised, but happy, and runner-up with us in the 1800-mile stampede, accomplished in 3 days, 7 hours, and 42 minutes.

Proof of Darwinian Theory

"The natives treated us very kindly, and interested us very much. They are known as 'Manikoos,' and are Darwin's only living proof of his startling theory of evolution—they still retain the first joint of the caudal appendage. The Hoco-Poco diamond fields were all that could be wished for. We netted \$750,000 each after six weeks work, after paying all expenses, including the damages for the rudder on the liner, the German government having sent seven regiments and two Gatling guns to the bay to collect same from us. All in all, the name Hoco-Poco brings pleasant recollections to me."

Discussion

Readers of the MINING AND SCIENTIFIC PRESS are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment. Insertion of any contribution is determined by its probable interest to the readers of this journal.

Stripping Frozen Gravel

The Editor:

Sir—I have read carefully your editorial on this subject, and in the main think that you have hit the nail on the head. There can be no question about Mr. McCarthy's experience in thawing by means of heat, but it must be borne in mind that conditions on Bonanza and Eldorado creeks, which comprise the holdings of the Yukon Gold Co., are very different from the Klondike valley where the Canadian Klondyke operates, and also to the conditions existing on Dominion creek controlled by the Granville Mining Co. The Canadian Klondyke has an unlimited supply of water in the Klondike river, which runs through the property from end to end. This water can be diverted to practically any part of the property without great difficulty or expense. Also there are large areas of thawed ground on which to work during the time the frozen areas are being stripped and thawed by natural means. This never has been possible with the Yukon Gold Co. As a matter of fact there can be no comparison drawn between the operation or costs of these two companies. The management in both instances is good. On Dominion, where the Granville Mining Co. is preparing extensive areas for dredging, the conditions are again quite different from those met by either the Yukon Gold Co. or the Canadian Klondyke company. The overburden is of a different character; it contains far more ice and less matter, and for this reason is more easily removed. Considerably more cubic yards per inch of water employed may be moved.

Steam thawing has very little effect on 'muck' that contains a large percentage of ice, especially where the overburden is heavy—in excess of four feet. Dominion creek carries 'muck' for the greater part of its entire length in excess of five feet in thickness. The removal of such overburden cannot well be undertaken except by the use of water. It would probably cost three times as much to thaw five feet of 'muck' as it would five feet of ordinary gravel. In gravel the heat could be applied through points placed at least 10 ft. apart. To attain the same results in 'muck,' the points would have to be placed not more than three feet apart. Steam would have to be applied the same length of time in both instances. I think that the fairest way to put it is that under certain conditions thawing by steam is undoubtedly preferable; such conditions exist on the properties of the Yukon Gold Co. Under others the best and cheapest plan is to strip the ground by use of water and allow same to thaw naturally.

The latter applies to the Canadian Klondyke company, and Granville. When it is understood that practically every creek has its own peculiar difficulties, it is not exactly fair to quote costs on any particular creek expecting them to be the standard for the whole section; this also applies with equal force to methods. Both systems have their good points, and it requires careful investigation and a clear understanding of the peculiar conditions to be overcome to determine which system is best, or whether a combination of the two might not prove more satisfactory. I think that Mr. McCarthy's statement that "it was demonstrated that stripping and natural thawing could not be depended upon for large scale operations," is a bit too strong, as again, this depends upon natural conditions, which were evidently adverse where attempted by the Yukon Gold Company.

In regard to the costs of the Canadian Klondyke company, and the Granville, which were quoted at the meeting of the Northwest Corporation, Ltd., 10c. per cubic yard, there can be no doubt that this is an extremely low estimate. However, there are grounds for expecting it to be realized. For example, suppose a section of ground 21 ft. deep from grass roots to bedrock be taken to see how it works out. To start with, there would be available 70c. for each square yard of bedrock uncovered, based on 21 ft. or 7 yd. in depth. Now on such ground on Dominion creek one would expect to find fully 7 ft. of 'muck' and 14 ft. of gravel; one-third 'muck' and two-thirds gravel. By ground-slucing under efficient management, the upper one-third of overburden can, or should, be moved for 5c. per cubic yard. Therefore, the upper one-third, equaling $2\frac{1}{3}$ cu. yd. per square yard of surface, would cost $11\frac{1}{3}$ c. to move, leaving a balance of $58\frac{1}{3}$ c. to be applied to the removal of the remaining $4\frac{2}{3}$ cu. yd. of gold-bearing gravel, or 12.51c. per cubic yard. Now, granting that the removal of the overburden results in thawing the ground, it will be seen that 12.51c. per cubic yard is sufficient to dredge unfrozen ground, and also to provide for a reasonable rate of interest on the amount invested per cubic yard during such time as it is necessary to wait for natural thawing to be accomplished. To thaw by natural means 14 ft. of gravel and, say, 3 ft. of bedrock will require three summers, and the gravel must be free from all overburden or 'muck.' Also it must not be forgotten that one-third of the deposit has been permanently removed, which is not the case where steam is employed. The upper one-third, of course, contains no gold.

There are a multitude of ways by which the overburden or 'muck' may be handled, and a close study would be necessary before deciding on any particular plan, but in the main water under control (pipe, giants, etc.) give the best result. The cross-ditches mentioned are not efficient and are used only where the water has not been properly harnessed. The piling up of debris can be overcome without difficulty if necessary preparations are made beforehand, such as building flush

dams, and the burning of stumps, moss, and roots, instead of allowing them to be carried away by the water. The experimental work carried on by the Yukon Gold Co., in 1906, 1907, and also in 1909, is in reality no criterion, for such conditions on Bonanza where this work was carried on, are not adapted to thawing by stripping and ground-slucing.

To refer again to cost of 10c. per yard, I think that there is no doubt that both the Canadian Klondyke company and the Granville officials have figured their estimated costs out on some such basis as I have attempted to illustrate, as there does not appear to be any other way for them to accomplish what they hope for. However, the Granville at first stated that the cost would be 18c. per cubic yard, which is a much safer figure. To follow out the same line as above, this would give them about 25c. per yard for working the gravel; which, if partly frozen, might still prove more economical than complete thawing by steam.

Altogether, I do not think it quite fair to the Canadian Klondyke company, the Granville company, or to the Dawson district as a whole to allow it to be definitely understood that dredging cannot be successfully carried on there for less than 30c. per cubic yard. The Yukon Gold Co. has no occasion to apologize for costs, for they are in all truth as low as the best sort of management can make them. Conditions are against them, and they cannot be changed.

EX-DAWSONITE.

San Francisco, April 28.

The Prospector in Mexico and 'the States'

The Editor:

Sir—I long to go prospecting again, so we decide to lease our mine, having found that many companies do this, following the old Cornish system: by this means they find out the exact value of their property very quickly, and the poor old overworked general gets a much needed rest.

My partner and I talk the matter over from all sides, and I plead to take our chances in Sonora, where the mining laws are just and fair, giving the prospector a chance. In the United States, apart from the difficulty of finding out where you are at, whether on private property or land not open to location, a prospector may perhaps forget that quail are out of season, and he is a law-breaker at once; or after tracking a deer for a few miles he finds it is a doe, and another law is broken. I believe strongly in woman's rights, and the idea of making Mormons out of those innocent animals by force of arms is scandalous. Government officials never seem to realize that after the deer and quail are gone (and they are fairly good at taking care of themselves), they can turn a few goats and turkeys loose, and there we are again; they never think of the great luck the Englishman had with the rabbits. Barbwire fences are a nuisance, too, when you are conducting a burro train, and in these cases I certainly admire my partner. His perfect command of the language appeals

to me. For myself, each time I see a picture of a buffalo, I shed a tear for his passing; with government protection he would surely clean up a few fences.

In my opinion there are only three chances left for a prospector in the 'States': 1. He can lease, and this is what many old-timers are doing, the married ones especially. 2. He can go on a still hunt for apexes, but this takes time, and he must have a well dressed partner to do the outside work: his own part must be to wander from one mine to another, working underground, until he finds one which has opened up a blind ore-shoot; of course it must be a recent discovery, otherwise the mine would not be working; then he posts his partner, giving him the general direction, and his share of the work is done. The partner, who meantime has the lay of the land surrounding, gets a bond on any property in said direction, and the lawyers do the rest, on shares, of course. 3. He can go 'high-grading,' which is not such a crime when all hands are laid off waiting for the decision to be reversed, and perhaps the rightful owner himself in on the play: law-breaking being the natural result of too much law.

Having a copy of the Mexican mining laws, we read it over carefully. We find that the districts are bounded by the watersheds as much as possible; each district has its mining agent, and for the sum of \$1, one can find out the standing of any monumented property, whether open to denouncement, or when liable to be. One can denounce as much ground as one wishes, and add to this at any time if still open. Title to said ground is secure as long as the owner pays his taxes. A prospector is happy in the knowledge that all the metal inside his boundary lines (which he has to monument and plainly mark) is his, and no enterprising brother in the next state can imagine that he has an apex and pass those lines. Said brother's lode can sprout spurs if it wishes, or can develop a case of dips, or get the heaves, or might fissure and take to angling around some; but it has to respect those boundary lines, and the only way they can juggle him into a lawsuit is for them to find the outcrop in the antipodes and raise into his ground. One can denounce a prospect on anyone's land, as the surface and underground rights are entirely separate, oil, coal, etc., excepted, as they ought to be. If you think there is mineral 1000 ft. or so underground, the Government will not interpose: its officers politely collect their \$6 per, and probably consider that your theories are your own affairs, possibly at the same time longing for a few more theorists to happen along. You can even form a company if you wish and start out after the widow and the seamstress; these latter will invite you in and divide their humble beans and tortillas with you, and will smilingly shake their heads. "Now, if the Señor had a few pictures of the saints, then perhaps—" and you will say good-bye a little shamefacedly, for you have learned that these people are wise in their ignorance; they get a nice long run for their money, at least. But

the revolution? Well, after all, it is quite a family affair, our neighbors are not fools by any means, they have no wish to kill the theoretical goose. The American who behaves himself is *persona grata* in their country, and a prospector with his burro or two, off in the hills, is as safe as a bottle of whisky in Heaven. As I say we look carefully over these mining laws, and rather to our surprise we find that it is a government leasing system, pure and simple, working so perfectly and smoothly that a mining camp lawyer is unknown, and I am willing to bet that nine-tenths of the mine owners of Mexico do not know that they are lessees.

JOHN WATSON.

La Caridad, Nacozari, Mexico, April 12.

Prospecting and Government Aid

The Editor:

Sir—I have read with a great deal of interest the discussion in the *Mining and Scientific Press* relative to the discouragements of prospecting and how to encourage it. The article by F. Sommer Schmidt, which appeared in your paper of April 4, contained an excellent suggestion on the system of government aid to prospectors and prospecting companies. Especially appealing is the action of the British Columbia government in building wagon roads to properties even before the tonnage had been developed. In contrast to this I may cite the experience of the Leesburg Syndicate which in 1890 was endeavoring to open a hydraulic placer property here. This syndicate built at its own expense ten miles of wagon road over the Leesburg summit at a cost of \$10,000. This road has ever since been used by the public. The prospectors and miners in this county alone during the past 30 years have made 200 miles of wagon road at their own expense.

One of your correspondents brings out the fact that with all due appreciation of the Geological Survey during the past it has not taken up work in a mining district until the mineral reputation has been established by a considerable amount of development. I believe that a system of having a permanent United States district geologist who would make frequent visits to localities where prospecting is being done, who would give advice where requested, and collect data of new developments, who would also make tests of ore for prospectors or have them made, would be of the greatest assistance to prospecting.

During the last annual session of the American Mining Congress a comparison was made of the federal aid given to agriculture and the amount given to mining. The amount given annually for the benefit of agriculture was stated to be \$17,000,000, the amount to mining approximately \$1,000,000. The Department of Agriculture has for many years past at great expense and effort published for free distribution more than 500 bulletins, the result of painstaking experiments relating to agriculture which have proved of great assistance to the farmers. May we not hope that the federal government, through the Bureau of Mines, will in the

future make like experiments in mining, milling, smelting, and all matters pertaining to prospecting and mining, and issue for free distribution bulletins giving the aforementioned information?

O. E. KIRKPATRICK.

Leesburg, Idaho, April 23.

We are glad to present this bit of experience direct from the field. The suggestion that the United States Geological Survey employ district geologists has much to commend it but fails to take into account differences in conditions. The work of the proposed geologists is exactly what is expected of the State Geologists and their staffs. None of us need wait for Washington to act. Get after your state legislature, which is nearer home and see that your own State Geologist is given funds to do this work. As to road building we wish heartily that it was possible to commute by cash payment much of the useless and wasteful assessment work now done on mining claims and thus build up a fund that could be used under proper supervision to build roads through our mining districts comparable to those in the Yukon and British Columbia. Possibly this can be brought about in connection with the mining law revision now under discussion. In theory our law leaves it to the prospector to build roads where they will do him most good and allows the work to be counted as done for the benefit of the claim. In practice the plan does not always work out well and we may well learn from our neighbors to the north.—EDITOR.]

Cost at the Commonwealth

The Editor:

Sir—In your issue of May 2, you print an excellent article on 'Milling Operations at the Commonwealth Property', by E. H. Leslie, in which it is stated that the total cost of mill construction was \$335,271. This is an error, the figure given being the entire cost for all construction work, including new shaft equipment, and power plant equipment. The cost of mill construction alone was \$241,070.81 as shown in accompanying statement of tabulated construction costs.

Mr. Leslie's article is so complete in every other respect, that it is unfortunate that we were unable to give him these detailed figures before the article was written.

EDGAR A. COLLINS.

Pearce, Arizona, May 6.

[The table of costs to which Mr. Collins refers will be found on p. 619 of the *Mining and Scientific Press*, April 11. The cost of the crusher plant, stamp-mill, and refinery alone amount to the \$241,070.81, and, as Mr. Collins states, the figure used by Mr. Leslie should have been stated to include power plant and other items.—EDITOR.]

Wages paid on Rhodesian mines are as follows: 1850 white employees, \$144 per month; 34,000 natives, \$7.20 per month. Dividends paid by all companies totaled \$2,545,000. Up to the end of 1913, Southern Rhodesia had produced minerals valued at \$121,000,000.

Concentrates

Most of these are in reply to questions received by mail. Our readers are invited to ask questions and give information dealing with the practice of mining, milling, and smelting.

Sulphuric acid manufactured by zinc and copper smelters in 1913 was 296,218 and 336,019 tons, respectively, averaging \$6.87 per ton.

Osmiridium nuggets have recently been found in Tasmania. The largest were 1 oz. 17 dwt. and 1 oz. 15 dwt., the former being probably the largest in the world for this metal.

Candles, caps and fuse, carbide, and powder used in the Bunker Hill & Sullivan mines, Idaho, in 1913, cost 1.4, 1.1, 0.2, and 7.3c. per ton, respectively, in mining 436,060 tons of ore.

Cryolite, a fluoride of sodium and aluminum, is mined in Greenland and exported to Denmark. The production during the past five years is as follows: 5754, 4593, 7376, 10,609, and 8041 tons.

Seger cones are used for the measurement of heat effect. They are made of silica, aluminum, and lime compounds for various temperatures. From the point of their collapsing in any kind of furnace the temperature is determined.

Electric switches in gaseous mines are liable to produce explosions if they are not properly designed and made. The U. S. Bureau of Mines recently conducted a number of tests with switches for mines. The permissible switch may be either of oil or of the explosion-proof types.

Molybdenite is recovered in Queensland and New South Wales. In February, a shipment of 8 tons, from Wolfram Camp, in the former state, and assaying 94%, was sold for \$2217 per ton, after keen bidding. It is reported that a process for the preservation of cordite in hot climates, involving the use of molybdenum, has been discovered in France.

There is no law in the United States against melting gold coin so as to entirely destroy its identity as money. The crimes against coinage consist in 'sweating,' or in any way removing part of the metal in the coin without rendering it unfit for circulation. It is, of course, a crime to attempt to recoin the metal when once melted, or even to have in one's possession dies or machinery which might be used for counterfeiting purposes. While coins may be used by jewelers in the British Empire, it is against the law to melt any coin. 'Sweating' coins has been done recently in Australia with disastrous results to those engaged in this illicit work.

Sections 1416 to 1422, inclusive, of the civil code, contain the general law of the state of California relating to appropriation of water. If the water is to be used for power purposes, an application must be made to and a permit secured from the State Water Commission before the water can be diverted or used. The law governing such applications may be found in the statutes of the extra sessions of 1911, pages 175 to 185, inclusive. Application forms and instructions may be had by mail from the Commission, whose offices are in the Mills building, San Francisco. The last legislature (1913) passed a new act making the appropriation and use of water for all purposes, including use by riparian owners, and use of percolating waters, subject to regulation by a new water commission, but this act has been held up by referendum petition and cannot become effective unless approved by the voters at the next November election. This act may be found in the statutes of 1913, pages 1012 to 1033, inclusive.

The rationale of bridge design was discussed by Charles Evan Fowler in *Western Engineering* for May. The article was accompanied by illustrations of ten different bridges throughout the world. The accompanying halftone shows a fine example of reinforced



VIEW OF GRAFTON BRIDGE, AUCKLAND, NEW ZEALAND.

concrete bridge work in Auckland, New Zealand, which was constructed in 1910. Dimensions are as follows: total length, 973 ft.; clear span, 320 ft.; greatest height, 140 ft.; height of span, 83.99 ft. from centre line of hinges; deepest foundation, 62 ft.; shallowest foundation, 18 ft.; and width of bridge, 36 ft., with 24 ft. of highway and two 6-ft. sidewalks. There are 2 major and 7 minor piers. The approaches are 20 and 22 ft. wide, respectively. There was used 330 tons of steel, 1130 tons of New Zealand cement, 2100 cu. yd. of basalt, 4050 cu. yd. of shingle rock, 230 cu. yd. of large boulders, and 60 cu. yd. of sand. For the falsework, 400,000 board feet of timber was used. In testing the finished structure, 292 tons of rock was loaded on one section, removed, and then two 16-ton steam rollers run across, showing deflections of only 0.143 in. and 0.083 and 0.066 in. respectively. The bridge was built in 32 months and cost \$205,000.

Special Correspondence

JOHANNESBURG, TRANSVAAL

DISCUSSION OF WORKING COSTS ON THE RAND—CHEAP OPERATIONS AT SOME OF THE DEEP-LEVEL MINES, AND WHOLESALE MINING RESULTS.

Since the publication of the evidence submitted by the Chamber of Mines to the Economic Commission, on the future of the Rand gold-mining industry, the necessity of reducing working costs has been generally recognized. Some idea of the urgent need of a material reduction in the working costs, if very deep mining is to be successful, may be gathered from the January statement issued by the Chamber of Mines showing the yield, cost of working, and profit. The average working cost for 50 producing companies was \$4.36 per ton, an average exceeded by 31 companies, leaving 19 with a working cost below the average. The cheapest worked mines are those controlled by the Consolidated Gold Mines of South Africa. For instance, the average working cost at the Knights Deep was only \$2.76, and at the Simmer & Jack Proprietary \$2.80 per ton, which are the two most economically worked gold mines here. The Glencairn Main Reef mine, with a working cost of \$2.98 per ton, does not throw much light on the future working costs of the Rand, as the mining conditions are abnormal when compared with those likely to be encountered in future deep mining in the district. The same cannot be said, however, of the Simmer Deep, with a working cost of \$3.18 per ton, which may be looked upon as a mine fully representing all the features and difficulties likely to be encountered in the immediate future in deep mining. Most of the cheaply worked mines are those without any costs for development, simply because they are practically fully developed. Under this category are such mines as the Simmer & Jack, Glencairn, and Robinson. The Simmer Deep, Robinson Deep, and Rose Deep are, however, mines with working costs below the average, and all the items of expenditure and conditions to be encountered in deep mining here. The Simmer Deep has the low average cost of \$3.18 per ton milled and under existing circumstances may be said to be the most economically worked of any deep mine on the Rand, it being the deepest mine at present being worked here. That it is not a profitable mine cannot be put down to its working cost, but to its comparatively poor yield, which during January was only \$3.40 per ton milled. Then there is the Robinson Deep, also controlled by the Consolidated Gold Fields, with the low average working cost of \$3.96, although the mine has to contend with all the difficulties and expenditure likely to be encountered in future deep mining. In the Knights Deep, Simmer & Jack, and Simmer Deep, the Consolidated Gold Fields controls the most economically worked gold mines in the district, the first and the last named being good examples of what may be achieved under existing conditions in the direction of reducing working costs to the lowest limit. It may be emphasized that the yield at these two properties is only \$3.34 and \$3.40 per ton respectively, and probably this low yield is the cause of the low working costs. In both instances these costs have been obtained by what is known as the 'big milling policy' combined with an adequate number of tube-mills, and when such a policy can reduce the costs to about \$3 per ton it would almost appear as the policy likely to be most successful in the future deep-mining operations on the Witwatersrand. Wherever this policy has been adopted, working costs have been reduced, and in future deep mining here it is far more likely to succeed, than in any attempt to raise by artificial means the grade of the ore sent to the mills. It will be remembered that some time ago, the big milling policy was hoped to be improved upon, and working costs still

further reduced by merging several mines under one management, but up to the present this policy has not come up to anticipation. A policy of consolidation to be successful, a concentration of operations becomes absolutely necessary, otherwise it exists in name only and this would seem to be the drawback of this policy on the Rand. The East Rand Proprietary, Crown Mines, and Randfontein Central are the three most striking examples of this wholesale policy, and so far the Crown Mines company constitutes the only instance where any serious attempt has been made at concentrating mining operations. In this instance the working costs have been reduced to \$3.70 per ton with prospects of still further reductions; but these concentration operations have in this instance cost such an enormous expenditure of capital that few concerns, even on the Rand, are in a position to undertake such a task. At the Randfontein Central the working costs averaged \$4.46 per ton, which was 10c. above the average of the whole Rand, despite the fact that the Company has by far the biggest mill. At the East Rand Proprietary the big milling and wholesale mining policy has been abandoned for selective mining with the result that working costs have advanced to \$5.36 and over per ton, with scarcely a corresponding improvement in the yield. The natural result follows that profits have fallen, and the future prospects of the concern become seriously imperilled by the reduction of the profitable ore reserves to at least one-half of the former estimate, that is, from 10,000,000 to 5,000,000 tons, a reserve scarcely ample for such a concern according to development ideas generally prevalent in this country. In conclusion it may be pointed out that working costs on the Rand are highest where the scale of operations is not in keeping with the size and importance of the property, such as for instance, at the West Rand Consolidated, Princess Estate, City Deep, and Geduld Proprietary mines, where the costs run from \$6 to \$6.12, as against \$4.36 per ton for the whole of the Rand. It must be concluded therefore that if future working costs are to be brought down to a profitable level the most likely policy will be that associated with wholesale mining, underground and surface concentration of operations, and last, but not least, big milling and large scale working which, as already shown, have in several instances brought down working costs to the low level of \$3 per ton below which, under existing conditions, it does not seem possible to go.

JOPLIN, MISSOURI

MANY NEW MILLS CONTEMPLATED.—SOME ENCOURAGING ZINC PROSPECTS.—SITUATION IN THE ZINC AND LEAD DISTRICT.

Several new concentrating plants are to be constructed in the Missouri-Kansas-Oklahoma zinc and lead district in the near future, according to plans of various operators in different parts of the district. Despite rather low ore prices that have prevailed for some time, operators are more or less optimistic concerning the future. A number of new mills have recently been completed and placed in operation, and work on new ones is to start immediately. The Osceola Lead & Zinc Co. has started the construction of a 200-ton concentrating plant on the Riseling land, West Seventh street, Joplin. The former mill on this property, operated by the Waneta Mining Co., was burned about a year ago. The Osceola company took over this lease recently and has been developing it. Hand jigs have been used so far by the Osceola company in cleaning the ore, but these will be discarded when the new plant is completed. This makes the third mill operated by this Company, the other two being in the sheet-ore district of the North Webb City, Missouri, field. The Waneta lease has produced \$700,000 in zinc and lead to date. New work is in virgin ground, and unusually good ore has been blocked out both in drilling and prospect driving. Recovery by the hand jigs has run as high as

12% sphalerite concentrate. J. R. Underwood, of Granby, Missouri, operator of one of the largest mines in that district, will soon commence the construction of a 150-ton mill some distance to the south of the main Granby district. Drilling has shown sphalerite deposits. Originally Granby was one of the heaviest galena producers of the district, but in recent years the galena production has been small. As a calamine producer, Granby leads all other camps of the district. Recently it has gained in importance as a zinc producer. The new development launched by the Underwood company promises to result in an increased output of zinc-blende. Another mill is to be constructed by the Lone Elm Development Co., operating on the Granby Mining & Smelting Co.'s land, Joplin. The plant will be used as a custom mill, handling ore from several small mines on the property. The Company has just started its third pump, two pumps having been at work for several months. On another part of the Granby land, one mile west of the Lone Elm tract, the Granby company is conducting some important development on its own responsibility. The Granby company has just purchased from the Excelsior Zinc & Lead Co. the Guveneur concentrating plant situated at the Four



CARSON-DODSON PROPERTY, MIAMI, OKLAHOMA.

Corner camp, several miles northwest of Joplin, and the mill will be removed to the Granby lease. In the reconstruction of the plant many improvements will be made. The capacity of the Guveneur mill was 150 tons per shift, but this will be increased to 250 tons by additional equipment. Other mills are planned by several companies, including the J. M. Short Co., operating at Oakland, northeast of Joplin.

Foreshadowing eventual mill construction, a number of important drill discoveries have been made recently. F. V. Wasserman and associates, consisting of Kansas City and Iowa people, have made three finds of exceptional richness on the Llewellyn land at Belville, Missouri. In view of the fact that deposits in this region have usually been found to be uncertain in dimensions, the richness of the new developments does not mean extensive deposits. However, as four holes have been sunk, three penetrating high-grade blende, it would appear that the tract is almost certain to become a producer. The ore shows a general depth of 118 to 145 ft., an average yield of at least 15% being indicated in the drill samples for the entire distance in all holes sunk. While some large producers have been opened in this immediate field, the tract on which the present Company is at work has never been prospected. In the Miami, Oklahoma, district a number of finds are reported. Recently the writer counted 23 prospect churn-drills in the Miami field, about 15 of them being in active operation, while the others were being moved to nearby leases where they would soon be placed in operation. The Miami field, once confined to a comparatively small area immediately north of the town of Miami, has broadened out, covering an area several miles square. Recent drill prospects in the Neosho river bottoms, northwest of Miami, show both zinc and lead ores at 50 ft. down to 200 ft. Already one new concentrating plant, owned by the McConnell & Barnes Mining Co., has been erected. This plant was put up solely on the strength

of drill samples. While the mill was being built a shaft was sunk to ore; the operators cut barren ground in shaft-sinking, but in extending a prospect drift they have opened good ore. The mill is now in operation and is producing. Drilling on the Connor estate, Central City, Missouri, has revealed calamine and lead at 50 to 72 ft. Childress & Co. are doing the work. Following several drill finds, a shaft has been sunk to ore, and a large pile of crushed rock is on the surface. Some 'turn-ins' of galena, occurring in large chunks, have been made.

KALGOORLIE, WESTERN AUSTRALIA.

THE LANCEFIELD MINE, PREPARATIONS FOR RESUMING OPERATIONS.—DEEP SINKING AT THE IVANHOE.—GEOLOGY OF EDNA MAY.—GREAT BOULDER RESERVES.—SONS OF GWALIA.—ASSOCIATED NORTHERN.—GOLD RETURNS.

The Kalgoorlie & Boulder Firewood Co., the new owners of the Lancefield mine, have 30 men employed overhauling the 300-ton treatment plant, which was in poor condition. Besides completely remodeling the furnaces, a new hoist, two suction-gas engines of 220 hp. each, and vacuum-filters are being added to the equipment. Alexander Porter, the chairman of the Firewood company and the biggest holder of its stock, is sparing no expense to give the venture a fair chance of success, and his enterprise in helping the mining industry in the present depression is fully appreciated. There is no question about size of the lode, as it averages 25 ft. in width, and has been proved to a depth of 1000 ft. on the incline. The ore-shoot is also 1200 ft. long, and has already yielded \$4,140,000 from 540,000 tons, or \$7.66 per ton, and, according to Bewick, Moreing & Co.'s estimate, there is 250,000 tons of ore in reserve of similar grade. There should be a good profit in the venture if strict economy is practised. The mine is in charge of John Dunstan, who has had a long experience in gold mining in this state; and the underground manager is Archie Long, who has recently held a similar position on the Great Fingall mine, but was formerly on the Lancefield.

The sinking of the main shaft of the Ivanhoe is being pushed ahead so as to get below the porphyry dike, which has impoverished the lode below the 2000-ft. level. The present depth of the shaft is 3015 ft. and it is to be sunk to 3500 ft., or well below the dike, into the quartz-dolerite, in which the lodes contain the best gold content. Owing to this intrusive dike the ore reserves during last year declined from 1,080,850 tons worth \$9.74 per ton to 991,400 tons worth \$9.24 per ton, a decline of 89,450 tons.

The Edna May mine at Weston's, 40 miles west of Southern Cross, has been giving remarkable returns and profits since June last. The total output to date is 14,689 tons for \$318,600, and dividends amounting to \$82,500 have been paid. A good deal of controversy has resulted regarding this mine, as it is in granite country, and geologists are of opinion that sooner or later the lode will be cut off. This opinion is backed by the fact that the Greenfinch company held the adjoining claim on the northwest, and granite has completely cut off the lode at a depth of 90 ft. The Edna May lode at a depth of 150 ft. is still strong and rich, although a 'floor' of granite 18 in. thick cuts horizontally through the vein at that depth, and if there are other floors, as in the Greenfinch, the life of the mine will be limited.

Although shaft sinking on the Great Boulder mine has been suspended for three years, since the main lode passed into the Golden Horse-Shoe ground at a depth of 2630 ft., the output and ore reserves are well maintained. During last year 212,205 tons of ore was treated, returning \$2,823,400, yet the ore reserves only decreased from 731,260 tons worth \$13.28 to 688,920 tons worth \$13.26 per ton. The life of the mine is certainly limited, unless the lode turns back from the Horse-Shoe as it did at a depth of 950 feet.

Acting on Malcolm MacLaren's advice, A. Wauchope, manager of the Sons of Gwalia mine, is sinking a prospecting shaft in the northern part of the property in search of a new ore-shoot. When J. MacDermott took charge of the mine in 1906, he found that there was no ore north of the main shaft below No. 8 level, and that at No. 4, the ore-shoot only commenced at 700 ft. south, the drift work at this point being in barren rock. Mr. MacDermott accordingly abandoned seven 24-acre claims on the north, and applied for a similar number on the south. The gold since won, and the dividends since paid, amounting to \$11,015,400 and \$2,579,600 respectively, recovered from 1,384,979 tons, have almost entirely come from these southern blocks. If Mr. MacLaren's theory is right, and a new ore-shoot is found at the north, the position of the mine, which is already excellent, will be further strengthened. The profits for the last 18 months have to a large extent gone in alterations and additions to plant, and when the work is finished, the increase in profits will be at once apparent. For instance, during February, expenditure on plant paid for out of profits was \$24,300, and this reduced the month's profit to \$7200.

The mill on the Associated Northern's Iron Duke lease at Kalgoorlie has been permanently closed down, and part of the plant will be transferred to the Victorious mine at Ora Banda. The Iron Duke claim has been let on tribute to Shepherd and Trenwith, who, for five years, have been working a lode on the Hannan's Consols lease. During this period they have treated in a Huntington mill 59,000 tons of ore yielding \$155,000, or \$2.63 per ton at a profit. There is a large tonnage of oxidized ore in the Iron Duke assaying from \$3 to \$4 per ton, which the lessees expect to be able to treat successfully after paying the Company a small royalty. There is also a possibility of finding rich patches in taking out the ore wholesale. The main shaft on the Victorious mine is being sunk to 700 ft. and should be completed next month. The level continues disappointing.

The February return from gold mines in the state was \$2,194,100, and from the principal mines as follows:

Name.	Tonnage.	Value.	Profit.	Dividend.
Great Boulder	16,518	\$219,600	\$121,500	
Kalgurli	10,030	102,500	45,900	
Ivanhoe	14,991	137,400	38,200	
Fenian	2,886	45,400	23,900	
Edna May	1,929	38,000	23,600	\$20,600
Lake View & Star ..	16,970	99,400	18,000	
Bullfinch	5,130	43,600	17,200	
Sand Queen	1,686	31,900	16,000	
Kyarra	900	22,400	14,400	
Oroya Links	11,000	64,500	10,500	71,800
Menzies Consols	2,287	26,400	9,100	
Yuanmi	9,724	73,100	9,500	
Perseverance	18,977	95,400	8,700	
Sons of Gwalia	12,441	96,500	7,300	
Mararoa	2,500	22,600	6,400	
Ida H.	1,164	21,600	5,300	
Black Range	2,816	28,300	4,600	
Ingliston Consols	1,650	14,000	4,000	
Ingliston Extended..	750	8,500	4,000	
Mountain Queen ...	3,408	16,500	3,100	
Boulder No. 1	546	4,700	3,000	
Golden Ridge	2,570	17,800	2,500	
Commodore	810	7,300	1,700	
South Kalgurli	8,982	43,300	1,400	
Golden Butterfly ...	1,655	8,300	1,000	
Lake View Consols..	7,958	6,100	800	
			Loss.	
Associated	9,807	55,800	450	
Golden Horse-Shoe..	25,308	141,500	1,000	
Queen of the Hills..	841	6,900	5,300	
Great Fingall	2,975	32,900	16,900	

WASHINGTON, D. C.

FAIR OF BILLS CONNECTED WITH THE MINING INDUSTRY.—WATER-POWER AND ALASKA COAL LANDS BILLS.—COPPER EXPORTS

It is not yet clear whether the program of the Democrats of the House, with reference to the remaining legislation of the session, shall include action on the bills that affect the mining industry, such as the codification bill, already passed by the Senate, bill for mining experimental stations; bill for mining rescue stations; and bills for the leasing of oil and gas lands which involve mining properties. It is certain that if any one of them meets with much opposition their passage will be difficult. It is not even certain what the fate of the codification bill will be. The sentiment in the House is not predisposed for legislation that can only go through by unanimous consent. Possibly, later, the disappointed ones will be in happier mood, and permit some of the much desired legislation to go through.

The House committee on public lands has reported out the water-power bill which interests so many mining men in the West. The bill authorizes the Secretary of the Interior to grant leases for water-power rights on the public domain, fixing royalties, and imposing restrictions to prevent monopoly. In states which have no public utility commissions, the secretary would be empowered to make regulations to insure fair rates to consumers. The Conservationists are said to be for the bill. Chairman Ferris of the committee has a letter from President Wilson favoring action at this session on this legislation, and also on the Alaskan coal lands bill and for the measure providing for the leasing of mining rights on the public domain. The desire is so general to shorten the session of Congress as much as possible that much of the Administration's program is being omitted.

The Department of Commerce has just made public its statement of the recent exports of copper from the United States, showing a high record, the exports for the six months ended March 31, 1914, amounted to 495,000,000 lb., or equal to the total for the calendar year 1906, and one and one-half times that for the year 1912. Copper ranks high among the articles exported from the country, being exceeded only by raw cotton and iron and steel. In the last calendar year raw cotton showed a total export of \$575,000,000; and iron and steel manufactures (including agricultural implements), \$330,000,000; while copper manufactures in the same year amounted to \$145,000,000. Present indications are that exports of copper manufactures in 1914 will approximate \$150,000,000.

PLATTEVILLE, WISCONSIN

LOW PRICES FOR ZINC ORES.—FUTURE PRICES PROBLEMATIC.—ORE SHIPMENTS IN APRIL.—MINES IDLE.

Diligent efforts on the part of large spelter consumers to avoid buying in quantity, constantly increasing stocks of metal in the hands of smelters, and a growing reserve of blende in the two leading zinc-ore producing areas of Wisconsin and Missouri, finally had its effect on the metal markets. Quotations on the closing days of April stood at \$4.80 per cwt. Blende suffered as a natural sequence, and the basis reported for the Wisconsin field at the end of the month, according to a report handed in by one of the leading buyers of the field, stood as low as \$34 and from this to \$38 per ton. The inferior grades suffered by comparison and producers were seriously discussing the advisability of shut-downs, while a noticeable curtailment was evident in all parts of the field. Shipments declined considerably and a conservative estimate of zinc ore carried over shows nearly 5000 tons of ore in bin, the highest quantity ever reported for the Wisconsin field. Prospect work with drills has been suspended, considerable underground development planned for this season has been checked, and new plants, upon which construction would now have been

well under way, is being deferred until market conditions have improved and prices warrant a normal production of zinc ore. Leading mine managers and ore buyers, thoroughly familiar with inside conditions, responding to personal interviews, think that no immediate relief is in sight, and look for no changes for the better within the next 60 or 90 days. Prices paid for April on the various grades produced in the field were given as follows: 30%, \$12.50; 35%, \$16; 40%, \$19; 45%, \$22; 50%, \$26; 55%, \$32; and 60%, \$38 per ton. Carbonate zinc-ore producers were out of commission entirely. Prices on pyrite were off as well, and shipments were half that usually reported for this period.

Shipments of ore from the various districts in April were as follows:

District.	Zinc, Pounds.	Lead, Pounds.	Pyrite, Pounds.
Benton	4,082,000	179,500	2,259,200
Galena	3,042,000	452,580	.....
Cuba	2,678,000	.....	141,520
Livingston	2,222,000	75,000	.....
Hazel Green	2,032,000	60,000	.....
Platteville	1,374,000	.....	.....
Linden	1,300,000	64,000	.....
Shullsburg	700,000	.....	.....
Harker	482,000	.....	.....
Highland	248,000	.....	.....
Montfort	160,000	.....	.....
Mineral Point Zinc Company.....	2,895,100	.....	.....
Total	21,215,100	831,080	2,400,720

Thirty-five mines, all with modern mining equipments, are idle at present. Two recently constructed mills are closed, with little prospect for operation in the near future.

TORONTO, ONTARIO

REPORT ON THE KIRKLAND LAKE DISTRICT.—CROWN RESERVE
WINS LITIGATION CONCERNING ITS STOCK.—LEGISLATION ON
EXPLOSIVES.—ALGOMA STEEL CORPORATION.

The report of F. H. Hatch, the well known mining geologist, who recently inspected the Kirkland Lake district, had been awaited with much interest, as likely to set at rest the prevalent uncertainty as to the prospects of the field. It is now announced by cable from England that his report will not be made public.

The Crown Reserve Mining Co. has won an important case, which after five or six years litigation in Canada, was taken to the British Privy Council on an appeal from the decision of the Canadian court, dismissing an action by John Black and others, claiming 569,950 shares, of which 338,807 had been disposed of. The Privy Council confirmed the judgment of the lower courts, ratifying the sales of stock made by the Company and declaring the remaining 231,143 shares to be its property. The final settlement of this long protracted litigation has considerably strengthened Crown Reserve stock on the market.

The need of more drastic legislation as to the manufacture, sale, and use of explosives has long been apparent, as accidents from carelessness or ignorance in this respect are of frequent occurrence. The dominion government, some years ago, ordered an investigation into the subject by an engineer specially brought over from England for the purpose; but as is often the case with official investigations, it led to no practical result other than the drafting of a bill which never became law. The principal difficulty in the way of effective legislation appears to be the conflict of jurisdiction between the dominion and provincial governments. It is now announced that another attempt will be made to deal with the matter. The Hon. Louis Coderre, Canadian minister of mines,

has given notice of the introduction of a bill on practically the same lines as that introduced by the former government, with some modifications as to provincial rights, providing for the regulation and control of the manufacture, importation and use of explosives. With the great expansion of the mining industry the necessity for such legislation grows more apparent year by year.

Though the secondary or finishing branches of the iron and steel industry continue much depressed, there is increasing activity in the basic branch. The Algoma Steel Corporation, Sault Ste. Marie, made new records in March, with an output of 30,420 tons of pig iron, and 29,640 tons of rails. It is running to full capacity with orders to keep it busy for several months. The Sydney plant of the Dominion Steel Corporation, which last January was only working to 40% of its capacity, operated up to 60% in April and finds business considerably improved.

NEW YORK

ELECTRIC SMELTING FOR REDUCTION OF BUTTE & SUPERIOR ZINC CONCENTRATE.—AMALGAMATED COPPER AND GREENE CANANEA.—HOLDING AND OPERATING COMPANIES.—DOME REPORT AND COBALT MINES.

Now that the infringement suit of the Minerals Separation, Ltd., against the Butte & Superior has been finally decided in the latter's favor, the Company has a clear field. Hayden, Stone & Co., the controlling interest, has secured the control of the American rights for the Johnson electric zinc smelting furnace, and with the high freight and penalty charge which the zinc concentrate now has to stand, there is a chance for the inception of electric smelting at Butte, though the furnace is better adapted for the treatment of complex ores.

The Amalgamated Copper Co., like the Anaconda company, reports a small deficit in its net receipts as compared with dividends paid during 1913, and, of course, for the same reason. This was made the most of as a 'bear' argument, but the stock rose in spite of it, probably because a less favorable report was expected. The reduction of the Amalgamated's surplus from \$24,000,000 to \$23,640,000 is scarcely reason for much consternation. The 1% dividend paid by the \$50,000,000 Greene Cananea Copper Co. may have puzzled some people, since the assets of the Greene Cananea consist of the stock of the Greene Consolidated Copper Co., a \$10,000,000 company, which declared a dividend of 50c. per share. The explanation, of course, is that the Greene Cananea shares are \$100 par value, while the Consolidated shares are \$10 par. The fractional prices of mining stocks are often a source of bewilderment to men familiar with general business, who suppose Utah Copper, for example, at 55 is at only one-half par, when it is actually at 5½ times par. The companies which expect active trading in their shares in the open markets commonly make the par value low, as the small investor would rather purchase 100 shares at \$1 each than 1 share at \$100.

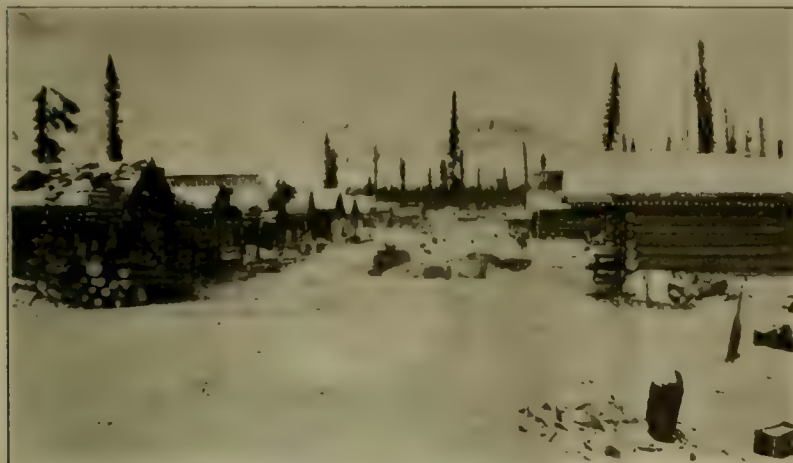
The report of the Dome Mines, Ltd., for 1913 has just come out and shows that the gross proceeds from its ore milled were \$1,204,600. Operating costs amounted to \$615,500, leaving a net profit of \$591,780. The sum of \$134,084 was set aside for depreciation and maintenance, leaving a net surplus of \$457,700. The Dome got into a bad position through the optimism of the original management, which was not careful enough to develop a sufficient ore reserve in a deposit which was obviously of variable gold content; but its position has been since greatly improved, and it will undoubtedly eventually make good. The Trethewey (Cobalt) Silver Co. has taken an option until October on the West Beaver, 25 miles southwest of Fort William, and is reported to be about to spend \$50,000 in testing it. Canadian Gold & Silver is still being boosted.

General Mining News

ALASKA

CHISANA

The accompanying halftone shows the first picture published of the town of Chisana, the centre of the new placer district, which has been the cause of considerable notice from



STREET SCENE, CHISANA, ALASKA.

time to time. In another issue will be shown some prospectors at work during the past winter.

CORDOVA

A good deal of development has been done at the Bouanza and Jumbo mines, according to T. B. Tansey, of Kennecott. A tramway is being constructed between the latter mine and the mill. The concentrator has started work.

COUNCIL

Two shallow-draft dredges with 2½ cu. ft. buckets have been shipped from the works of the Straub Manufacturing Co., Oakland, California, to the Council district for the Flume Dredge Company.

JUNEAU

The Alaska-Gastineau Mining Co. will add to the electrical equipment of its power-house a 540-kva. synchronous motor and switchboard, the apparatus having been purchased from the General Electric Company.

VALDEZ

In the Granite mine, on Hobo bay, the gold-bearing vein is 14 ft. wide. It is probable that three Nissen stamps, a Lane mill, and 150-hp. power-plant will be erected.

ARIZONA

GRAHAM COUNTY

The Shannon Copper Co. reports as follows for the first quarter of 1914:

Shannon ore treated, tons	51,960
Outside mines, tons	13,254
Copper, pounds	2,922,889
Gold, ounces	397
Silver, ounces	19,480
Net profits	\$46,676
Cost of producing copper, cents per pound.....	12.687

Results showed a decreased profit of \$54,962 compared with the last quarter of 1913.

GILA COUNTY

(Special Correspondence.)—The most important transaction that has occurred in the Globe district for many months is the purchase by the Iron Cap interests of the ground known as the Bird group, consisting of eleven claims, six of them patented. The claims adjoin the United Globe, Arizona Commercial, Iron Cap, and Superior & Boston, and are considered desirable ground—the Old Dominion, Superior & Boston, and other companies in the Globe district having negotiated for their purchase at different times during the past few years. The general manager of the Iron Cap, Frank A. Woodward, through whose negotiations the claims were finally secured by his Company, has wanted the ground for six years, although he says there will be no work done on the property at present. It probably will be held in reserve and later worked from the present Iron Cap workings, which it parallels on the north. The first payment on the property was made on May 9. The property was owned by Wenthrope Church and associates.

Globe, May 7.

PINAL COUNTY

The Ray Consolidated Copper Co. reports as follows for the first quarter of 1914: The orebody tributary to No. 1 shaft produced 59% of the tonnage; that at No. 2, 36%, and that at No. 3, 5%. Of the total tonnage, 11% was produced from development, 26% from active stoping, and 63% from reserve

drawing. Mining and coarse crushing cost was 68.411c. per ton.

Development, feet	29,832
Ore milled, tons	714,009
Average copper content, per cent.....	1.7978
Recovery, per cent	67.13
Milling cost, cents per ton.....	53.15
Copper production, including 473,028 lb. in ore shipped to smelter, pounds.....	17,707,374
Net profit, including that from the Ray & Gila Valley Railroad	\$877,444
Dividends	543,964
Net surplus	333,480

All departments showed an improvement over the last quarter of 1913. Average price received for copper was 14.4117c., and the cost was 9.14c. per pound. Metal on hand and in transit, sold and unsold, amounts to 22,614,122 pounds.

YAVAPAI COUNTY

(Special Correspondence.)—Increased activity is being shown in the Mica district, which produces gold ore.

Skull Valley, May 14.

YUMA COUNTY

(Special Correspondence.)—A number of prospectors and miners from towns and mining camps have gone to the gold discovery at Mineral Hill, 20 miles east of Parker, made by E. Osborne. The formation is limestone and granite.

Parker, May 14.

CALIFORNIA

On completion of the work at the University of Idaho, about May 23, J. Boardman, first-aid miner, will leave his position with the U. S. Bureau of Mines car No. 5 and will proceed to California to give first-aid instruction in some of the mining camps which are remote from the railroads. Mr. Boardman will probably be sent first to the southern part of the state, where he will visit the following

mines: Tumco and American Girl near Yuma, Dale, and vicinity; Atolia, Randsburg, Skidoo, Tropico mine, and Mojave. He will probably be sent to the Mother Lode district, where he will visit the mines at Plymouth, Amador City, Sutter Creek, and Jackson, after which he will visit other districts where there are mines at some distance from railroads. He will make stops of from five days to two weeks at each group of mines, depending on the number of men employed. This work has been arranged in cooperation with the Industrial Accident Commission, which will pay Mr. Boardman's expenses in California. After car No. 5 completes the Nevada itinerary, it will probably proceed to California and visit the mines which are situated near the railroad. It will give training in the use of artificial breathing apparatus, as well as in first aid to the injured.

As a result of the work of Mr. Boardman and the mine rescue car of the Bureau of Mines, it is hoped to awaken interest in the work of first aid to the injured. Little attention has been paid to this matter in California mining districts in the past. If there are districts in which the services of Mr. Boardman are particularly desired, applications should be made to the Industrial Accident Commission to have him visit them.

ELDORADO COUNTY

There is little being done in the Georgetown district, but negotiations are under way for several properties, the Georgia Slide being one. The Eureka mine, at Cumming's station, has been sold to an English syndicate for \$30,000. It has produced a good deal of gold down to 750 feet.

MARIPOSA COUNTY

(Special Correspondence.)—The Bondi mine, 16 miles north and 4 miles west of Mariposa, and idle for over twenty years, is yielding some rich gold ore, according to Clinton I. Mentzer of Coulterville. There are a number of good mines in Mariposa county which were opened thirty or forty years ago, and with high transport and other expenses were shut down and have remained idle since. A state highway will pass through Mariposa soon, and the county supervisors are alive to the fact that the mining interest of the county demands good roads. The Number Five mine, of Hornitos, is under bond to S. W. Parker, of Berkeley, California. This property has an incline shaft 300 ft. deep, and a fair tonnage of low-grade ore is developed. The Mountain King mine, on the Merced river, is being actively worked under new management, a dam, ditch, and water-power plant are being constructed, and it is said that additional crushing machinery will be added in the near future. There are 30 men at work.

The Matone mine, on Buckingham mountain, is being opened by San Francisco parties.

The Sweetwater mine is being developed under the management of Mr. McAllister. This mine is equipped with 10-stamp mill, four concentrators, two tubular boilers, compressor, hoisting engine, and three machine-drills.

Mariposa, April 29.

NEVADA COUNTY

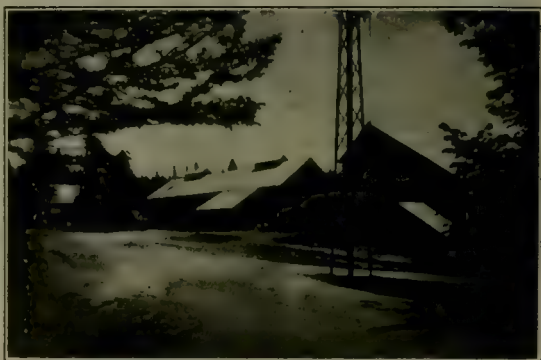
Foundations for 20 additional stamps are being prepared at the Empire mill, which will make a total of 60 head. Development at the Golden Center mine continues to be satisfactory. A 5-stamp mill is to be erected at the Premier mine, north of Grass Valley. The adit is in 1800 ft., showing a good tonnage of ore. The Narrow Gauge Railroad Co., operating between Grass Valley and Colfax, 17 miles, has paid a dividend of \$16 per share. The payroll in the Grass Valley-Nevada City district amounts to about \$100,000 per month.

PLACER COUNTY

The Gold Blossom mines at Ophir have been bonded to Charles Bugg, of Rochester, and other Nevada people for \$100,000.

SHASTA COUNTY

(Special Correspondence.)—The East Side copper belt is showing improvement, with several small companies at work. The Pit River Copper Co. was recently formed to develop a group of claims near Heroult, and has opened promising ore 70 ft. in from the adit portal. Fred Grotendorf, of Redding, is manager. The Shasta Belmont company has completed its new wagon-road from the mine to Heroult, and has arranged to ship high-grade copper-zinc ore to Nevada smelters. A second vein, carrying large quantities of zinc and copper, was recently cut west of the main orebody. It is about 30 in. wide. W. E. Casson, of Carson City, Nevada, is president and manager. At both the Afterthought and Bully Hill smelters experiments continue to devise a satisfactory process for economical treatment of the zinc-copper ores. It is stated that the Afterthought people have devised a process, which will be employed, as soon as sufficient capital is available, to erect a new plant. The Shasta Copper



EMPIRE MINE, GRASS VALLEY.

Exploration Co. has arranged to establish a camp between Spring and Boulder creeks, near Kennett, and will vigorously prospect its extensive acreage. The Company controls 530 acres in addition to the large area recently bonded to the Mammoth Copper Co. San Francisco people are largely interested. Charles Wheelock is in charge of operations. M. E. Dittmar, of Redding, is consulting engineer. The new camp of the Mountain Copper Co., at Minnesota station, is rapidly taking shape. Several buildings have been completed and work on the main 200-ton concentrating plant will soon be well under way. The Mad Ox Mining Co. has been formed by Oakland and Seattle people to operate the Mad Ox mine near Stella. It is capitalized at \$115,000. Warren Beckwith is acting manager.

Redding, May 11.

A party of smeltersmen visited Redding and Kennett on May 17 by invitation of the Mammoth Copper Co., the particular purpose of the visit being to view the experiments being made at the Holt & Gregg farm, near Anderson, by Richard Sprague, chemist for the Company. He is investigating the effect of acid fume on vegetation, and determining what damage, if any, is being done by any gases that may be in smelter smoke coming from the plant at Kennett.

An electric hoist has been installed in the Gladstone adit at French Gulch, 3700 ft. in, and at a depth of 700 ft. A shaft is now 1100 ft. below the adit and is to be sunk farther. Lessees have opened 4 ft. of \$20 ore in the American mine, adjoining the Gladstone.

SIEIRA COUNTY

Work has been resumed at the Twenty-One mine at Alleghany, with 15 men. This property is on the Tightner contact between the Rainbow and Sixteen-to-One mines. F. M. Phelps is manager.

TRINITY COUNTY

The Asbestos claims, 22 miles northwest of Trinity Center, are to be developed this summer, in charge of C. Meehan. At the Bonanza King mine, Carverville, No. 4 adit is to be extended from 700 to 6500 ft., where it should cut the vein. George Foster is manager, and Thomas Grayner superintendent.

COLORADO

It is estimated that the output of radium-bearing ores from Colorado for the current year will total \$3,000,000.

TELLER COUNTY (CRIPPLE CREEK)

For the first quarter of 1914 the Doctor-Jack Pot Mining Co. shows that there are 13 sets of lessees working, and 1588 tons of \$14 ore was shipped. Development totaled 350 ft. on Company account at a cost of \$4.51 per foot. The cash on hand amounts to \$57,436. The Golden Cycle Mining Co. has already subscribed \$40,000 for the present extension of the Roosevelt tunnel, and has promised \$50,000 more for the extension from the Elkton shaft to the Golden Cycle shaft. On May 12 the Copeland Sampling Co. sampled 580 tons of ore in 570 minutes. Eleven 'clean-ups' were made during this shift.

THE SAN JUAN

The American Smelting & Refining Co. is starting the Silver Lake plant as a custom mill for the treatment of ores of the Silverton district, and is now ready to purchase and receive ores from anyone desiring to ship to this mill. An unloading station and sampler has been installed at the tracks of the Silverton Northern railroad, and all ore is sampled as unloaded, then trammed to the head bins of the mill. A satisfactory schedule has been prepared, and the ore is paid for as received and sampled. The Company then treats the ore and ships the concentrates, the lead going to the Company's smelter at Durango and the zinc to the smelter at Blende, near Pueblo. L. R. Clapp is manager.

IDAHO

SHOSHONE COUNTY

The Federal company's Frisco mine has been shut down, partly on account of the difficulty of treating the zinc-lead ore. The mill operated for about two months recently with varying success. The National Mining Co.'s new 500-ton mill, near Mullan, which began operations April 1, treated about 12,000 tons of ore in the first 30 days, or a daily average of 400 tons. The mill is now running three shifts, and it is expected that the maximum production will be reached by June 15. Metallurgical tests of the tailing show that the plant is saving 90% of the copper content, or 7% in excess of the original estimate. It was thought that only 20% of the copper could be saved by concentration, but the month's run shows 24 per cent.

The Montana-Idaho Copper Co., capitalized at \$600,000, has been organized by C. H. Gibbs, W. J. Kirby, and John L. Dirks, all of Spokane. The new Company has taken over the holdings of the Monitor Mining Co., comprising 125 acres of patented ground. It already had acquired a number of claims near the Monitor property, and has extensive water-power and dumping ground. Surveys have been established for a power-plant and plans are being prepared for a long lower adit that will develop the entire group to a vertical depth of not less than 1700 ft. The Marsh Mining Co. is to sell 165,712 shares of treasury stock at 25c. per share.

NEVADA

The itinerary of U. S. Bureau of Mines rescue car No. 5, in this state, is as follows: Copper Flat, near Ely, June 22 to 27; McGill, June 29 to July 3; joint Ely and McGill maneuvers, July 4; Virginia City, July 6 to 11; Goldfield, July 13 to 18; Tonopah, July 20 to August 22. While the car is

at Tonopah, the crew will visit Manhattan, July 27 to August 1, Blain, August 3 to 8; Wonder, August 10 to 15, and Enterprise, August 17 to 22. The car will then proceed to Reno and Sparks, August 24 to 29.

ELKO COUNTY

Good developments are being made in the Jarbidge district. The Elko Mining Co. has 18 ft. of \$20 ore at a depth of 420 ft. in No. 4 adit. Rich ore is being mined in No. 2 adit. A 5-stamp mill is at work. Four feet of \$30 ore has been opened on the surface of the Long Hikes claim. A 24-ft. vein is showing on the Pick & Shovel claim. A new vein is being driven on 60 ft. from the vein which has been developed to 300 ft. The latter is producing some rich ore. Prospecting is under way at the Jarbidge Gold, Arizona L's, Legitimates, Jarbidge-Altitudes, Coeur d'Alene-Jarbidge, and Ole Normal claims. The Beaver River Power Co. will supply electric power from either Malad or Buhl, in Idaho, this summer.

ESMERALDA COUNTY

At the Darms coal mine, at Coaldale, the incline shaft is down 326 ft., and is to be sunk deeper to prove the coal veins. H. E. Darms is manager.

HUMBOLDT COUNTY

(Special Correspondence.)—The suit of Samuel and Peter Stevens and I. P. George v. Jos. F. Nenzel has finally been settled, and the 210,000 shares of the Rochester Mines Co. involved has been distributed to the first-named interests. Shortly after having made the original find, Nenzel bought out the interests in the claims held by Samuel and Peter Stevens and I. P. George, and formed the Rochester Mines Co. Later, when the lessees on the main vein had proved the value of the property, those who had sold out instituted suit, which was tried in the federal court at Carson and has dragged along for about a year with the final result as stated above. While this suit has never involved the mines, being only a suit among various interests, it has tended to retard the development of the camp. It has long been predicted that, with the end of the litigation, a mill would be erected, and it is expected that such will prove to be the case. A large tonnage of mill-ore has been developed in the various leases.

It is expected to have the extension of the Nevada Short Line finished to Rochester and Nenzel Peak by August. A stock exchange has been organized here. Lessees at the Camelle Rock, Big Four, Codd, and Cole and Colligan claims are meeting with promising results.

In this camp driving or cross-cutting is no longer attempted with piston machine-drills, but is done with stopers and jackhammers. Progress has been found to be more rapid and the cost per foot of this work has been considerably reduced. While exact cost data are not available, it is significant that none of the lessees has used a piston drill for months past, and all adit work in the leases equipped with air has been accomplished with stopers and jackhammers in combination.

Rochester, May 5.

Placer work at the head of Limerick cañon, north of Rochester, is yielding about \$15 per day per man. So far the work is not extensive, but is rich. Primitive methods have to be employed, the gravel being either hauled to a spring a mile distant, or water hauled from the spring to the diggings. Quite a number of prospectors are in the field, some going into the east range.

At a meeting of the directors of the Rochester Mines Co. held at Lovelock on May 13, Wayne T. Wilson and E. B. Mills resigned, and were succeeded by W. C. Pitt and Samuel Platt. J. F. Nenzel resigned as president and general manager, and John F. Cowan was elected to his place. Plans are being prepared for a mill. Thus is settled the controversy that threatened to wreck the Company and stop the development of the camp of Rochester.

MINERAL COUNTY

The 100-ton copper-leaching plant is ready for work at the Wagner-Azurite mine, Luning. The process is that devised by John D. Fields.

LYON COUNTY

The Mason Valley Mines Co. reports as follows for the first quarter of 1914:

	Mar. quarter, 1914.	Dec. quarter, 1913.	Mar. quarter, 1913.
Mason Valley ore smelted, tons	22,229	27,825	29,707
Total ore smelted, tons.....	45,008	50,197	70,709
Copper produced, pounds....	2,742,932	3,694,227	4,611,881
Net profit	\$9,128	\$15,289	\$73,517

During the week ended May 13 the smelter received 3390 tons of ore.

NYE COUNTY

At Manhattan, lessees at the White Caps have removed the pumps and the mine was being flooded until the Company secured others. There has been friction among the board of directors.

The following April returns have been published from Tonopah mines: Belmont, 15,230 tons yielding 320,336 oz. bullion with a profit of \$150,494; Jim Butler, 3554 tons yielding a profit of \$36,727; North Star, which has cut 8 ft. of ore at 1130 ft., a profit of \$7000; and Tonopah Mining, 11,561 tons, producing 207,350 oz. bullion and 106 tons of concentrate worth \$35,000, the profit being \$103,100. A new tube-mill, Dorr classifier, and Trent agitator have increased the capacity of the Extension mill from 160 tons to 200 tons per day.

STOREY COUNTY

The 200-ton tailing plant of the Metals Recovery Co., east of Six-mile cañon, is nearly complete. It is estimated that there is 300,000 tons of old tailing to be treated which contains some copper.

WHITE PINE COUNTY

A suit for dissolution of the Consolidated Coppermines Co., of Ely, and the appointment of a receiver has been filed by Colonel Enos A. Wall, of Salt Lake City. He also asks for a return of his stock. There are 18 defendants in this suit. The Coppermines company has six churn-drills at work, boring 30 ft. each per day.

OKLAHOMA

TULSA COUNTY

During the current month the Tulsa Spelter Co. will start its plant at Sand Springs with 1600 retorts, there being 4000 retorts building in 1913, according to the U. S. Geological Survey.

OREGON

JACKSON COUNTY

(Special Correspondence.)—With only a few men employed, and a small mill working a few days each month, the Lucky Bart mine, in the Sardine Creek district, is doing well. The gold output in March was \$800, and the regular clean-up produced between \$700 and \$1000. The De Luse Mining & Dredging Co., of Sutherlin, has purchased the Lyman apple orchard, on the Rogue river near Gold Hill, for \$12,000. The area will be dredged, machinery having been ordered. The orchard yielded \$500 per acre last season, and the trees will be reset as soon as uprooted for the dredge. A. E. Bamber is to be in charge. Southern Oregon capital is to develop and equip the St. Albans copper-gold claims on the upper Applegate, in the Blue Ledge district. Henry Callahan and associates have been opening the property for some time past. A concentrating plant, to cost about \$25,000, will probably be erected.

Philomath, April 24.

(Special Correspondence.)—Kubli Bros., owners of the Gold Standard mine, of Galis creek, in the Gold Hill district, announce that this old property, which has been idle for the past seven years on account of litigation, will soon be reopened. About 2000 ft. of underground work has been done, and returns in the past have averaged as high as \$40 per ton. In a claim owned by Zeb Hyde, on the Applegate river, 12 in. of rich quartz ore has been opened.

Philomath, May 10.

UTAH

JUAB COUNTY

The Chief Consolidated, at Tintic, is shipping 3500 to 4000 tons of ore per month to smelters, and earnings are about \$14,000 per month. The present surplus is \$202,257. A new shoot of 15 to 20% copper ore has been opened at 2300 ft. in the Grand Central mine. Similar ore is also exposed at 2000, 2100, and 2200 ft. At the May Day mine, the cyanide plant is treating 2000 tons of ore per month. Lessees at this property have produced 21 cars of silver-lead ore.

SALT LAKE COUNTY

The Montana-Brigham tunnel is in 3000 ft., in softer ground than formerly. During the first quarter of 1914 the Utah-Apex company's gross receipts from lead ores were \$115,008, and net profit \$28,326. The mill was shut down in February and March for overhauling. There was a lower price for lead, which affected the revenue.

SUMMIT COUNTY

In April the Mines Operating Co.'s mill made a recovery of 82%, in treating 165 tons per day. A new roasting furnace is doing good work. The Nelson and Minola groups of claims of 150 acres have been merged by Park City people, and will be operated by the Three Kings Silver Mining Co. The ground is situated between the Silver King Coalition and Silver King Consolidated mines. The tailing problem in the Park City district is causing a good deal of discussion. Residue from the mills flows down Poison creek, and at one point covers the Union Pacific line. A conference between the railway and mining officials was recently held to deal with the trouble.

UTAH COUNTY

Ore is now being hauled from mines in the American Fork cañon district, and there is a large tonnage awaiting shipment.

WASHINGTON

FERRY COUNTY

(Special Correspondence.)—Ore shipments from mines at Republic during the past two months were as follows:

	March, tons.	April, tons.
Ben Hur	1870	3869
Black Tail	96	106
Knob Hill	605	1426
Lone Pine	41	25
Rathfon Reduction Works .....	...	53

The destinations of these ores are to the San Poil mill at Republic, and smelters at Grand Forks, Greenwood, and Trail, in British Columbia.

Eight inches of shipping ore, assaying well in copper, has been opened in the Lakeside company's mine, north of Pierre lake, near Orient. The property is under bond to Dayton Stewart of Spokane.

KITITAS COUNTY

(Special Correspondence.)—The Bigney placer claim during a recent week produced \$234 with three men working. The largest nugget was worth \$23. This claim has done well this winter. The owner is now driving an adit to drain some ground ahead. Some time ago an attempt was made to drive down stream from this ground, and owing to the water, only 10 ft. was driven, but about \$300 in coarse gold was recovered.

so good results are expected from that area. J. E. and Charles Bowles have recently sold two placer claims on Lyons gulch to William Brennan, of Cleveland, Washington. York and Siegel commenced hydraulic operations on Trilby gulch recently. The first clean-up netted them about two ounces. W. McCauley, owner of the Taft quartz mine, has arrived in camp and will soon start work at his property. Tom Livingston is opening up the Deer Gulch placer. This claim was one of the big producers some years ago, and is still considered valuable. E. M. Wells, who recently opened 'pay' on the Williams Creek placer, was compelled to shut down for a week owing to an accident to the hoist. E. Varden is contracting ore from the Whaleback claim. This claim contains some high-grade ore. From one month's run last fall, with an arrastre, Mr. Varden saved about \$800. The concentrate was run out with the tailing, as there was no way to save it.

Liberty, April 11.

OKANOGAN COUNTY

(Special Correspondence.)—The Okanogan Free Gold mine and 10-stamp mill has been acquired by J. L. Harper of Republic. The weekly output is about \$1000 in bullion and concentrate. Probably 20 additional stamps will be installed. Rich ore has been discovered in the Recco mine, in the Myers Creek district, and prospectors are getting busy.

The Central Mining Co., in the Nespelem district, has opened 14 ft. of ore worth \$14.10 per ton in gold, silver, and copper, on the 100-ft. level. An adjoining property is yielding \$28 copper and \$2 silver ore. The Multnomah company has opened a good shoot of silver-lead ore. In the Double Header mine, 5 ft. of \$8 to \$22.50 gold-silver ore has been opened.

Oroville, April 21.

CANADA

BRITISH COLUMBIA

Fire at Stewart, in the Portland Canal district, recently destroyed a considerable quantity of property. The adit being driven by the Portland Canal Tunnels Co. was in 3050 ft. on April 11. Twenty-two miners are employed in charge of W. J. Elmendorf. Net earnings of the Standard Silver-Lead Mining Co. in 1913 were \$731,225, and after paying dividends the surplus was \$81,225.

Mining in the southern part of this province is more active this spring than for years past, according to Herbert Sharp, who has been 10 months in Nelson. All the mines around this place are being worked. Fatalities in mines of the province during the first quarter of 1914 total seven in collieries, and five in metal mines, against seven and three respectively in 1913, according to the chief inspector of mines, Thomas Graham. The Hedley company's power dam on the Similkameen river is practically finished.

Considerable attention is now being paid to the alluvial deposits of the Similkameen and Tulameen rivers in the southern part of this province, owing to the fact that the Tulameen district has the richest platinum deposits on the North American continent. C. E. Lee, of Seattle, Washington, is examining the claims of Coulthard and Snowden Bros. of Princeton. C. Lambert is to work his ground on Granite creek. An engineer of the Consolidated Mining & Smelting Co., of Trail, is examining the Union mine at Gloucester, and others in the North Fork district.

ONTARIO

During April, the Nipissing high and low-grade mills treated 170 and 6663 tons of ore respectively, and the refinery produced 550,150 fine oz. of silver. The yield was worth \$323,251 net. The new orebody has been developed for 540 ft. at No. 4 level. At 900 ft. the cross-cut is in 164 ft. and should cut the vein at 255 feet.

During April, the Dome mine produced 14,770 tons of ore yielding gold worth \$97,455. The annual meeting is to be held on May 26. During the financial year, 145,305 tons was treated, producing \$1,204,598 at a cost of \$919,512.

At the Tough Oakes mine, No. 2 vein has been opened to 300 ft. depth, where it is 12 in. wide assaying \$79 gold per ton.

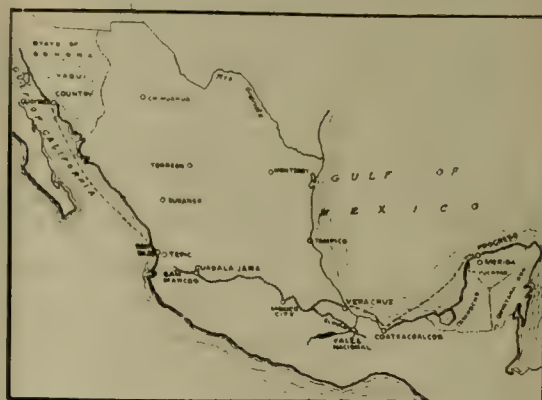
Two per cent nickel ore has been opened in Keewatin formation north of Sesehtinika, near Swastika. During March the Buffalo mill treated 7915 tons of ore yielding 142,786 oz silver. Dividend No. 59 was paid on April 1. During 1913 the Beaver Consolidated mine produced 25,256 tons of ore yielding 762,699 oz., valued at \$438,552.

YUKON

During the week ended May 2, the Canadian Klondyke Co.'s dredges produced 844 oz. gold. The first boat to reach Dawson this season arrived on May 18.

MEXICO

Cabled advice to the offices of the respective companies in London shows that mining has been suspended at the Buena Tierra in Chihuahua; the mills of the El Oro, Esperanza, and Mexico Mines of El Oro companies are shut down, but development is proceeding in charge of the Mexican staff; and at Pachuca the Santa Gertrudis mill is also not working, although the mine is being worked. The Buena Tierra ships its lead-



MAP OF MEXICO.

silver ore to the A. S. & R. smelter at Chihuahua, but this is out of commission, hence the shut-down.

SONORA

(Special Correspondence.)—The Pilares (de Nacozari) is owned by the Moctezuma Copper Co., but the Pilares (de Texas), 10 miles north of El Tigre, is the old Colonel Garcia silver property, confiscated and now worked by the Constitucionalistas. There has been a little excitement here lately, but the Mexicans have behaved well and no damage was done. The Pilares mine and Nacozari concentrator kept running as usual, also El Tigre mine and mill, entirely by the Mexican employees. El Tigre cyanide plant was shut down, as the chemicals were locked up. The Caridad was kept running and there was no trouble at all.

La Caridad, May 5.

The combined annual report of the Greene Consolidated Copper Co. and Cananea Consolidated Copper Co. shows a total revenue of \$7,436,390 and profit of \$2,180,260, which is only \$94,539 less than in 1912.

Exports from mines in this state through the 'port' of Agua Prieta in April were as follows: Moctezuma, 11,560 tons; El Tigre, 204; Calera, 36; El Temblor, 32; Estrella, 23; La Ventania, 23; San Ygnacio, 23; El Gallo, 34; Vacuero, 41; Cobre Verde, 5; El Globo, 59; Good Enough, 20; San Francisco, 10; Mexico, 31; Los Angeles, 21; Monte Cristo, 7; and Santa Rosa, 454; a total of 12,633 tons. El Tigre shipped 58 bars of bullion weighing 8475 lb., 55 sacks precipitate weighing 3970 lb., and 14 sacks sulphides weighing 900 lb. The total value of these exports was \$2,678,000.

Personal

C. S. HERZIG is in Norway.

WILLIAM C. WEISBROD is in New York.

A. W. ALLEN is at Cambridge, England.

JOSEPH STRUTHERS has returned to New York.

JULES LEBARTH was in San Francisco last week.

T. J. ANDERSON has returned to New York from Panama.

AUSTIN C. BRADY, of Guadalajara, Mexico, is in San Francisco.

E. A. STROUT has left Mexico and is now at Los Angeles, California.

E. A. WALLERS has been elected president of the Transvaal Chamber of Mines.

ARTHUR FEUST has returned from Nicaragua and is at 462 E. 138th street, New York City.

J. H. COLLIER has been appointed superintendent of the Montezuma Mining Company.

HOWLAND BANCROFT is back from Peru and is expected in Denver by the middle of May.

W. F. MACK has returned to Candor, North Carolina, from a visit to New York and Boston.

A. W. HOOKE, manager of the Forum River Co.'s property, has left England for northern Nigeria.

D. C. JACKLING was in San Francisco last week and is now in Nevada. GALEN L. STONE is accompanying him.

F. DANVERS POWER has returned to the University of Sydney, New South Wales, after a nine months tour of the world.

A. H. BOYD has severed his connections with the Denver Rock Drill Mfg. Co. His present address is 3700 Race street, Denver.

JOSEPH EMBLETON is now manager for the South Kalgurli mine, Kalgoorlie, in place of JOHN MORGAN, who resigned owing to ill health.

A. R. LEDOUX sailed for Europe on May 15, as commissioner of the United States government and consulting engineer to the Bureau of Mines.

RALPH ARNOLD is to give a series of lectures at the Throop Polytechnic Institute, Pasadena, California, where a course on petroleum has been started.

ERROL MACBOYLE, field assistant for the California State Mining Bureau, is collecting data on the Grass Valley and Nevada City mining districts.

RICHARD HAMILTON, of the Great Boulder Proprietary, was elected president of the Chamber of Mines, Kalgoorlie, for the seventeenth time, on March 25.

JOHN M. BOUTWELL has finished a detailed geological survey of the Old Dominion property at Globe, Arizona, and has returned to his office at Santa Barbara.

C. W. PURINGTON has been appointed consulting engineer to the Lenskol Gold Mining Co. of St. Petersburg, and technical adviser to the Lena Goldfields, Ltd., of London.

JAMES HEIBARD, manager for the Central mine (Sulphide Corporation), Broken Hill, New South Wales, is on a tour through Asia, England, Europe, and the United States.

T. A. RICKARD, representing the Royal School of Mines, of England, will speak on 'The Mining Engineer as a Pioneer,' at the Semi-Centennial celebration of the Columbia School of Mines.

K. M. SIMPSON has resigned as general manager for the Atlantic Mines Co. and Goldfield Mergers Mines Co. ARTHUR I. D'ARCY will succeed him as general manager for the Atlanta Mines Company.

ELWOOD MEAD returned to Melbourne, Victoria, on May 12. Under the auspices of the Commonwealth Club of San Francisco, he gave an interesting hour's talk, May 8, on 'Land Settlement and Irrigation.'

J. TAFFANEL, mining engineer, former French inspector, and now the director of the French mine experiment station at

Llewin, is paying a visit to the United States, as a guest of the Bureau of Mines.

Operating officials of the Butte & Superior Copper Co. in Montana are as follows, according to the report for 1913: manager, J. L. BRUCE; mine superintendent, ARGUS McLEOD; mill superintendent, FRANK R. WICKS; and cashier, CHARLES BOCKING.

Among the refugees from Mexico who recently arrived in San Francisco are the following: J. C. ARCHIBOLD, Cinco Minas; R. A. CONRAD, Cinco Minas; W. F. HENDERSON, Amparo Mining Co.; C. F. JOYCE, Amparo Mining Co.; M. L. KAISER, Casados; Walter C. Minsch, Cinco Minas; S. H. PYLE, Amparo Mining Co.; and EDWARD THOMPSON, Espada Mines.

Operating officials of the Alaska-Gastineau Mining Co., controlled by the Alaska Gold Mines Co., are as follows: manager, B. L. THANE; assistant manager, J. R. WHIPPLE; superintendent of mines, G. T. JACKSON; chief engineer, H. L. WOLLENBERG; engineer for mill construction, C. E. BRUFF; and superintendent of the metallurgical department, E. V. DAVELER.

Obituary

J. C. HAUVER, a well known geologist, died at Auburn, California, on May 15. He was a native of this state and was 69 years old. He leaves a widow, one son, and two married daughters.

JAKOB BOLIN, head of the physical education department of the University of Utah and one of the most widely known and popular men of that Institution, died on May 15 after a short illness.

DUNCAN McMARTIN, a mine owner and a member of the Timmins-McMartin-Dunlap syndicate, which has figured so conspicuously in connection with the Cobalt and Porcupine camps of Ontario, died on May 2 at Toronto as the result of an attack of pneumonia. When Mr. La Rose, a French-Canadian blacksmith, discovered silver ore at Cobalt, he consulted the McMartin Bros., who were constructing a railway at that time, and formed a syndicate which led to the present La Rose Consolidated Co. When the Porcupine boom started they were early in the field, and acquired the Hollinger, Miller, Dixon, and other claims. Mr. McMartin had numerous interests, including the development of electrical power at Cobalt and Waiwaitan falls. He enjoyed great popularity among mining men, and was noted for his liberality, especially to those with whom he had been associated in his early days.

PAUL LOUIS TOUSSAINT HEROULT, whose name will ever be connected with aluminum and the electric furnace, died in Paris recently. Mr. Heroult pere was born at Thury-Harcourt, April 10, 1883, and received his early education in England and France. He later went to the Lyceum at Caen and to St. Barbe, Paris. In 1882 he attended the School of Mines in Paris, and the next year took his military service in the army. On finishing this he worked for a metallurgical firm, and giving his attention to aluminum, in 1886, two years thereafter, he obtained a patent for the production of this metal electrolytically. On his discoveries are based the improvements in methods that brought the price of the metal from \$20 a pound in 1884 to about 50 cents in 1901. The more recent achievements of Heroult have been in developing the electric furnace for steel, aluminum, and other metals. His principle here was the introduction of two electrodes into the melting-pot, so that the ore received the full effect of the heat and the furnace was little more than a container. A later improvement consisted of a third electrode, which was in the nature of a starter and which burned away when the furnace rose to its proper heat. For his furnace he received in January 1904 the medal of the French Society for the Encouragement of National Industries. The Heroult furnace is in extended use today in many places.

The Metal Markets

LOCAL METAL PRICES

San Francisco, May 21

Antimony	4 — 9½c
Electrolytic copper	15½ — 15¾c
Pig lead	4.15 — 5.10
Quicksilver (flask)	\$39.00
Tin	40½ — 42 c
Spelter	6½ — 6¾c
Zinc dust, 100 kg. zinc-lined cases, 7½ to 8c per pound.	

EASTERN METAL MARKET

(By wire from New York)

NEW YORK, May 21—A good business is being done in copper, principally for domestic consumption. Copper shares are steady, but neglected, and a waiting policy reigns on Wall Street. Lead and spelter are firm, with practically no change. Business in London and Paris is dull. Metal quotations are: copper, 163 75c 6d.; lead, 119, spelter, 121 75c 6d., and tin 1149 per ton, but silver easy at 26½d (53c) per ounce.

SILVER

Below are given the average New York quotations in cents per ounce, of fine silver.

Date		Average week ending	
May 14	58.62	Apr. 15	58.15
" 15	58.62	" 22	58.30
" 16	58.50	" 29	58.35
" 17 Sunday		" 29	58.93
" 18	58.50	May 6	59.14
" 19	58.00	" 13	58.73
" 20	57.62	" 20	58.31

Monthly averages.

	1913.	1914.		1913.	1914.
Jan.	63.01	57.58	July	58.70	
Feb.	61.25	57.53	Aug.	59.32	
Mch.	57.87	58.01	Sept.	60.53	
Apr.	59.26	58.52	Oct.	60.88	
May	60.21		Nov.	58.76	
June	59.03		Dec.	57.73	

Writing on April 30, Samuel Montagu & Co., London, discuss the silver position as follows: The fact is that demand is no longer the chief factor of the situation. For many years past the market has been wondering whence fresh demands could come sufficient to absorb supplies, visible or expected. The output had been on an increasing scale, the defunct Indian Specie Bank held a vast stock, financed by borrowed money, and an impression permeated quarters interested in silver that while these circumstances existed, no improvement in the price could take place. The problem faced now is of quite a different character. The Cobalt district in Canada appears to have reached the height of its production, and even betrays signs of retrogression. Owing to the trouble in Mexico, many of the important silver mines have been shut down, and whatever may be the outcome of this trouble, a stoppage more or less prolonged must take place in the contribution of Mexico to the world's available supply of silver. It will thus be seen that, contrary to the indications which have prevailed for many years past, any operator desirous of forming an opinion as to the future price of silver, needs to consider how long this shrinkage will continue, rather than what will be the extent of future demand. Demand is certain to arise in due course, and any competition, or continuity of purchases from a large buyer, such as the Indian Government, for instance, will find an ill provided market from which to draw the desired supplies.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date		Average week ending	
May 14	3.90	Apr. 15	3.80
" 15	3.90	" 22	3.80
" 16	3.90	" 29	3.80
" 17 Sunday		" 29	3.90
" 18	3.90	May 6	3.90
" 19	3.90	" 13	3.90
" 20	3.90	" 20	3.90

Monthly averages.

	1913.	1914.		1913.	1914.
Jan.	4.28	4.11	July	4.35	
Feb.	4.33	4.02	Aug.	4.60	
Mch.	4.32	3.94	Sept.	4.70	
Apr.	4.36	3.86	Oct.	4.37	
May	4.34		Nov.	4.16	
June	4.33		Dec.	4.02	

COPPER

Quotations on copper as published in this column represent average wholesale transactions on the New York market and

refer to electrolytic copper. Lake copper commands normally 1-5 to 1-10 per lb. more. Prices are in cents per pound.

Date		Average week ending	
May 14	14.95	Apr. 8	14.06
" 15	14.95	" 15	14.27
" 16	14.95	" 22	14.07
" 17 Sunday		" 29	14.24
" 18	14.00	May 6	14.02
" 19	14.00	" 13	14.03
" 20	14.10	" 20	14.09

Monthly averages.

	1913.	1914.		1913.	1914.
Jan.	16.54	14.21	July	14.21	
Feb.	14.93	14.46	Aug.	15.42	
Mch.	14.72	14.11	Sept.	16.23	
Apr.	15.22	14.19	Oct.	16.31	
May	15.42		Nov.	15.08	
June	14.71		Dec.	14.25	

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending	May 7
Apr. 23	38.50
" 30	39.00

Monthly averages.

	1913.	1914.		1913.	1914.
Jan.	39.37	39.25	July	41.00	
Feb.	41.00	39.00	Aug.	40.50	
Mch.	40.20	39.00	Sept.	39.70	
Apr.	41.00	38.90	Oct.	39.37	
May	40.25		Nov.	39.40	
June	41.00		Dec.	40.00	

TIN

New York prices control in the American market for tin, since the metal is almost entirely imported. San Francisco quotations average about 5c. per lb. higher. Below are given average monthly New York quotations, in cents per pound:

Monthly averages.

	1913.	1914.		1913.	1914.
Jan.	50.45	37.85	July	40.70	
Feb.	49.07	37.75	Aug.	41.75	
Mch.	46.95	38.10	Sept.	42.45	
Apr.	49.00	36.10	Oct.	40.61	
May	49.10		Nov.	39.77	
June	45.10		Dec.	37.57	

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date		Average week ending	
May 14	4.95	Apr. 8	5.10
" 15	4.95	" 15	5.06
" 16	4.95	" 22	4.90
" 17 Sunday		" 29	4.90
" 18	4.95	May 6	4.87
" 19	4.95	" 13	4.90
" 20	4.95	" 20	4.95

Monthly averages.

	1913.	1914.		1913.	1914.
Jan.	6.88	5.14	July	5.11	
Feb.	6.13	5.22	Aug.	5.51	
Mch.	5.94	5.12	Sept.	5.55	
Apr.	5.52	4.95	Oct.	5.22	
May	5.23		Nov.	5.60	
June	5.00		Dec.	5.07	

METAL PRODUCTION OF THE BUTTE & SUPERIOR MINE

In 1913 the mill treated 296,940 tons of ore averaging as follows:

Gold, ounces	0.021
Silver, ounces	10.59
Copper, per cent	0.23
Lead, per cent	1.169
Zinc, per cent	19.89

Zinc concentrate produced totaled 104,174 tons, containing:

Gold, ounces	0.05
Silver, ounces	24.19
Copper, per cent	0.47
Lead, per cent	2.08
Zinc, per cent	49

Metal content of this concentrate was:

Gold, ounces	5,201
Silver, ounces	2,520,375
Copper, pounds	977,405
Lead, pounds	4,330,422
Zinc, pounds	102,102,868

There was also produced 2269 tons of lead concentrate containing 188 oz. gold, 98 oz. silver, 14,151 lb. copper, 1,788,465 lb. lead, and 895,048 lb. zinc. The gross value of the metal output was \$3,526,661. Spelter averaged 5.6c. per pound during the year, and costs were 4.45c. per pound.

The Stock Markets

SAN FRANCISCO STOCKS AND BONDS

(San Francisco Stock and Bond Exchange.)

May 20.

BONDS

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Natomas Con.....	\$ 33 1/2	35 1/2	Pac. Port. Cement 6s....	100	—
Unlisted.			Santa Cruz Cement 6s....	85	88
General Petroleum 6s....	37 1/2	41	Union Oil.....	86 1/2	87 1/2
Natomas Consol. 6s....	5	—			

STOCKS

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Amalgamated Oil.....	—	80	General Petroleum....	4 1/2	—
Associated Oil.....	39 1/2	39 1/2	Noble Electric Steel.....	50c	75c
Giant.....	85	—	Natomas Consol.....	50c	—
Pac. Oil. Borax, com....	—	57 1/2	Pac. Port. Cement.....	60	94
Sterling O. & D.....	—	14	Riverside Cement.....	—	6 1/2
Union Oil.....	—	74	Santa Cruz Cement.....	39	—
West Coast. pfd.....	—	112 1/2	Stand. Port. Cement....	—	20

NEVADA STOCKS

(By courtesy of San Francisco Stock Exchange.)

May 21.

Atlanta.....	\$ 18	Montana-Tonopah.....	\$ 77
Belcher.....	37	Nevada Hills.....	33
Belmont.....	7 1/2	North Star.....	37
Con. Virginia.....	37	Ophir.....	11
Florence.....	52	Pittsburg Silver Peak....	28
Goldfield Con.....	1 1/2	Round Mountain.....	24
Goldfield Oro.....	10	Sierra Nevada.....	55
Halifax.....	70	Tonopah Extension.....	2 1/2
Jim Butler.....	1 00	Tonopah Merger.....	57
Jumbo Extension.....	22	Tonopah of Nevada.....	6 60
MacNamara.....	33	Union.....	38
Mexican.....	85	Victor.....	38
Midway.....	28	West End.....	38 1/2
Mt. Pabon Extension.....	30	Yellow Jacket.....	22

CALIFORNIA STOCKS

(Latest Quotations.)

Bid.	Ask.	Bid.	Ask.
Argonaut.....	\$2 85	Central Eureka.....	\$0.14
Brunswick Con.....	1.00	Mountain King.....	0.53
Bunker Hill.....	1.90	South Eureka.....	1.25

COPPER SHARES—BOSTON

(By courtesy of J. C. Wilson, Mills Building.)

May 21.

Bid	Ask	Bid	Ask
Allouez.....	\$ 40 1/2	Mohawk.....	\$ 44
Ariz. Commercial.....	43	Nevada Con.....	14 1/2
Butte & Superior.....	39 1/2	North Butte.....	26 1/2
Calumet & Arizona.....	66 1/2	Old Dominion.....	47 1/2
Calumet & Hecla.....	426	Oscoda.....	75
Copper Range.....	37	Quincy.....	58
Daly West.....	14	Shannon.....	6 1/2
East Butte.....	11	Superior & Boston.....	2
Franklin.....	43	Tamarack.....	36
Granby.....	84 1/2	U. S. Smelting, com.....	34 1/2
Green Cananea.....	32	Utah Con.....	104
Isle-Royale.....	20	Winona.....	3 1/2
Mass Copper.....	51	Wolverine.....	42 1/2

NEW YORK CURB QUOTATIONS

(By courtesy of E. F. Hutton & Co., Kohl Building.)

May 21.

Bid.	Ask.	Bid.	Ask.
Braden Copper.....	7 1/2	La Rose.....	1 1/2
Braden 6s.....	15 1/2	Mason Valley.....	2
B. C. Copper.....	1 1/2	McKinley-Dar.....	70c
Con. Cop. Mines.....	2 1/2	Mines Co. Am.....	2 1/2
Davis-Daly.....	1 1/2	Nipissing.....	6
Ely Con.....	2	Ohio Copper.....	3 1/2
First National.....	2 1/2	Stand. Oil of Cal.....	20 1/2
Giroux.....	1 1/2	Tri Bullion.....	1 1/2
Hollinger.....	16 1/2	Tuolumne.....	5 1/2
Iron Blossom.....	1 1/2	United Cop. com.....	3 1/2
Kerr Lake.....	1 1/2	Yukon Gold.....	2 1/2

NEW YORK STOCK EXCHANGE

(By courtesy of J. C. Wilson, Mills Building.)

May 21.

Bid	Ask	Bid	Ask
Amalgamated.....	\$ 72 1/2	Miami.....	\$ 22 1/2
Anaconda.....	32 1/2	Nevada Con.....	14 1/2
A. S. & R. com.....	63 1/2	Quicksilver, com.....	14 1/2
Calif. Pet. com.....	20 1/2	Ray Con.....	21 1/2
Chino.....	41 1/2	Tenn. Copper.....	34 1/2
Guggenheim Ex.....	54 1/2	U. S. Steel, pfd.....	109 1/2
Inspiration.....	16 1/2	U. S. Steel, com.....	61 1/2
Mexican Pet. com.....	61 1/2	Utah Copper.....	56 1/2

Mineral Production of Peru in 1912

The following table is from *Boletín 80* of the Cuerpo des Ingenieros de Minas del Peru:

Productos.	Mineral.	Value.
Carbón (coal).....	tons 278,927	Lp. 180,326
Petroleo (oil).....	tons 233,600	879,976
Oro (gold).....	kilograms 1,435	186,987
Plata (silver).....	kilograms 324,352	1,233,407
Cobre (copper).....	tons 26,970	1,867,855
Plomo (lead).....	tons 4,050	64,252
Vanadio (vanadium).....	tons 3,048	150,000
Bismuto (bismuth).....	kilograms 51,038	14,155
Tungsteno (tungsten).....	tons 195	19,500
Mercurio (quicksilver).....	kilograms 400	104
Borax.....	tons 1,674	15,096
Sal (salt).....	tons 23,292	16,305

Total value.....*Lp. 4,627,963

The output for 1912 showed an increase of Lp. 928,348 over that of 1911.

*1 Libra=\$4.8665 U. S. coinage.

The department of mining engineering of the University of Illinois, the State Geological Survey, and the U. S. Bureau of Mines have coöperated during the past three years to study Illinois mining conditions. The information collected at 100 mines is published in district reports. In *Bulletin 2*, 'Coal Mining Practice in District VIII (Danville),' by S. O. Andros, are discussed causes of accidents to miners in Vermillion and Edgar counties; loss of natural resources by wasteful methods of blasting and mining; and the use of steel and concrete as substitutes for timber in the mines and other phases of underground work. The bulletin also contains a description of the methods of removing the overburden from a coal bed by steam-shovels, a system of mining which has been highly developed in this district. Copies of the bulletin may be obtained by addressing State Coal Mining Investigations, Urbana, Illinois.

THE total Panama canal excavation to April 1, 1914, was 219,618,104 cu. yd., leaving 12,734,986 cu. yd. remaining to be excavated under the revised estimate of July 1, 1913. Excavation for March was 1,226,644 cu. yd. as compared with 1,430,050 cu. yd. in February. The wet excavation amounted to 964,055 cu. yd., and dry excavation to 262,589 cubic yards.

GOLD PRODUCTION of Nova Scotia during the fiscal year ended September 30, 1913, amounted to 2365 oz. against 4385 in the previous year. The coal output was over 7,000,000 tons.

PIG IRON PRODUCTION in the United States in April totaled 2,269,955 tons, against 2,347,867 tons in March. There were 211 blast-furnaces in operation on May 1.

NITRATE OF SODA purchases from Chile by the United States in the fiscal year 1913 amounted to \$20,718,968, against \$15,431,892 in 1912.

THE AMERICAN METAL CO., LTD., has removed its offices in New York to 61 Broadway.

Company Reports

V-WATER TIN COMPANY

This Company operates alluvial tin deposits at Emmaville, New South Wales. During the six months ended January 31, 1914, there was sluiced 235,000 cu. yd. of drift, yielding 154.5 tons of tin oxide, an average of 1,473 lb. per yard. The revenue was \$84,000; profit, \$29,000; surplus at credit of profit and loss account, \$53,000; and dividends, \$19,000. To date, a total of 2,485,000 cu. yd. has yielded 1369 tons of black tin.

GLOBE & PHOENIX GOLD MINING CO., LTD.

This Rhodesian company had another profitable year in 1913, the operating profit amounting to £355,592, against £351,634 in 1912. The mill treated 76,051 tons of ore yielding gold worth £500,971. The net profit was £299,072. Three dividends, totaling \$1.50 per share, were paid, and a balance of £51,985 was carried forward. Ore reserves contain 14,426 tons of \$110.50 ore, and total 180,757 tons averaging \$27.20 per ton. Developments were satisfactory, especially on No. 20 level north from No. 2 winze. During March of 1914, 71 ft. was driven on this level averaging \$134 per ton.

SONS OF GWALIA, LTD.

This is a Western Australian company, operating a large and profitable mine about 160 miles north of Kalgoorlie. Development in 1913 showed that reserves are about 625,000 tons of ore. The main ore-shoot is longer on No. 19 level than in those immediately above, and a winze has opened it to No. 20 level. The other shoot has not been found below No. 17 level, a geological examination showing an intrusion of country rock. The 50-stamp mill and cyanide plants treated 162,101 tons of ore yielding £269,792. The working profit was £66,277, out of which £66,300 was paid in dividends, the deficiency being drawn from £12,523 brought forward from 1912. The balance to 1914 was £12,501.

CIA. MINERA CHONTALPAN Y ANEXAS

This Company operates in the state of Guerrero, Mexico, and the report covers the year 1913. Exploration work totals 930 metres at a cost of \$35,138. The Modesto shaft was sunk to 140 metres, on No. 6 level, where prospecting is being done. Ore reserves in the mine and patio total 34,188 tons. The value of the reserves is estimated at more than \$1,000,000. High-grade ore was shipped during November and December. Five stamps have been in operation since July, and it is planned to increase this number to fifteen. New equipment cost \$36,387. While the Company has been molested by 'Zapateastas,' the losses due to them have been small.

Receipts from ore, concentrate, and silver, etc., were \$323,517, and profit \$168,195. Results of the past 8 months' operations have been satisfactory. The Company's balance in the bank, and in mineral pending liquidation, amounts to \$140,693 with ore reserves sufficient for four years.

BALAGHAT GOLD MINING COMPANY, LTD.

Balaghat is one of the Indian companies, operating at Kolar, state of Mysore. The report covers the past calendar year. The superintendent, Henry M. A. Cooke, states that at the end of the year there were 1538 employees, of whom 21 were Europeans. Mining was done to a depth of 3300 ft. Development totaled 5498 ft., with an average of 7.33 machine-drills per month. Ore reserves are estimated at 21,886 tons. A promising shoot was opened south on the 3175-ft. level. The 30-stamp mill crushed 42,700 tons of ore yielding 12,789 fine oz., with 81.14% recovery. The cyanide plant treated 38,436

tons of current and 57,816 tons of old tailing for 3075 fine oz., with 47.5 and 40.5% recovery respectively. The heads and tailing assayed \$1.60 and \$1.32, and 80c. and 32c. respectively. The gold realized £67,103, and £1,552,499 to date. The profit for 1913 was £2348. Cash assets over liabilities amount to £30,458.

EASTERN SMELTING COMPANY, LIMITED

The Company was registered July 20, 1911, to acquire as a going concern, from January 1, 1911, the business of a company of the same name, carrying on the work of smelting in Penang and elsewhere in the Federated Malay States. The undertaking comprises tin-smelting works and other property, also agencies at Kuala Lumpur, Seremban, and Sungai Besi. The year ended August 31, 1913, shows a profit of £25,893, which, together with £8217, the balance of the appropriation account remaining from last year, makes a total of £33,910. The interim dividend on the preferred ordinary shares absorbed £2500, and out of the balance of £25,745, £2500 was paid in respect of the final dividend on the preferred ordinary shares. Smelting operations were seriously affected by the retirement of the works manager, when reorganization was in progress. Although the balance of unappropriated profits, after the payment of the full preference dividend of 10%, will amount to £23,245, no dividend will be declared on the ordinary shares. Expenditure on a new plant, designed to secure a higher extraction of metal from the ores, is contemplated.

NORTH BUTTE MINING COMPANY

The report of the North Butte Mining Co. for the year ended December 31, 1913, contains the following information: The Granite Mountain shaft was sunk 779 ft. and stations were cut at 2200 and 2400 ft. Drilling was done at 2000, 2200, 2400, and 2600 ft. on the Adirondack vein. On the first level mentioned, the east and west drifts have opened 235 and 300 ft. of ore 30 in. wide, assaying 8 and 7% copper, and 8 and 7 oz. silver per ton. At 2200 ft., the west drift has opened a further 90 ft. of ore, while at 2400 ft. this drift developed an additional 300 ft. of 4.5% copper ore, 10 ft. wide. The 2600-ft. level has not reached this large shoot yet, but the drift for 170 ft. has opened 3 ft. of 3.5% ore. Development on the Edith May, Jessie, South Gem, South Croesus, and Snowball veins was generally satisfactory. There was a fair amount of faulting at 2000 ft. on the last-named vein. Results were as follows:

Employees	880
Ore sent to smelter, wet tons	462,799
Precipitate, wet tons	71
Copper, pounds	28,318,321
Silver, ounces	1,602,163
Gold, ounces	1,567
Revenue	\$5,182,674
Net earnings	1,437,777
Dividends	820,000
Surplus at end of 1913	3,418,556
Cost per pound of copper, cents	9.76

WHIM WELL COPPER MINES, LTD.

The Company operates a copper mine on Balla Balla creek, West Pilbarra district, Western Australia. During the year ended March 31, 1913, the ore produced was 17,123 tons, averaging about 8.5% copper. Of this amount, 3168 tons averaging 18% was shipped to England in bags by steamer, and 4682 tons of ore assaying 11.25% was exported in sailing vessels; the total ore shipments for the year being 7850 tons averaging 14%, worth about £80,708. The average price obtained was £73 8s. 9d. per ton of best selected copper. The gross tonnage of ore exported was lower than in the previous year, due largely to a hurricane in Febru-

art, 1912, which disorganized the shipping arrangements for some months. On March 31, 1913, the ore on dumps was 100,000 tons of 4.5%. There was developed and available in the mine about 100,000 tons of 5% ore, while the probable ore above water-level exceeds 1,000,000 tons of the same average. A Murex magnetic plant has been installed and is now in operation. The net profits for the year amounted to £20,175, which added to the last year's balance of £9714, after providing for the dividend of 5% paid July 8, 1912, and the mine manager's commission gave a total available balance of £29,889. Of this the directors have written off £9761, leaving a net amount carried forward of £20,127.

IVANHOE GOLD CORPORATION, LIMITED.

On a capital of 200,000 shares of £5 each, this Kalgoorlie company has paid £2,250,000 in dividends to April, 1914, or £10 5s. per share. Since 1897 to the end of 1913, the year covered by this report, the output was 2,762,166 tons of ore yielding 1,757,883 fine oz. gold worth £7,494,844. The sum of £950,582 has been spent on mine development and equipment to date, of which the former accounted for £529,838. The Com-



VIEW OF SURFACE EQUIPMENT AT IVANHOE MINE.

pany has investments worth £184,203 in 44 different stocks scattered throughout the world.

During 1913, mine development amounted to 3728 ft., including sinking the main shaft 199 ft. to 2953 ft. Development cost 56c. per ton, according to the report of the general manager, R. B. Nicolson. A geological report on the East lode and the influence of a porphyry dike between 3028 and 3200 ft. depth, will be published in another issue of this journal. Ore reserves in four lodes total 991,417 tons averaging \$9.24 per ton, of which 738,365 tons are in the East lode. The estimates show a decrease of 89,433 tons and 50c. per ton compared with 1912. Mining costs were \$3.61 per ton.

The 100-stamp mill, sand leaching, slime filter-pressing, and concentrate plant treated 239,314 tons of ore, 104,292 tons of sand, 111,563 tons of slime, and 23,459 tons of concentrate, yielding 106,683 oz. gold and 22,071 oz. silver worth £455,519. The recovery was 88.77% at a cost of \$2.16 per ton. Filter-pressing costs were 14c. per ton of ore treated.

ANACONDA COPPER MINING COMPANY

The holdings of this great Company in Montana are too well known to require much comment, and results for 1913 are best tabulated as follows:

Development in all mines, miles	35.3
Ore mined, tons	4,644,201
Ore treated in Washoe plant, tons	4,016,689
Ore treated in Great Falls plant, tons	1,170,150
Custom ore included in the above, tons	619,864
Precipitates, etc., smelted, tons	7,767
Metal production from all ores:	
Copper pounds (Company's share, 241,983,323) ..	270,301,644
Gold, ounces (Company's share, 64,898)	64,898
Silver, ounces (Company's share, 8,719,132)	10,321,296

Coal mined at Belt and Washoe, Montana; Diamondville, Wyoming, tons	736,231
Sawmill output, board feet	87,780,763
Lumber purchased, board feet	49,934,678
Lumber sold, board feet	63,515,212
Butte, Anaconda & Pacific Railway operation:	
Ore carried, tons	5,842,944
Passengers	304,138
Net income	\$232,421
Financial:	
Revenue from copper, gold, and silver	\$ 44,003,473
Metals on hand at end of 1913	16,173,788
Other revenue	1,084,494

Total revenue	\$ 61,258,755
Revenue in 1912	\$ 67,262,041
Metals on hand at beginning of 1913	\$ 14,895,384
Mining expenses	18,457,559
Treatment expenses	8,709,580
Depreciation (\$727,350) and other expenses	4,470,276
Balance for dividends	\$ 11,323,498
Dividends paid	12,997,500
Deficit	1,674,002
Previous surplus	8,695,172
Final surplus	7,021,170
Net assets	\$108,312,500

The reduction in output was due to bad weather in January and February, and a stoppage of 11 days to clean out the main flue of the Washoe plant. Development generally in the mines was satisfactory. There was a marked improvement on the 2400-ft. level of the Anaconda, and a large vein was opened to 3000 ft. in the Original mine.

COPPER RANGE CONSOLIDATED COMPANY.

This Michigan company controls the Baltic, Champion, and Trimountain mines, and the report is for the year ended December 31, 1913. Like all other properties in the Houghton district, the strike of last July affected operations considerably. Results from individual mines are as follows:

	Baltic.	Champion.	Tri-mountain.
'Rock' stamped, tons	333,289	421,849	229,149
'Mineral' produced, pounds	13,282,825	19,251,470	8,546,070
Refined copper, pounds	7,736,124	12,080,594	4,990,938
Revenue from copper, etc.	\$1,152,026	\$1,802,530	\$746,529
Total profit	230,211	504,767	113,363
Dividends	200,000	900,000	200,000
Surplus at end of 1913	\$336,317	\$548,643	\$444,757
Cost per pound of copper, cents	11.91	10.71	12.62

The Copper Range railroad had a revenue of \$575,065, and after paying expenses, taxes, bond interest, etc., there was a deficit of \$17,046, but the final surplus for the year amounted to \$425,781, there being \$465,548 brought forward from 1912.

The Copper Range Consolidated report is summarized as follows:

	1913.	1912.
'Rock' stamped, tons	984,287	1,784,402
Copper produced, pounds	24,852,026	37,584,647
Total revenue	\$3,707,091	\$6,084,202
Net income	490,533	1,692,566
Dividends paid	1,084,498	788,428
Deficit	593,965	
Surplus		904,138

The decreased results were due to the strike mentioned, and the lower price received for copper, namely 14.89 and 16.16c. per pound for 1913 and 1912. Development totaled 19,489 ft. in all the mines. New drilling machines were installed with satisfactory results. Work on the new power and regrinding equipment was continued, costing \$230,835 and \$290,000 to the end of 1913.

Recent Publications

CONSTITUTION AND BY-LAWS OF NEVADA INDUSTRIAL SAFETY ASSOCIATION. P. 27. Reno, Nevada. The work of this association has been noted from time to time in this journal.

RADIUM AND ITS ORES. By R. A. A. Johnston. Press bulletin 13 of Geological Survey of Canada. Ottawa, April 1914. Describing history of the metal and discoveries in Canada.

PRODUCTION OF LEAD IN THE UNITED STATES, 1913. By C. E. Schenthal. P. 5. U. S. Geological Survey. Washington, 1914. The total output of this metal last year was 436,430 tons from domestic ores.

EFFECTS OF DEFOLIATION AND THE APPLICATION OF NITRATES ON THE COMPOSITION OF THE SUGAR BEET. By William P. Headen. Proceedings of Colorado Scientific Society. P. 14. Denver, March 1914.

WATER-POWER ON PUBLIC LANDS. Speech in U. S. Senate by Hon. Wesley L. Jones, March 5, 1914. P. 12. Washington, 1914. An interesting resumé of the power available, and to what use it could be put.

FEEL BRIQUETTING IN 1913. By Edward W. Parker. Advance chapter from 'Mineral Resources of the United States, 1913.' P. 5. U. S. Geological Survey. Washington, 1914. This was quoted in this journal of May 9.

ESTADÍSTICA MINERA EN 1912. By Carlos P. Jimenez. Boletín 80. P. 125. Cuerpo de Ingenieros de Minas del Peru, Lima, Peru, 1914. Statistics are given of the mineral production of this South American republic in 1912.

OIL, GAS, POTASSIUM, PHOSPHATE, AND COAL. A bill to authorize exploration for and disposition of these minerals. Hearing before the Committee on Public Lands, House of Representatives. P. 391. Washington, D. C., 1914. This was discussed in this journal of May 16.

THE OIL FIELDS OF CRAWFORD AND LAWRENCE COUNTIES, ILLINOIS. By Raymond S. Blatchley. Bulletin 22. P. 442. Ill., charts, 11 maps, index. Urbana, 1913. Everything connected with these important oil-producing areas is described by the author, who spent about three years in the investigations.

Wyoming State Geologist's Office, Cheyenne, 1914:

ATLANTIC CITY GOLD MINING DISTRICT, FREMONT COUNTY. By L. W. Trumbull. Bulletin 7. P. 30. Ill., maps. Details will be given in the news department of this journal.

SALT CREEK OIL FIELDS, NATRONA COUNTY. By L. W. Trumbull. Bulletin 8. P. 46. Maps. This is an important oil district, there being 19 operating companies. Casper is the centre for the area.

GEOLOGY OF THE AROHA SUBDIVISION, HAURAKI, AUCKLAND. By J. Henderson and J. A. Bartrum. Bulletin 16. P. 127. Ill., maps, charts, index. Geological Survey, Wellington, New Zealand, 1913. The area described contains about 662 square miles, of which 250 square miles is hilly. The mineral wealth is considerable, Karangahake being the active centre. A large quantity of timber is being cut. The principal wealth of the district is in its wide pasture lands. The rainfall varies from 55.75 to 83.06 inches in different parts, and the temperature averages 58.4°F. To the end of 1911 mines at Karangahake had produced bullion worth £2,594,822 from 890,809 tons of ore. Those at Te Aroha had yielded £116,646 from 55,572 tons. The highest peak is 3126 ft. above sea-level, and a prominent point at Karangahake is 1775 ft. high. There are several large rivers flowing through the subdivision. Rocks are andesite, dacite, and rhyolite, and quartz forms the principal gangue of the ores. Lodes have been faulted in many places, and decrease in number and size with depth.

Decisions Relating to Mining

CANCELLATION OF PATENTS—NO DISCOVERY

In a suit brought by the federal government to set aside certain placer patents of land adjoining the junction of the Noplen and Columbia rivers, it was held that evidence showing that the only discovery of gold ever made on the lands had been merely a few fine traces such as occur all along the Columbia river, and that the real economic value of the lands in question lay in their power-site possibilities, was sufficient to justify a decree canceling the patents to the same as having been obtained through misrepresentation and fraud.

Multonomah M. M. & D. Co. v. United States (Washington) 211 Federal, 100, January 5, 1914.

CONDEMNATION FOR MINING PURPOSES

The Goldfield Consolidated Milling & Transportation Co. has been awarded a condemnation decree by the Nevada District Court, entitling it to take the title in fee to the surface of certain adjacent claims owned by the Old Sandstorm Annex Gold Mining Co. and others, for the purpose of storing and treating tailings from the plaintiff's mill. Storage and treatment of tailing was held to be a 'mining purpose' which constitutes a public use under the laws of Nevada. Held also that merely the surface of said lands could be taken and paid for under such proceedings as distinct from the sub-surface mineral rights.

Goldfield Con. Milling & Transportation Co. v. Old Sandstorm Annex Gold Mining Co. (unreported). District Court of Nevada (Esmeralda county), March 16, 1914.

LODE LOCATIONS—VOID AS TO EXCESS—LIMITATIONS

An interesting decision has just been rendered by Judge Farrington, sitting in the United States District Court of Nevada, in the controversy which arose out of conflicting locations in Copper cañon, Lander county, Nevada. The liquidators of the Glasgow & Western Exploration Co., who were complainants in the quiet title suit, relied upon lode locations covering the ground in controversy designated as the Salt Lake No. 3, Evening Star, and Midas lode claims. Six years subsequent to the date of the last lode location the defendants who were prospectors covered the identical ground with placer locations. Suit was brought by the owners of the lode claims to quiet title, and the defendants set up a defense that the west side lines of the lode claims were more than three hundred feet from the centre line of the vein. This fact was not substantially controverted, but the lode owners claimed that the statute of limitations barred the defense. There was also a dispute as to the validity of the lode discovery, although the court held that a preponderance of the evidence sustained the complainant's claim. The rulings of law were as follows:

1. It has never been held that in order to constitute a valid location commercial ore must be discovered; a discovery of mineral rock in placer is sufficient.

2. The lode claims were void as to the excess over 300 ft. on the west side of the centre line of the vein. The excess amounting to as much as 200 ft. in some placers, there could be no question of a bona fide mistake in determining the position of the apex such as induced the court to allow the excess in the case of *Harper v. Hill*, 113 Pacific, 163.

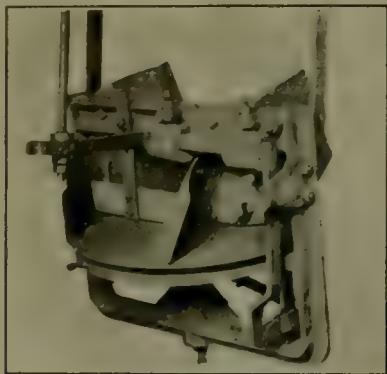
3. The statute of limitations did not apply as to the excess. Decrees were ordered in accordance with the foregoing opinion. It is probable that an appeal will be taken.

Lamont v. Davis et al.—cases A-19 and A-20, U. S. District Court for Nevada.

Industrial Progress

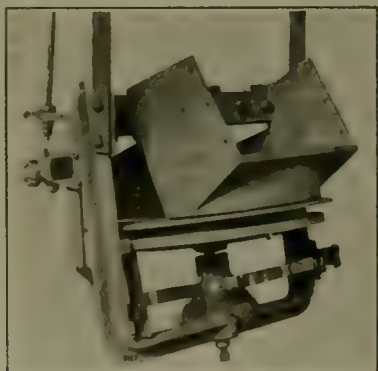
New Ore Feeder

The Denver Engineering Works Co., which supplies the material for the following description, is selling a new ore feeder of the 'Monkey Wrench' type illustrated in the accompanying figures. This feeder retains the revolving disk and stationary plows of the well known Challenge type, but the number of parts is greatly reduced and the wearing parts are such that they can be made by any good blacksmith. There are no gears, cams, clutches, pawls and ratchets, shoes, deli-



FRONT VIEW OF FEEDER.

cate springs, or other such troublesome parts. Each piece of the actuating mechanism is of most rugged construction and only one heavy spring is used. The money-wrench type of grip gets its name from its similarity to the monkey wrench when applied to the rim of a pulley for the purpose of forcibly moving it. This grip, applied on the edge of a secondary disk below the main disk of the feeder, is shaped like the open jaws of a monkey wrench. When pushed in one direction by the action of the falling tappet the jaws clamp on the disk



BACK VIEW OF FEEDER.

and carry it around. When pushed in the opposite direction by the spring, the jaws slide along the edge of the disk instead of clamping and are then in position for the next movement to carry the disk around again.

The tappet arm, shaft, and depending lever which actuate the grip are forged from one piece of carbon steel. The shaft

is carried in two bearings with adjustable caps. The hand screw adjusting the range of grip movement has a heavy four-winged check nut which may be set with a hammer. The feeder disk has a renewable steel wearing plate and the feeder disk shaft is adjustable vertically by a set-screw at its lower end. The gate is adjustable in the usual manner. The feeder hopper is open at the back with bolt or rivet holes suitably placed along the edges for connecting to the sheet steel or wooden chute from the ore-bin. The shipping weight is 1050 lb. and the heaviest single piece weighs 200 pounds.

The announcement is made that the United States Steel Corporation and its subsidiary companies propose to have a comprehensive exhibit of its operations at the Panama-Pacific Exposition in San Francisco in the year 1915. It will begin with mining and include rail and water transportation, dock operations, coal, coke, and pig iron production, and steel manufacturing in its various lines. It will also present the processes of manufacturing of many of its subsidiary companies' products (such as the National Tube Company), also the many by-products. There will be displayed the uses in which its general products are employed, typifying the advancement in the uses of this country's resources. In addition to the material exhibits the Corporation intends to exhibit in a comprehensive manner, by moving pictures, its operations throughout all departments showing the ramifications of the processes of the corporation's operations. It is also proposed to set forth to the world the work which the United States Steel Corporation has done toward the social welfare of its employees and those depending upon them. Also it will exhibit many forms of safety devices that have been conceived by the corporation officials and its employees.

At the annual meeting of the stockholders of the JOSEPH DIXON CRUCIBLE Co., held at Jersey City, N. J., on Monday, April 20, 1914, the retiring board of directors, consisting of Geo. T. Smith, William Murray, George E. Long, Edward L. Young, William G. Bumsted, J. H. Schermerhorn, and Harry Dailey, were unanimously re-elected. The meeting was attended by a large number of stockholders who expressed satisfaction with the present management and recorded the largest vote ever represented at an annual election, 9628 out of a possible 10,000 shares being represented. The officers of the Company were also re-elected.

The DODGE MANUFACTURING Co. has opened southwestern sales and engineering offices at Dallas, Texas, and a sales and engineering office at Grand Rapids, Michigan. J. H. Drapier of the general sales department, Mishawaka, has been made manager of the Dallas office, and Oscar W. Gregg, late of the Gilbert Pulley Co., representative at Grand Rapids. A short time ago the Company opened an office at Indianapolis in charge of E. M. Carver.

'Mine and Quarry' for April, issued by SULLIVAN MACHINERY Co., is at hand, and as usual is replete with interesting matter. The drill boat *Burrard*, now in use at Vancouver harbor, B. C., is described.

'Leschen's Hercules' for May, issued by A. LESCHEN & SONS ROPE Co., St. Louis, Missouri, has for its leading article a description of a method of handling stone in a quarry by wire rope.

WM. POWELL Co. is distributing a circular on the new Powell extra heavy iron body, straightway 'Y' blow-off valve, and a booklet describing the Powell Union composite disc valve.

ELSPASS ENGINEERING & MINING MACHINERY Co., Denver, has issued a catalogue on the New Principle Chilean mill.

CHICAGO PNEUMATIC TOOL Co.'s Bulletin No. 172 gives details concerning the No. 5 Chicago Plug and Feather drill.

"Science has no enemy save the ignorant."

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EDITORIAL

A ZOLOTNIK per cubic sagene does not mean much to the average English-speaking engineer. We are, therefore, glad to present in the current issue a translation from the Russian by Mr. William H. Shockey of the gold and platinum dredging production of Russia for 1912.

NATOMAS CONSOLIDATED report for 1913 shows the working profit from dredging operations alone to have been \$992,366. The interest on bonds and miscellaneous losses, however, make the actual profit to the Company only \$107,840. The dredging profit for the year was previously estimated at \$1,350,000, and that it did not reach this amount was largely the result of high cost of production, this cost increasing from 4.463 cents in 1912, to 5.354 cents in 1913. In that negotiations are pending for re-financing Natomas, the report is of special interest at this time.

COMMITTEE ON MINES AND MINING of the House of Representatives has recently reported favorably upon a general bill for the establishment of ten mining experiment stations and fifteen mine safety stations. The bill has the hearty support of the Bureau of Mines, and it is believed that it will become a law by the first of next year. In a report on the bill by chairman of the Committee on Mines and Mining of the House of Representatives, it is stated that Congress is now appropriating \$28,000,000 annually for agricultural advancement, and that while the conditions underlying agricultural progress differ as to many details from those associated with mining, the broad general principles of progress are the same. The favorable response to the national aid for agriculture is itself an evidence of the result which can be depended upon if similar aid is extended to mining.

NEW MINING REGULATIONS of China present many interesting features, chief among which may be mentioned the provision which permits foreigners to hold one-half the total number of shares in a mining company. With characteristic Chinese indirection, the Minister of Industry has publicly stated that foreigners may provide whatever portion of the capital is necessary if the Chinese fail to subscribe their part. This would provide for the control of mining companies by the foreign interests, which is a pre-

requisite to securing foreign investment in Chinese mines. The great difficulty in the development of Chinese mines has been the bad administration of the Chinese in control, and it is only by foreign methods of business administration that mining enterprises can be successful in China. With the present personnel of the Ministry of Commerce and Industry and the Mining Bureau, it is scarcely probable that foreign companies will invest money in enterprises which are to be strictly supervised and regulated by these officials.

MOOORE FILTER COMPANY of New York has commenced suit in the United States District Court of Delaware against the Tonopah Mining Company of Nevada and the Montana Tonopah Mines Company for an injunction restraining these Companies from using the Butters filter process and also for an accounting of damages. This suit comes as a sequel to that brought against the Tonopah-Belmont Company for an infringement of the patent rights in respect to the same filter process and was decided against the Belmont company in the U. S. Court of Appeals in November 1912. Since this decision this Company, together with the Tonopah Mining Company, Tonopah Extension, West End, Mac-Namara, and the Montana Tonopah have modified and are changing the filter processes used in order to avoid all possibility of future litigation. In that changes have been made in the filter processes used, it is believed at Tonopah that the granting of injunctions will not interfere with the operation of the mills involved. When the mining laws have been revised and disposed of by Congress in a manner which will reduce the number of legal entanglements, it would seem that a revision of the patent laws and methods would be in order.

OUR attention has been called to an error in the article on 'Tin Mining in Bolivia,' written by Mr. G. W. Wepfer and printed by us February 7. In it the Compañía Estañífera de Llallagua is credited with an annual production that in fact about equals the present monthly output. In 1913 this Company produced 114,938 quintals of 65 per cent tin concentrate. In March 1914 the output was 12,000 quintals, and it is expected that by the end of the year 15,000 quintals will be produced per month. This makes the mine one of the most important tin-lode mines in the world. The value of the annual output is approximately \$3,000,000, and it is a matter of pride that the excellent technical work being accomplished is under men educated in the United States. In addition to the two large veins mentioned by Mr. Wepfer, others, some of which do not outcrop, are now mined, so that in all there are workings on 14 veins. The same veins are worked by the Compañía de Uncia of St. Simón I. Patiño and there is now threat of litigation over the ownership of certain of the orebodies. We are also informed that there is now no agreement with the Bank of England as to exchange on Bolivianos.

Bering River Coal

The report of the Bureau of Mines on the coal resources of Alaska and their possible use by the United States Navy has recently been referred to the Committee on Naval Affairs by the Secretary of the Navy. While the report is of a negative nature as to the use of this coal by the Navy, the thoroughness of the work is to be commended and the results obtained are invaluable as a compendium of information on the fuel value of the visible Alaska coal measures.

The requirements of navy coal, as specified to the examining engineers and geologists, were that the coal should have a fair proportion of lump, free from slate, and low in sulphur; with volatile matter not lower than 12 nor higher than 22 per cent, and preferably between 14 and 18 per cent; with not more than 8 per cent ash and with high fixed carbon and heating value of above 14,000 B.t.u. After preliminary explorations, the engineers in charge agreed that the most likely deposits were those on Trout creek, Carbon creek, and the east slope of Kushtaka ridge, of which that on Trout creek, known as the Tenino claim of the Cunningham group, was selected as being the most promising. From the three most promising beds, 850 tons was mined, sacked, and subsequently transported to tidewater, and placed on board the U. S. S. *Maryland*. Fifty tons was reserved for shipment to the engineering experiment station at Annapolis, while the balance was consumed in steaming tests on board the *Maryland*.

The coal was tested in comparison with Pocahontas coal and resulted in the conclusion that full speed cannot be maintained with Bering river coal; the quantity of ash and clinker produced, and constant clinking, throws such excess work upon the men as to make impossible even moderate speed except for a short period; the coal, however, is far superior to Pocahontas in smokeless qualities, but cannot compare with Pocahontas in efficiency. It is therefore recommended that Bering river run-of-mine coal is unsuitable for use with forced draft in naval boilers.

The coal tested at the engineering experiment station of the Naval Academy at Annapolis was screened and washed to represent the best grade that can be expected from the Bering River fields. This reduced the ash content from 14.06 per cent to 5.42 in the dry coal, causing a loss of 48.59 per cent of the fuel as mined. The evaporation was 5.04 pounds of water from and at 212°F. per square foot of water heating surface, and a combustion of 19.11 pounds of dry coal per square foot of grate surface per hour. The cost of preparation on a large scale would be \$6.34 per ton of cleaned coal. These results show even the cleaned coal to be of inferior grade and unable to compete with Eastern bituminous coals when shipped to the west coast. It is therefore to be concluded that the Bering river coal is unavailable as a source of coal for the Navy until extensive general development shall find a coal not possessing the serious objections

found in the samples tested by the department. While the result of the investigation has shown the visible coal to be unsuited for use in the Navy, it is not unlikely that future exploration will reveal deposits which will be available for this use and also that the coal in sight will find a commercial use in the industries of the future.

Radium

Radium has within the past year been the subject of a great deal of comment and the amount of mis-information regarding the nature and therapeutic value of this element is far in excess of what has actually been proved regarding it. The medical fraternity is hopeful that radium salts will be demonstrated to be beneficial if not a cure for certain malignant growths; but the real value in this respect has by no means been determined. The proposed radium bill, discussed in our issue of April 11, now appears to be doomed, and interest taken by the Government toward the conservation and investigation of this element have tended toward an exaggerated publicity of all phases of the subject. The nature and origin of the element is exceedingly hazy in the minds of most people and we are therefore glad to publish an article by Mr. C. T. Kennan on 'Radium and its Sources' in this issue.

Radio-activity belongs to the field of higher physics and physical chemistry and it is, therefore, difficult for one wholly unfamiliar with these subjects to understand the rudiments of radium-therapy. The subject dates back to 1901, but is still in its infancy and those interested will find 'Radium-therapy' by L. Wickham and P. Degrais, translated by S. Dore, to be both interesting and instructive. Although our present knowledge of its physiological action is extremely limited, it is believed by many who have made a special study of the element to be the most valuable agent that we possess. Harvard University is at present conducting an investigation of the radium therapy, and while a very conservative view is being taken by the commission of this University, it is planned to pursue the investigation indefinitely with the hope of eventually determining just what radium and its derivatives can do.

The radio-activity, to which the element owes its value, is a property possessed by some forms of matter, which is due to a process of spontaneous atomic disintegration. Most forms of radio-active matter are characterized by the sending out of rays, which are of three types. The alpha rays are easily absorbed and are positively charged with helium atoms which are emanated from the disintegrating atoms with great velocity. The beta rays are more penetrating and consist of negative electrons (particles 1700 times smaller in mass than the hydrogen atoms) and move with a velocity about that of light; and the gamma rays, whose emanation is a very penetrating form of radiation analogous to the Röntgen rays. The final radio-active forms of matter resulting from the decay products of the uranium, actinium, and thorium series are not definitely

known, although, according to Mr. C. H. Viol, lead would seem to be the end product in the uranium-radium series and bismuth has been suggested as the end product in the thorium series.

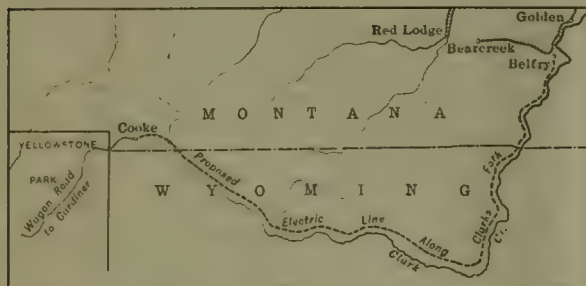
The measurement of radio-activity may be made in several ways, as the effect of the rays on a covered photographic plate, the measurement of the heat emission, by counting the alpha rays while observing the scintillations which these rays produce when they impinge upon willemitite, or diamond screens. Electric methods, however, such as the electroscope are usually employed for this purpose. When a radium salt has been kept sealed for a month, the maximum amount of emanation and active deposit has been accumulated and the gamma ray activity, which is the ray of therapeutic value, reaches a maximum. The rate of decline of the radio-activity is almost unappreciable and the radio-active life of the element has been estimated at 4000 years. Until recently a milligram of pure radium bromide, which contains 53.6 per cent radium element, has been the standard of measurement for radium salts. The Committee for an International Radium Standard has defined the 'curie' as the quantity of radium emanation in equilibrium with one gram of radium element, which standard has met the approval of the scientific world and is now accepted.

Only those minerals and ores which contain uranium contain radium, and these ores are found in commercial quantities in the United States in Utah and southwestern Colorado. The great part of this ore is the brilliant yellow uranium mineral, carnotite. But little pitchblende is produced in this country, the sole output being from Gilpin county, Colorado. The world's annual production of radium was estimated a short time ago at nine grams, about one-third of an ounce, and of this amount six grams are produced by the Standard Chemical Company of Pittsburgh. With recent enlargements of the laboratories of this Company and scope of operations it is expected materially to increase this output. The question arises, however, as to whether the mines will be able to deliver to Mr. Flannery and his associates, a continuous supply of carnotite to produce such an output. In that the percentage of radium in the ore mined is about that of gold in sea-water the reduction presents interesting problems, which the Bureau of Mines is now investigating. The work of the 'radium trust' is being largely conducted behind locked doors at present and no information as to the concentration and refining is available from this source. The work of the Bureau toward disseminating knowledge and information on this subject is most commendable and whether the Government does or does not exercise the control over the output of radium ore in this country, the Bureau of Mines investigation is producing results and we trust that the work along this line will be continued on a still larger scale in the future. Radium is at least worth investigating in the interest of humanity, and if results are near what is anticipated by many, a great good will be effected.

New World Mining District

By E. D. GARDNER

The New World, or, as more commonly called, the Cooke City mining district, is situated in Park county, Montana, in unsurveyed townships 14 and 15 east, range 9 south, at the headwaters of the Stillwater and the Clark's Fork of the Yellowstone rivers. It adjoins the northeast corner of the Yellowstone National Park, and is in the Beartooth National Forest. Min-



SOUTHWEST MONTANA, SHOWING POSITION OF NEW WORLD DISTRICT.

eral has been found in an area about eight miles north and south by six miles east and west.

Cooke City, the only settlement, is in the southern part of the district, and is reached by a wagon road from the Northern Pacific railway at Gardiner, Montana, about 65 miles distant. Approximately 62 miles of this road is within the Yellowstone National Park and was built and is still kept in repair by the federal government. The road is splendidly laid out and constructed, the grades being easy, and the streams well bridged. The first 25 miles, or so, of the road, which is a part of the general park tourist route, is very well kept up, but the other end has been allowed to get in a bad state of disrepair. It is, however, far better than most mountain roads of similar character. In the summer time the stage easily makes the trip to Cooke City from Gardiner in 12 or 13 hours.

The elevation of the New World mining district ranges from 7500 and 7700 ft. above sea-level at Cooke City to 12,000 ft. at the top of some of the peaks. The rocks in the lower levels of the cañons are generally concealed from observation by a mantle of boulders and soil. The rocks at the higher elevations on the mountainside are well exposed, and in many places outcrop in bold cliffs. The whole country has been glaciated, and there are evidences of terminal moraines throughout the region. On the sides of the higher peaks the moraines are comparatively recent and consist mainly of huge boulders. There are several live glaciers now in the district, one of which, notably the Grasshopper, has more than local interest. This glacier, which is about one mile long and one-half mile wide, has proved mainly of interest from the fact that many grasshoppers are found embedded in the ice.

A large number of mineral prospects have been located above timber line in this region. In an effort to develop the mineral outcroppings beneath the surface, adits, whose portals are in banks of perpetual snow, have been driven into the sides of the mountains. Lands lying below an elevation of 8300 or 8400 ft. for the most part support a stand of merchantable timber. According to estimates recently made by the National Forest Service, there are twenty-five to thirty million feet of saw timber available for the needs of the mining industry, consisting of Engelmann spruce and Douglas fir. In addition to this, there is a large amount of lodgepole pine suitable only for stulls or fuel.

The summer season is short and very pleasant, although water may freeze any night. The winter snows are very heavy, and in ordinary years lie to a depth of about 6 ft. on the level in Cooke City, and deeper as the elevation increases. The only means of travel in the winter is on snow shoes, except on the public road leading to Gardiner, which is kept in passable condition by the mail stage. Snow falls in early October and lies on the ground well into May. In the spring break-up, during the last of May, the district is practically isolated for a couple of weeks. The only means of communication with the outer world during this period is through the Forest Service telephone line and a dog sled which brings in the mail. Trails and wagon roads from Cooke City lead to the outlying mines or prospects, and all parts of the district are fairly accessible.

Cooke City District

The region about Cooke City is one of the most rugged and picturesque in the United States, and its scenic beauty is rivaled in but few places. The innumerable mountain lakes, gorges, waterfalls, and other works of nature, are well worth further notice. Eastward from the confines of the mining district there is a vast country of which little is known, and which has even greater scenic beauty. But few men have overcome the barriers and withstood the hardships necessary to penetrate this region. These returning prospectors and explorers report an absence of large mineral showings, and tell of a wilderness of high mountain peaks, mountain gorges, ice fields, wonderful ice caves, forests, and many other interesting features. The hunting and fishing in the entire region is good, and, in the event of a railroad being built into the district, it will be justly famous as a summer resort.

Horn Miller, Pike Moore, and Pat O'Hara, trappers and prospectors, in the year 1871 explored the country in and adjacent to what is now the New World mining district, which was then in the Crow Indian Reservation. In some of the gulches, near what is now Cooke City, they found evidence of placer gold and staked

out and worked, in a small way, several claims. One of the first locations is still being worked by Horn Miller, although the production of placer gold in the camp has never been important. The discovery of gold, as a matter of course, brought in more men, and it was but a short time until lead-silver, gold, and copper deposits were discovered in the mountains. The high cost of getting ore to the railroad has seriously retarded the development of the district from the beginning. The miners have been periodically encouraged by railroad surveys into the district, but none of these have ever materialized into a railroad, and cheaper transportation is no nearer than it was 20 years ago.

Several attempts have been made to smelt ore on the ground, but with little success. In 1877, before a wagon road had been built, a small blast-furnace was constructed at Cooke City, and about 60 tons of bullion was smelted, by using charcoal, made nearby, as fuel. The ore was produced at the Republic, Shoo Fly, and Elkhorn mines. The bullion remained in the furnace

use. In addition, they cut up and carried away all leather belting found at the smelter, and took whatever else was detachable. Not much more was done in the way of mining until the district was eliminated from the Indian Reservation and opened for entry in



THE DISCOVERERS OF THE COOKE MINING DISTRICT, HORN MILLER AND CHARLES CONNON, AT THE GRACE MINE.

until a raiding party of the Nezperce Indians, which was being chased by General Howard during the Nezperce war, carried part of it away to make bullets to use against the soldiers. The Indians were also resourceful enough to cache the remainder for future



FALLS ON THE UPPER CLARKSFORK.

1882. The surface, however, had been previously well prospected. At this time there was a rush to the district, and all of the old mineral claims were necessarily re-located, and hundreds of new ones staked out. After the rush to the district considerable work was done, but very little ore was found rich enough to stand the cost of transportation to the railroad. Since then, however, small shipments of high-grade ore have been made from time to time from various mines in the district to outside smelters. A second attempt at smelting was made in 1883, when the Republic company built a small blast-furnace at the mine, which was run at intervals up to 1910. The main production of this Company, however, was before 1886. Previous to that time, 420 tons of bullion had been smelted and hauled by wagon to the railroad station at Cinnabar, which was then the terminus of the Park branch of the Northern Pacific railway. At the smelter coke was used as fuel, and was brought in by wagon.

A copper blast-furnace, which made two short runs, was erected in 1906 by the Cooke City Smelting Co.

One of the runs was made in 1906 and the other in 1910. The operation of the smelter during these periods evidently was not successful. Since there are now about three railroad cars of coke and 100 tons or so of ore in the smelter bins at this time, presumably some cause, in addition to the high cost of transportation, is responsible for the discontinuance of the operations of the plant. Another attempt at smelting on the ground was made in the early eighties, when a Hartfield portable furnace was built on Miller mountain. This furnace, however, did not prove to be a success.

At the end of the first ten years, 450 claims were being actively held out of 1450 which had been previously located. Up to the present time, about 3500 claims have been located: of these about 200 are patented, 200 are still held as locations, and the remainder have been apparently abandoned. Assessment work, however, is not being done each year on every unpatented claim. In order to avoid assessment work, the practice is to locate certain claims from year to year. A large proportion of the locations are being held by old-timers who have more claims than they can properly represent. Most of the best claims have been gathered into groups and patented, and have passed into the hands of mining companies that are controlled by outside capital.

Neither development work, nor production, has progressed steadily at any of the properties. In many instances companies have raised some money, made a spurt with a large force of men, only too often to be as quickly involved in difficulties and forced to shut down. At the present time everything is inactive, awaiting the coming of a railroad, except a few of the smaller properties in the outlying districts which employ a few men occasionally. The population of the district has been fluctuating. It has varied from 1800, as reported one winter when the Republic mine was operating, to 20 or 30 in some of the winters of late years. Ordinarily there are more people at Cooke City in the summer time than in the winter, as many of the regular inhabitants spend the winters elsewhere.

Geology

The geology of the district is interesting, and the good exposures of the formation afford many opportunities to see the geological features. The rocks of the southern part of the district consist of sedimentaries cut by intrusives. In the northern part the country rock is granite. The western portion of the district was covered by the same basic lava flow described by W. H. Weed as covering the greater part of the Yellowstone National Park. The elevation of the mining region existing at the time of the lava flow was higher than the main part of the park, as the streams in this locality have cut through the lava, which is now seen only as cappings on some of the mountains, while in the park the stream beds are in the lava. The whole of the district was covered by the ice field, also described by Mr. Weed as covering the park after the close of the volcanic era. Remnants of this ice field are still

found in the mining district in the shape of small glaciers on some of the higher peaks.

The sedimentary rocks consist mainly of limestone, impure quartzite, and shale, with no individual bed of any great thickness, and generally limited to a few feet. These rocks are metamorphosed at the contact with the larger igneous intrusions. The strata are all quite flat, varying from the horizontal at the northern end of the sedimentaries, to a dip of ten degrees to the southwest at the Republic mountain. The occurrence of the intrusive rocks is quite general, and they are found in various quantities, ranging from dikes 2 ft. in thickness to great masses. Although the formation is cut up by numerous fissures, it is not badly faulted, and the orebodies are generally found in place.

Lead-Silver Ores

The lead-silver ores are found mostly in the limestone, but also occur in the other sedimentary rocks and at the contact of these rocks and porphyry. Copper and gold are found both in granite and porphyry in this locality. The lead ore, at the depths reached in the district, has shown itself to be free from zinc, except in a few instances. Development work is not expensive, as none of the rock is very hard, and all of it stands well without timber, but the workings in the limestone and in some of the porphyry cave after a few years, so as to become inaccessible, if no attention is given them. It is often claimed that the New World mining district has more ore in sight, considering the amount of development work, than any other district in the world. While this is probably an overstatement, the fact remains that there are scores of partly developed low and medium-grade orebodies in the district. Both oxide and sulphide ores outcrop all over the region, and there are few places in the country where there are as many surface showings of mineral. In the greater number of mines no ore is actually blocked out, as one face of the body seems to satisfy the owners as to the permanency of the ore-shoot and the amount of ore available.

The Republic property has been the most important producer in the district up to the present time. The mine was discovered while the country was still in the Indian Reservation, and was re-located when the Reservation was opened to entry. It is owned by the Buffalo-Montana Mining Co., and is under the management of M. J. Tredinnick. The orebodies occur in a bed of limestone about 150 ft. thick, which overlies shale. The main development work consists of two adits, 300 and 500 ft. long respectively, driven on the vein. Several ore-shoots have been developed that assay well in silver and lead, but not high enough to warrant the 65-mile wagon haul. Some high-grade ore has been found, but it is reported that the ore will average about 50 oz. silver and 10 to 15% lead. The ore not being rich enough to ship direct, a smelter was built in the early days to treat the ore on the ground. This smelter has run intermittently up to the last few years, but no great production has been recorded. It is

now, of course, out of date. It costs \$20 per ton to freight the bullion to the railroad, and the same amount to bring the coke and other supplies to the smelter. Evidently, under the existing handicaps, the Company has not been able to operate the works at a profit. The ore is more or less zincy, which would also have an effect on the operations of the furnace.

The Alice E. is a gold mine on the south side of Henderson mountain, and was located in 1884. The orebody is in a porphyry intrusion, and it is reported that an adit 300 ft. long, and a cross-cut 100 ft. long, are all in ore that will average about \$30 per ton in gold. The workings are now caved. A cyanide mill stands on the property, but never ran any length of time, as the ore is base, and a small percentage of copper was soon encountered.

The Daisy is a lead-silver mine at Daisy Pass. The vein is a fissure in the bedded sedimentaries and in porphyry. The ore is mostly of concentrating grade, although there is a small amount of ore of first class. A small shipment of ore, of a gross value of \$85 per ton, was sent to the smelter in 1896. A mill has been constructed on the property, but ran only about two weeks on some rich ore, after which it was permanently shut down. The mine has been quite extensively developed, and has more than 2000 ft. of workings. The main adit, which has a connection through the mountain, cannot be inspected now, as it is completely filled with ice. As a result of the connection, the ventilation through the adit in the winter has frozen the dripping water, which does not thaw during the summer.

The Copper King is a copper mine situated at Goose Lake, and is operated by the Goose Lake Copper Co., under the supervision of John Martin. The ore consists of high-grade sulphides, and occurs in bunches in a strong persistent fissure vein 17 ft. wide in the granite. The vein is developed by an adit about 350 ft. long, and by a shaft about 100 ft. deep. Thirty-seven tons of ore, which ran 16% copper, was smelted at the Cooke City Smelting Co.'s plant in 1910. Some work is being done each year on the property.

The Scotch Bonnet property consists of 14 claims west of Lulu Pass, at the headwaters of the Clark's Fork river. The country rock is a light colored acid porphyry of varying composition. Several large orebodies have been developed on the group—one of which, on the Spaulding claim, is over 35 ft. wide, with its length not yet determined. It consists of solid pyrite carrying over \$20 in copper, gold, and silver.

Another orebody, on the Lizzie claim, is 167 ft. wide, and consists of milling rock carrying about \$7 per ton in copper, gold, and silver. About 1500 ft. of development work has been done on the group. In this age of copper leaching, it may be interesting to note here a case of natural precipitation of copper. At the base of the hill on the Scotch Bonnet property are found several small springs carrying copper in solution. This water runs into a small peat bog, and the copper is deposited in the peat and vegetable muck in the form of small shot-like particles.

Among other properties in the district in various stages of development are the Seward, Young Bonanza, King and Queen, Yellow Jacket, and Homestake.

Mining in the whole district is now practically at a stand-still. Companies owning the best properties, as stated before, have patented their claims and are sitting back to await the coming of the railroad. Many of their adits are caved, and their shafts are either



COPPER KING MINE AT GOOSE LAKE.

caved or full of water, and it is next to impossible to get a good idea of the ore reserves in the district, without expending a large sum of money. Many of the mines do not even employ a watchman. There is, of course, some work going on, but this is almost entirely in the nature of assessment work on unpatented ground, and done by men who do not have the money to get their claims patented. The assessment work on the whole is done in a very perfunctory manner, and in such a way that a little work goes a long way in representing a claim; but even, at that, more work is done for a hundred dollar assessment here than in most camps in the West. About 30 claims are represented each year by the local residents for outside people. For the last few years the money paid for this work is all that has been put into circulation, and has kept the spark of life in the district. Prospects of a railroad keep interest alive in the district, and many expect ultimately to realize large returns on their investments.

The operators say that enough work has been done to demonstrate that a profit cannot be made without transportation, and there is no need to mine ore and pile it on the dump and wait indefinitely for the road. On the other hand, no doubt a line would have been built into the district long since, if there was enough ore in sight to justify so doing.

The latest railroad project is that of the Eastern Montana Electric Railroad Co., which, within the last year or so, has made a survey for an electric line from Billings, up the Clark's Fork of the Yellowstone river, to Cooke City. Negotiations are now under way with the Department of Agriculture for a right of way across the National Forest, and for permits to construct power plants to furnish electricity to run their trains. A steam railroad is already in operation to Belfry, which is about 55 miles from Cooke City, and on the line of the projected road. The people resident in the mining district have great hopes that this road will be built, and point out that, beside the ore that would be hauled from Cooke City, there is a forest of merchantable timber along the Clark's Fork, a sulphur deposit at Crandall creek, and the Pat O'Hara irrigation project on the creek of that name, which would all be tapped by this line. Another reason for building this road probably as strong as any, is that it will furnish an entrance to the Yellowstone National Park, which, in the hands of a transcontinental road, would be a valuable asset. The real mountain scenery about Cooke City is far superior to any found in the Park, and has the added attraction of the glaciers. The scenery up the Clark's Fork is also better than along any of the branch railroads reaching the Park. All this could be featured, and no doubt if the road is built this entrance would be extensively used. With the advent of automobiles in the Park, the disadvantage of the forty-mile ride to the main tourist route would be materially lessened.

The camp has been comparatively free from litigation, and has been the scene of only a few of the ever-to-be-expected squabbles of stockholders among themselves. It is reported, however, that some of the properties in this district were shut down and never started again for this reason. It may be well to add that there is hardly a mine in Montana that is closed down, but that the inhabitants of the district claim that it is a case of 'big fish eating the little fish,' and that the mine will start up again as soon as the small stockholders have been frozen out. It is seldom admitted that the mine is not operating because it is out of ore, or because it does not pay to work it.

The fact that the owners of the 200 patented claims have elected to patent their ground and then let it lie idle has been the main drawback of late years in securing the much needed railroad. If by some law, work, only enough in amount to keep the workings open, had been required of the mine owners, it would materially help the railroad situation, inasmuch as it would enable examining engineers to see all of the ore that has been opened up in the district instead of that in only a few cases. A law similar to the Australian form, which

calls for a specified amount of labor being performed each year on all claims under penalty of forfeiture, may not be practical in the country as a whole, but it would certainly be a great benefit to this district. The showings are so good in the district that very few claims would have reverted to the Government, had such a law been in force. If one hundred dollars worth of work, the amount required on unpatented claims each year, had been done on each of the 200 patented claims for the last 20 years, the total amount expended would have gone a long way toward proving the size and permanency of the orebodies.

There has been very little wild-cattling in this district, but one company has been active during the last few years along this line. In this case, a man secured the assets of a mining company at a sheriff's sale for \$1700, under an attachment for his salary as president of the Company. He then proceeded to organize a new company, and sold stock on a \$3,000,000 basis. He has reorganized his company several times since, under a more rosy prospectus each time, but it seems that no great amount of stock has been disposed of. What money has been raised has gone to pay his salary and office expenses, and no actual mining work has been done.

Costs at the Nipissing Company

Costs at mines and mills are generally calculated on a per ton basis, but at Cobalt, Ontario, the silver mining companies publish them on this and also on a per ounce basis. The last report of the Nipissing Mines Co. shows the following costs, based on a production of 77,240 tons milled and 4,552,172.59 ounces:

	Per ton ore.	Per oz. silver.
Hydraulicizing and clearing land	\$ 0.554	\$0.0094
Diamond-drilling	0.093	0.0016
Development and exploration	3.685	0.0625
Stoping	2.191	0.0372
Loading and sampling	0.064	0.0011
Assaying, engineering, and research.....	0.151	0.0025
Administration and office	0.381	0.0065
Boarding house and camp maintenance	0.278	0.0047
Insurance and taxes	1.013	0.0172
General and legal expense	0.366	0.0062
High-grade mill	0.618	0.0105
Low-grade mill	4.144	0.0703
Custom milling by Nova Scotia Co.	0.017	0.0003
Depreciation	0.793	0.0135
Marketing product	0.305	0.0052
Corporation, New York office, and traveling..	0.155	0.0026
	<hr/>	<hr/>
	\$14.808	\$0.2513
Less rents and interest	0.615	0.0104
	<hr/>	<hr/>
Total operating cost	\$14.193	\$0.2409

Sand-lime brick manufactured in the United States in 1913 was valued at \$1,238,325. Michigan was the leading producer. Prices range from \$6.27 to \$10.61 per 1000 bricks. The industry has been the victim of 'boomers'.

Radium and Its Sources

By CHARLES T. KENNAN

A great deal of interest is now being taken by the public in the sources and physical properties of radium, and general lack of information seems to prevail regarding the fundamentals involved. Therefore the following brief statement of source of the more salient facts may be of interest.

Radium is a chemical element.

Uranium is a chemical element.

Radium is a transformation product from uranium.

Radium is not found 'free' in nature, but is obtained only as a transformation product from uranium. Radio-activity is the property a substance has of emitting a certain kind of invisible ray. The radio-active elements are radium, uranium, thorium, polonium, and actinium. Radium was discovered, not by direct observation, but through its effects.

Rays of Radium

The rays of radium are divided into three classes, according to the physical properties exhibited by each, and are designated by three Greek letters, alpha, beta, and gamma.

The alpha rays have little penetration, and are stopped, or absorbed, by an ordinary thick sheet of paper. They have very little photographic effect. They are electrically positively charged particles. These are the strongest ionizers, that is, when allowed to pass through a non-conducting gas they make it a conductor of electricity—this effect is called ionization. Ninety per cent of all the rays are alpha rays.

The beta rays have more penetration than alpha rays, but are absorbed by a thick sheet of copper or tinfoil, or five millimetres thickness of aluminum. They have the greatest photographic effect, but less power of ionization than alpha rays. Nine per cent of the rays are beta rays. They are negatively charged particles. These rays are found to stimulate the growth of cancer.

The gamma rays have the greatest power of penetration, and will pass through thirty centimetres of iron, or a half-inch steel bar, without apparent diminution in intensity. These rays travel through space at the rate of about 185,000 miles per second. They have little photographic action, and little power of ionization. They do not appear to be charged with electricity. These are the rays used in the cure of cancer. By wrapping metal foil around the tube of radium salts, the alpha and beta rays are excluded from passage, while it is no obstruction to the gamma rays. Only one per cent of the rays are gamma rays, but these are the most wonderful of all. Of all the radio-active elements, radium has the strongest rays, and the element is about 1,000,000 times more active than uranium.

Radium exhibits the wonderful power of continuous emission of energy in the form of heat without any diminution of its substance, and from no source except itself. It is found that one-half grain of radium bromide gives out heat at the rate of two calories per hour. Radium is usually placed upon the market in the form of radium bromide, or radium chloride—the latter containing 76% radium, and the former less than 59 per cent.

The ratio of radium to uranium present in any unaltered mineral, as pitchblende, is constant, and stated by Rutherford and Boltwood to be 0.00000038 gm. of radium to 1 gm. of uranium; or, in other words, one ton of 60% uranium ore will contain two-tenths of a gram of radium. An exception to this rule has very recently been noted in favor of certain carnotite ores. It takes about 215 tons of 2% uranium ore to produce 1 gm. of radium, if 100% is saved.

More than 40 different uranium minerals have been discovered, of which pitchblende, carnotite, alunit, and torbernite have been of commercial importance—pitchblende and carnotite having thus far produced practically all of the radium supply. Pitchblende is the richest ore of uranium, frequently carrying between 50 and 80% uranium. Uraninite is a crystalline variety of pitchblende.

Pitchblende in commercial quantities has quite invariably been found in fissure veins in the old igneous rocks such as granite, gneiss, schists, etc., and always associated with gold, silver, copper, lead, zinc, or tin ores. It is considered essentially the black oxide of uranium, but always contains many impurities, usually massive and amorphous. The color of pitchblende is pitch black to brownish, sometimes with grayish or greenish cast. The ore is brittle with a dull, metallic, and pitch-like lustre. The fracture is conchoidal, and hardness from 5 to 6. Its specific gravity is 9 to 9.7 in crystals and 6.4 and higher in massive form.

Carnotite

Carnotite, named after Adolphe Carnot, a noted French chemist, is considered to be a hydrous vanadate of uranium and potassium, but is probably a mixture of minerals, the exact nature of which analysis fails to reveal, though to a considerable extent made up of calcium and barium compounds. It is usually found in sandstone and sometimes in other sedimentary rocks. It practically always occurs in 'pockets' or 'chimneys,' and isolated discontinuous deposits of comparatively small size; a 'pocket' producing 50 tons of shipping ore is considered a good deposit. The color is a bright canary yellow. Carnotite is found in powdery form, or in slightly cohering masses, and as yellow stain in rock crevices, or in a calcareous sandstone. Hereto-

fore buyers have refused to handle ores containing less than 2 per cent U_3O_8 . The carnotite ores, as shipped from Paradox valley, Colorado, have averaged about 2.5 per cent U_3O_8 and 3.5 per cent V_2O_5 .

While prices have been variable, yet as based upon the uranium and vanadium content, perhaps the following scale would be an average:

	Per pound.
2% U_3O_8	\$1.30
2.5% U_3O_8	1.40
3% U_3O_8	1.50
V_2O_5	\$0.30 to 0.50

If the scale of prices is based upon U_3O_8 alone, it is then worth \$2 to \$2.50 per pound; but on 5 to 10 per cent U_3O_8 , \$2.75 per pound, and for 10 to 20%, and higher U_3O_8 , \$3 per pound. The probable maximum cost in Europe of extracting radium from carnotite is \$20 per milligram, corresponding to \$20,000 per gram. The average price of radium bromide is \$70 per milligram, corresponding to \$70,000 per gram, or \$2,000,000 per ounce; and for radium chloride, \$90,000 per gram. During the year 1912, for which approximate statistics are available, it is certain that American ores produced more than twice as much radium as all other sources combined and practically all of this ore was mined in Colorado. It is reliably estimated that during the year 1913 American ores contributed 60% of the world's production of radium for that year. Two large plants for the extraction of radium are now in operation in Pennsylvania, each said to be of larger capacity than any similar works in Europe.

That the United States has produced such a large proportion of the radium ores does not necessarily imply a paucity of such ores elsewhere, but is rather in the nature of a handsome compliment to the superior energy and enterprise of the American prospectors and miners, as, even at this early stage of the industry, it has become quite apparent that such ores are widespread and abundant, having already been found in many states of the Union, including Montana, Washington, Idaho, Wyoming, South Dakota, Utah, Colorado, Arizona, and New Mexico, also in Germany, Bohemia, Austria, Sweden, Russian Turkestan, Portugal, Peru, England, and Australia.

The value of the secondary metals, exclusive of gold, silver, platinum, and iron, recovered in the United States in 1913 was \$72,845,000, according to J. P. Dunlop, of the U. S. Geological Survey. Even this large figure is a decrease compared with 1912, when the value was \$77,396,000. The term secondary is applied to metals recovered from scrap metal, sweepings, skimmings, drosses, etc., as distinguished from primary metals, which are derived from ore, but without implication that the secondary metals are of inferior quality.

Mineral paint output of the United States in 1913 amounted to 392,812 tons worth \$34,666,473. This includes natural mineral pigments, pigments made directly from ores, and chemically manufactured pigments.

Fellowships in Metallurgy

By an act of the legislature of the state of Utah, which became effective July 1, 1913, there was established in connection with the State School of Mines, a department of the University of Utah, a metallurgical research department. The particular purposes for which this department was established are the "finding of ways and methods of profitably treating low-grade ores, of securing a higher percentage of extraction of metals from their ores, of obtaining other information that shall have for its object the benefit of the mining industry."

By an agreement with the United States Bureau of Mines, the work of this department is to be under the direction of metallurgists of the Bureau, assigned to duty at the University and Salt Lake City. Since January of this year the metallurgist of the Bureau, D. A. Lyon, has been in charge of the work, assisted by other members of the metallurgical staff of the Bureau.

In connection with this new department there have been established five research fellowships in metallurgy, each having an annual value of \$720. These fellowships are open to college graduates who have had a good training in chemistry and metallurgy, and applications for them will be received up to June 15, 1914. Applicants should send a copy of their records from the registrar's office of the college where they have, or will be, graduated, and the names and addresses of at least three references who know their character, ability, and attainments.

Due to the fact that Salt Lake City and vicinity is one of the chief non-ferrous metallurgical centres of the United States, and that the work which is taken up is of a practical nature, that is, has to do with the solution of definite problems, the University believes that these fellowships offer a splendid opportunity to young men intending to enter the metallurgical profession, to thoroughly familiarize themselves with up-to-date metallurgical practice, especially in the treatment of non-ferrous ores, and to become proficient in the adaptation of those processes which may be in line with the investigation carried on by them in connection with their work.

Holders of these fellowships will be subject to the rules governing employees of the U. S. Bureau of Mines, and will report for duty about September 15, 1914. They must also register as students in the University of Utah and become candidates for the degree of Master of Science in Metallurgy (unless this or an equivalent degree has been previously received). Their class work will be directed by the heads of the departments of instruction, and their laboratory work, as previously stated, by metallurgists of the Bureau of Mines. Fellows are appointed for one year, but the appointment may be renewed. Address applications to Jos. F. Merrill, Director of the Utah State School of Mines, Salt Lake City.

The Engineer's Office

By CARL A. ALLEN

Probably of all the engineering professors he who follows mining has the greatest variety of problems to solve and in his office are to be found books, periodicals, maps, and specifications covering nearly the whole field of engineering, as well as chemistry and geology.

In an endeavor to economize space and make available the material in a general engineering office, I have evolved a few very simple methods that may be of benefit to others. Large engineering corporations and large mine offices have elaborate and efficient methods and sufficient clerical and engineering help to carry them out, but there are many small engineering and mine offices where the engineer, the superintendent, and a draftsman or book-keeper, is about all the clerical force available, and the methods used must be simple or they will not be successful. The Dewey system of classification, as explained later in this article, is not simple to learn and may require considerable application, but after once thoroughly understood it is simple, and the only method that has stood the severe tests of the public libraries.

Methods of Filing Maps

There are many ways of filing maps, the principal of which are: (a) filing flat in drawers, (b) rolling and placing in drawers or deep pigeon holes, (c) placing on rollers attached to wall or ceiling, making it possible to roll the map up like an ordinary window curtain, and (d) filing in books. Of these, filing in drawers is one of the most common and one of the most unhandy where a large number must be handled. The drawers take up much space, it is difficult to remove a map without disarranging all the others, the corners of disarranged maps are apt to be torn when the drawer is pushed in, and it is difficult to get a map back in its proper place among the other maps after it has been taken out for reference. It has the advantage of keeping the map flat and a map can be quickly found. The rolling of maps requires more space for filing, unless they are rolled together, and then it is difficult to get at those on the inside of the roll. Rolled maps will persist in rolling up and will not lie flat. Large maps must necessarily be rolled, however, and only one map should be placed in a roll. This one should be carefully marked on the outside. Nothing is better for large maps to which constant reference is being made than the curtain roller, but the space required, and also the expense, forbids the consideration of this method for small maps. The fourth method, of filing maps in books, obviates practically all the disadvantages of the others and has proved to be a very simple and convenient method. The illustration shows two different ways of making the books. The book shown on the left of Fig. 1 has two covers, and this is probably the best form where the maps will seldom have to be removed,

but the books are expensive. The back cover only is used on the book on the right of the illustration and the maps are filed on arches, as is often done with invoices or duplicate bills. The back is made of what is known as panel or drawer bottom material, which costs about 10c. per square foot. For small maps cheaper material may be used, such as compo-board; and for large maps a special panel may be made, built up like a door, which prevents any chance of warping. The posts or arches cost 25c. each, making the cost of a book in which to file 24 by 36-in. maps a little over a dollar, if ordinary panel material is used. I am using four different sizes as follows: Size D, 12 by 18 in.; size C,

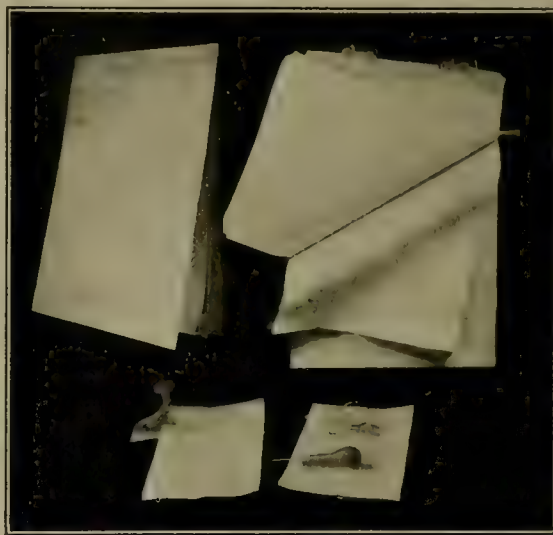


FIG. 1. METHOD OF FILING CLIPPINGS.

18 by 24 in.; size B, 24 by 36 in.; and size A, 36 by 48 in. Any map larger than 36 by 48 in. is rolled. A border is left on the left hand edge of the map for filing and the edge should be doubled over or an extra piece glued on where the holes are punched, as this prevents the holes from tearing out. Fifty to 100 maps, 24 by 36 in., may be filed in one book without having too much weight, and the books can be placed in drawers or, if space is an item, can be hung up by hooks on the wall.

One mistake that is often made in making maps is not to have standard sizes. If standard sizes are not adopted, a bunch of maps of all possible dimensions will soon be accumulated. The dimensions above noted are all even feet or half feet, mostly multiples of 24 by 36 in. Maps 12 by 12 in. (or 8½ by 11 in., sometimes necessary to use in letter size reports) can be filed in a 12 by 18-in. book; 24 by 12-in. maps may be filed in a 24 by 36-in. book, and so on, making possible a map

or 'Useful Arts,' which general division may be subdivided in the following manner:

- 610. Medicine.
- 620. Engineering.
- 630. Agriculture.
- 640. Domestic Economy.
- 650. Communication and Commerce.
- 660. Chemical Technology.
- 670. Manufactures.
- 680. Mechanic Trades.
- 690. Building.

These divisions are again subdivided into parts. Number 620, or 'Engineering,' is divided as follows:

- 621. Mechanical Engineering.
- 622. Mining Engineering.
- 623. Military.
- 624. Bridge and Roof.
- 625. Road and Railroad.
- 626. Canal.
- 627. River and Harbor.
- 628. Sanitary. Water Works.
- 629. Other Branches.

Mining Index

Mining Engineering has the number 622, and books or articles numbered 622 would be placed on the shelf between those numbered 621 and those numbered 623. As the classes are divided into ten divisions and the divisions are each divided into ten parts, so the parts are subdivided and this subdivision can be carried as far as desired. In the original classification it was carried to five figures and for a general library this is sufficient. For the library of a mining man, however, it is not enough. For example, 622.69 is Surface Transportation. The average mining engineer will accumulate too many articles that would be classed under Surface Transportation, but which would be different; as, for instance, Aerial Tramways and Wagon Roads. Hence, a further extension or subdivision is necessary, and such an extension was prepared by me and published by the Colorado School of Mines as Volume Seven, Number Three of the *Quarterly*.

The Dewey system has stood the test of libraries, but it has been but very little adopted by engineers, because many engineers will not take the trouble to become familiar with the system and also because libraries have large numbers of books, while engineers have relatively few books on one distinct subject but a vast number of articles that occur in the technical press. The technical magazines may be bound in book form, but their contents form a heterogeneous mass of information and it is this material that must be made available to the engineer.

Many engineers keep a card index of these articles. Each card describes and tells where a certain article can be found, and these cards are arranged in the file in alphabetical order according to the subject; timbering would come under T, etc. Here the Dewey system can be applied by numbering the cards and placing the

cards in the file in numerical order. An article on timbering would be given the number 622.28 and placed in the drawer between cards numbered 622.27 and 622.29. This obviates the disadvantages of an alphabetical index as already noted and where the engineer does not keep in his office the articles to which the cards refer, the card index arranged numerically is probably the best method of keeping track of articles in the technical press.

There are two very serious disadvantages to the card index. First, the time required to keep it up to date. An engineer must probably make out three or four cards for each magazine received; often the magazines accumulate and are misplaced before the cards are made out. Second, it is difficult and requires time to put on a card sufficient data to tell just what the article contains. This means that when any information is wanted the cards must be gone over to find what articles are available, then the articles hunted up, with the chance that some may not contain just the information wanted and that others may be hard to find.

Magazine Index

These serious disadvantages have led me to adopt the following method. When a magazine arrives and is read the binding clips are removed as shown in Fig. 1, each article is taken out and numbered according to the Dewey system; if the article covers two sheets, they are bound together; then they are filed away just as a letter would be filed, except that they are arranged according to number. The filing can be done in pigeon holes or in any of the books or drawers used for filing letters. There is one disadvantage to the scheme which can best be illustrated by an actual example. In the *Mining and Scientific Press* for August 16, 1913, on page 268, there is an article on 'Transportation in the Orient.' This article, if cut out and filed, would have the number 622.69, but the other side of the sheet contains the last part of an article on 'Under-Estimating the Cost of Milling Plants,' which would have the number 622.79, and, of course, the two articles could not be filed in the same place. What can be done in this case is to put pages 267 and 268 in the article on 'Transportation in the Orient' together and file under 622.69 and the first four pages of the articles on milling plants together and file under 622.79 with a note written at the bottom of the last page that the remainder of the article will be found with 622.69, 'Transportation in the Orient.' This is the method that must be used when two articles valuable for reference conflict, unless another copy of the paper can be secured. Unless both articles are very valuable, however, I usually discard the one less likely to be needed for reference, because after all it is quality and not quantity that counts. It is better to have a small amount of material immediately available, under a simple system which will be kept up to date, than it is to have a large mass of material not quickly available and which, for indexing, requires an amount of work that will not be done by the average busy engineer.

Gold Placers on the Kuskokwim River, Alaska

By H. W. REETH

A number of new discoveries have been made within the past few years on the lower Kuskokwim. While no bonanzas have been found, pans of sand assay from 1 to 25c. on different rivers in the district. The field, as far as prospected, promises to be an extensive one, both for hydraulicking and dredging. A number of claims were recently purchased in the Eel River district, and the first payment has been made. Work will commence in the spring. On two of these claims 25c. per pan is frequently found, and 5 and 10c. per pan is a common yield. At present there is a mystery in Bethel about a discovery which is said to be rich,



REINDEER-SLEIGH IN ALASKA.

and pans often yield several dollars. The gold is found as nuggets and coarse shot above the bedrock, which has not been reached. On the Kwisluk river there were some claims sold last summer, and there is a large vein of arsenic-bearing ore carrying gold and silver. The coal seam is in sandstone formation and is reported to be four feet thick. Riglugalie, Tuluksak, and Anyagak rivers promise to become producers in the near future. The last two have produced considerable gold in past years by working on a small scale.

The greatest drawback in developing this country is the lack of transport facilities, as there is no regular steamer service between Seattle and Bethel. Prospecting is expensive, and there are no large mines working at the present time. Men were paid \$1.25 per hour last summer, and were hard to get at that wage. The living and transportation costs are quite high. So it may be said that it is a country for capital and not for a poor man.

The reindeer is a useful animal for the mining industry in this district, being good for both food and freighting purposes. Their meat sells at 20c. per lb. in Bethel, and freight is 5c. per lb. to Tuluksak and 2½c. per lb. to Riglugalie river. One reindeer can haul 200 lb. with ease and make 30 miles

per day, and with good roads 50 miles and over. The annual reindeer convention was held at the village of Akiak, and J. H. Kilbuck reported that 7000 reindeer are in this district, a territory 100 miles long and about 25 miles wide. There was present at the convention the Rev. Adolf Stocker from Kwinhagak, Rev. S. H. Rock, F. Drebert, and Mrs. Boyd, the government school-teacher, from Bethel, together with 25 reindeer herders. Arrangement was made to subdivide the herd and place them on tracts with certain boundary lines between each herd. Interesting races have been run with reindeer. The first one took place in 1912 and was won by the same Indian that won the blue ribbon this year. This was the government chief herder, Karl Kavalag, from Kwinhagak. The distance was five miles, which was covered in 16 minutes, there being no track. Here is a good opportunity for quick and good mail service during the winter season. The Government has a large herd of reindeer in this country, and by building stations, say 50 miles apart, along the survey of the Alaska Short-line railway, which is surveyed from the Iliamna bay to Anvik on the Yukon, a distance of about 469 miles, such a service could be established. This would make nine stations in all, and the mail could be delivered on the Yukon in nine days, and on Kuskokwim in about seven days. During the short days in December it would take a little longer, perhaps. There is good feeding ground for the deer all along the route, so they could be stationed there the year round, and move the mail from station to station in the winter without any hardships to the men or deer.

Phosphate rock was produced and sold in the United States in 1913 to the amount of 3,097,021 long tons, valued at \$11,767,092, according to W. C. Phalen, of the U. S. Geological Survey. This was an increase over 1912 of 123,689 long tons in quantity and \$91,318 in value. The main output of phosphate rock came, as usual, from Florida, Tennessee, and South Carolina. Florida continued to be the leading state in the industry. The production of Idaho and Wyoming amounted to only one-fifth of 1% of the whole. The quantity of phosphate marketed in Florida in 1913 was 2,531,076 long tons, valued at \$9,533,945. Compared with 1912, this was an increase of 124,177 tons in quantity and \$72,648 in value. The amount of phosphate rock marketed in Tennessee in 1913 was 451,559 long tons, valued at \$1,774,392.

With 32 Nissen stamps, 5 tube-mills, and a cyanide plant, the new Shamva plant in Rhodesia crushed 18,078 tons of ore and treated 6713 tons yielding gold worth \$26,000. Absorption during this first run was 58 per cent.

There are 333,000,000 acres of public lands in continental United States, and approximately 370,000,000 acres in Alaska, or a grand total of 700,000,000 acres in all.

Soluble Losses

By HARAL R. LAYNE

The subject of soluble losses occurring in cyanide plants has received only a small proportion of the study and attention to which it is entitled from those persons who are in charge of the operations of cyanide plants. Visits to some of the larger of those plants of Central America, Mexico, and the United States have caused the truth of the previous statement to be forcibly impressed upon me.

Discrepancies Due to Losses

Soluble losses are in some cases the cause of serious discrepancies occurring between the actual and theoretical recoveries, when the theoretical recovery is based upon the difference between head assays and tail assays. An example of such a case is taken from a well known mill in Honduras some few years ago. At this place a usual difference varying from 3 to 5% occurred monthly between the actual and theoretical recovery. The theoretical recovery was based upon the difference between the head and tail assays, and it was usually the 3 to 5% greater than the actual recovery, mostly due to the unestimated soluble loss. The tail sample was taken from the Butters filter-leaf holding the washed cake, by means of a scoop attached to the end of a stick, the sample being scraped from one or two leaves of each charge by means of the scoop. The sample from each charge was dumped into a pan which held all of the charge samples for 24 hours. When the pan would be nearly full the sampler would pour off any solution from which the pulp had settled, in order, I presume, to make room for more of the charge samples. The worthlessness of such sampling is obvious, especially in a mill where the solution entering the zinc-boxes would assay over 20 oz. silver per ton, yet nevertheless I have seen the same or nearly the same method practised in more recent times in other well known mills. One can well imagine the extent of the undetermined soluble loss which occurred at the mill in Honduras upon considering the losses as shown in the examples which follow hereinafter.

Tailing Sample

A somewhat common method of sampling filter tailing is to take a cut or so from the washed cake before it is discharged from the filter-leaf. I have always found this method to be incorrect, more especially so with the Butters or Moore type of filter. Some reasons for its unreliability are that in taking the sample the sampler usually selects a cake which is not frozen, that is, one which does not adhere to the opposite cake contained on another leaf; coarse particles or heavy particles of ore, such as concentrates, which have a tendency to concentrate close to the filter medium during cake making, are not caught in the sam-

ple owing to the unevenness of the filter surface caused by slats or cocoa matting; and the failure to obtain solution in the sample which was discharged with the cake and which remained in the pipe connections and spaces of the filter-leaf at the end of the wash before discharging.

A number of carefully conducted comparative tests which I have made have proved in each and every case that the leaf sample was lower than a properly taken flume sample.

The following tests were made at a mill treating about 1000 tons of ore per day using a Butters filter which made a 60-minute cake with a 60-minute wash, and are examples of the foregoing statement. The unwashed pulp entering the agitators rarely assayed over \$4.

Charge.	Sample.	Tail assay washed..	Au. oz. unwashed..	Soluble loss by difference	Solution: Assay	Ratio ore = 1...	Soluble by solution assay
A	leaf	0.035	0.035	none	0.003	1.04	0.0031
A	flume	0.035	0.05	0.015	0.027	0.91	0.0245
B	leaf	0.027	0.03	0.0033	0.0045	1.08	0.0049
B	flume	0.035	0.045	0.01	0.013	1.0	0.013

The method used in sampling at this mill prior to the operators learning of the unreliability of the leaf sampling, some few months ago, was very similar to the method described in the fore part of this article. According to the difference between the solution solubles of the leaf samples and the flume samples as shown by charge B, the company operating the mill was losing over \$61,000 per year more than it was aware of. The loss was mostly due to frozen cakes, and a few simple changes in the filter and filtering overcame most of the loss which had theretofore been unrecognized. The following figures show the smallest difference found between the soluble of the frozen and non-frozen cakes:

Charge.	Sample.	Tail assay washed..	Au. oz. unwashed..	Soluble by difference	Solution: Assay	Ratio ore = 1...	Soluble by solution assay
C	leaf	0.027	0.03	0.003	0.0045	1.08	0.0049
C	frozen leaf..	0.027	0.05	0.023	0.036	0.92	0.033
C	flume	0.035	0.045	0.01	0.013	1.0	0.013

A considerable difference is shown in the foregoing

figures between the soluble loss as shown by solution assay and that as shown by the difference between washed and unwashed sample assays. This difference is partly due to the difficulty of obtaining close assays when charges of only one assay-ton size are taken for assay. The main reason for the difference is probably due to the method used in drying the unwashed sample. The possibility of error in soluble determination by the differential method arising from the method followed in drying samples containing soluble metal is shown by the following:

Flume sample C was thoroughly mixed and divided into four portions. Portion 1 was dried in a clean tin pan in the customary manner of ordinary practice. Portion 2 was enclosed in oiled paper and dried, the paper was reduced, and its gold content found and calculated. Portion 3 was treated with acid copper sulphate followed by sodium sulphite and a little sodium sulphide to precipitate the metals, then it was dried and assayed. Portion 4 was mixed with water, filtered, and washed in a filter-press, the filtrate measured and assayed, and the residue dried and assayed. The following results were obtained:

Soluble by difference between washed and No. 1	=10.00c. per ton
Soluble by difference between washed and No. 2	=19.63c. per ton
Soluble by difference between washed and No. 3	=27.69c. per ton
Soluble by solution assay (No. 4)	=26.87c. per ton

Another example is shown by the following:

Sample dried as ordinarily	=10.33c. per ton soluble
Sample dried in oil paper	=20.95c. per ton soluble
Soluble by solution assay	=24.80c. per ton
Washed sample	=28.68c. per ton

The above figures clearly show in the case of the particular ore that drying samples in clean tin pans does not give correct results. This is probably due to the concentration or precipitation of the soluble metal on the pan. In these cases an electric stove was the heat medium for drying.

I have noticed the same effect in drying silver ores in Honduras, but as I cannot find record in my notebooks I am unable to give the figures.

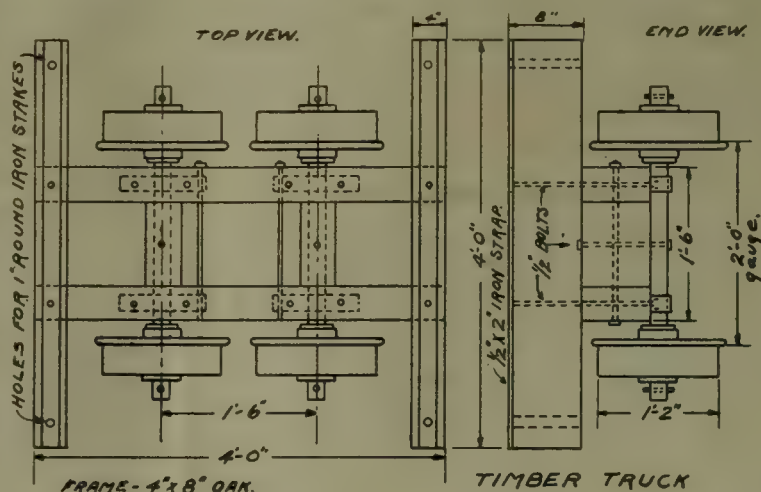
The subject of drying samples containing dissolved metal is quite interesting from the evidence shown by the foregoing examples, and it should be investigated more thoroughly than I have investigated.

The soluble loss of cyanide varies considerably, and the rate does not follow any fixed rule. In a mill where water is none too plentiful and where solutions are not wilfully discarded, the soluble loss of cyanide through a Butters type of filter averages about 0.6 lb. KCN per ton when the circulating solution averages about 1.2 lb. KCN. The soluble loss in cyanide is quite an item, and I believe that it will be overcome to a great extent within the near future.

An Underground Timber Truck

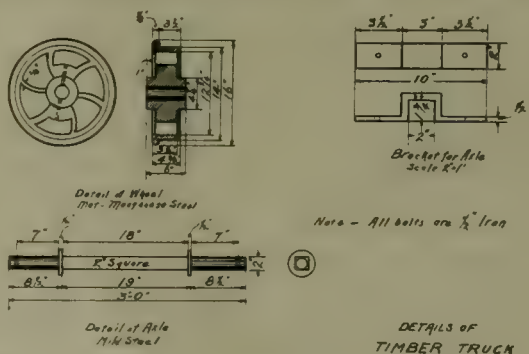
By P. B. McDONALD

An underground timber truck is used for transporting timber, dynamite, rock-drills, drill steel, heavy machine parts, etc. They are very convenient in a



large mine. A timber truck should be low, light, and strong, with wheels near together for easy pushing, as one man usually trams it.

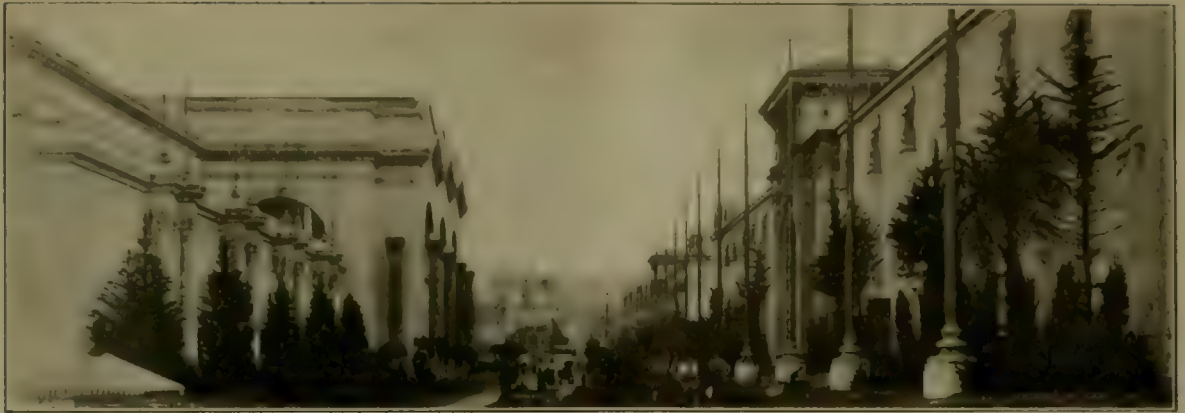
As is evident from the sketches, the truck here shown has four holes for 1-in. round iron stakes at each end.



for holding on round mining timber. The gage of track is 2 ft., the frame is of 4 by 8-in. oak, the axles are immovable and of 2-in. square mild steel. The wheels are substantial and of manganese steel, and the truck is well bolted together.

Talc and soapstone production of the United States in 1913 was 149,271 and 26,562 tons, worth \$1,280,020 and \$628,077 respectively. This country is the greatest producer in the world of these minerals. Most of the output comes from the Eastern states.

Bauxite production of the United States in 1913 amounted to 210,241 tons valued at \$997,698.



MACHINERY HALL AND EASTERN FACADE OF THE PALACE OF MINES AND METALLURGY.

The Model Mine—Panama-Pacific Exposition

Beneath the floor of the Palace of Mines and Metallurgy, there will be constructed a model mine. From either side of two main parallel drifts there will be, on one side, model coal-mining rooms, and on the other side, model metal mining stopes, each of such dimensions as may be appropriate to the mine represented. The mine drifts and working places will be outlined in metal lath, plastered with cement plaster, and in this will be embedded the appropriate ore and wall-rock, or coal, or slate, as it occurs in the several mines represented. The mine is to be truly coöperative, each exhibitor bearing his portion of the expenses.

There will be reproduced metal mine stopes illustrating mines in such characteristic districts as the Mother Lode, California; Comstock or Goldfield, Nevada; Coeur d'Alene, Idaho; Anaconda, Montana; Mesabi, Minnesota; Gogebie, Michigan; Joplin, Missouri; Bisbee, Arizona; and Franklin, New Jersey; and typical coal mines from various parts of the country.

These will be provided by the mine owner or groups of owners concerned in such a manner as to reproduce as accurately as possible the interior appearance of such working places as they occur in their mine. The makers of mining machinery or appliances in use in each particular mine are to place in the model mine such machinery as they sell to the mining company concerned. The cost to each party involved will be inconsiderable. It is estimated at a minimum of about \$300. The manufacturers will place in the various mine stopes or rooms the mining machines or appliances which they sell.

The Bureau of Mines will, through its engineers and other permanent employees, transact the business connected with constructing and operating the coöperative mine, furnish the necessary engineering superintendence during construction and operation, and will, if desired, supervise the placing of the materials and timbering, or the mining machinery, in the several mining rooms or stopes.

The entrance to the mine will be through the Bureau of Mines space in the Mines and Metallurgy Building. Visitors will be given portable mine lamps, and will be lowered in a mine cage which will move very slowly to the level of the mine floor beneath the building floor. A panoramic effect of the strata and lining of a mine shaft will move by them rapidly so as to produce the illusion of descending a considerable depth. Passing into the main drift they will come to the various mines, the names and locations of which will be displayed, and they will see the mining machinery and appliances in place as shown or demonstrated by the makers.

The only concern the Bureau of Mines has in this, and the chief concern which mine owners or machinery makers can have in it, is a public-spirited and coöperative interest in the welfare of the mining industry as a whole, and an unusual opportunity to illustrate to a vast audience the extent, diversity, complexity and expense of conducting mining operations throughout the United States.

Approval of the project and recommendation to their principals for coöperation has been had from the following, and there is every reason to expect favorable action in the immediate future:

An Anaconda Copper Mining Company, stope; a Minnesota iron stope; a Mother Lode, California, stope; a Comstock, Nevada, stope.

Coal mines will be illustrated by an Oklahoma coal mine; a Pittsburgh, Pennsylvania, mine; an Illinois mine.

Electric locomotives have been promised by the Westinghouse company of San Francisco; mine pumps by Byron-Jackson, San Francisco; air-compressor, drill sharpeners, etc., by the Compressed Air Machinery company, San Francisco; mine cage, track, and cars by the Joshua Hendy company, San Francisco; 'Justrite' carbide lamps by the Justrite company, Chicago; and enamel signs will be furnished by J. W. Stonehouse, of Denver.

Dredging in Russia in 1912

Translated by WILLIAM H. SHOCKLEY

In *Zoloto i Platina* for January 14, 1914, is a condensed table of the results of dredging in Russia for 1912. These figures give the result of the yearly investigation that is undertaken by the 'Permanent Consulting Board of Gold and Platinum Producers' and show that answers were received from 18 companies operating 52 dredges (one more than in 1911). Full details, on which the averages in the following tables were based, were received from only 42 dredges (six less than in 1911).

The following operators did not send information: Yenesei Gold Mining Co.; Novo Udilsk G. M. Co.; Orsk G. M. Co.; Tanyarska G. M. Co.; 'Central Siberia'; Uskova; and Oleminsk G. M. Co. The following did not work during the year: Bogoslovsk G. M. Co.; Verk-Isetsk Works; and Putiloff Works, and therefore no statistics are available.

In the following it is seen that the number of hours worked per dredge increased from 3026.67, in 1911, to 3137.53, in 1912, that is, about 3.7%. The ground worked increased 0.6% and the output of precious metals 3.7%. The total production of gold and plat-

inum in 1912 was 654 oz. greater than in 1911, or about 0.6 per cent.

These figures show that there has hardly been any increase of production in 1912. Therefore, unless poorer ground, accidentally worked, be taken into account, the conclusion is forced that there has been little technical improvement during the year 1912.

(Classified production by dredges:

Ounces.	Number of dredges.
Less than 527	3
From 527 to 790	1
" 790 " 1053	7
" 1053 " 1317	7
" 1317 " 1580	7
" 1580 " 1843	3
" 1843 " 2107	5
" 2107 " 2370	6
" 2370 " 2633	1
" 2633 " 2897	6
" 2897 " 3160	1
" 3160 " 3423	1
4402	1
5011	1
7094	1
7879	1
Total	52

Comparison of the results of the past five years:

	1908.	1909.	1910	1911.	1912.
Number of hours worked per dredge	2,502.24	2,771.57	2,914.93	3,026.67	3,137.53
Number of cubic yards worked per dredge	166,363	186,892	182,488	212,268	213,438
Amount of metal produced per dredge, oz. (Troy)	1,434	1,811	1,792	2,021	2,096

The following footnotes present details regarding the production statistics presented in the table on the opposite page.

'Dredge made at Werf Conrad works, Haarlem, Holland 1906. The volume of the ground excavated by the dredge is frequently checked by comparing the volume obtained by counting the number of buckets, with the actual volume excavated as determined by measuring the ground; from this measurement is deduced a coefficient by which the volume estimated by counting the buckets can be corrected.

The machinery made in England by Arthur Brown. The dredge was built locally. The dredges began working: No. 1, early in August 1908; No. 2, middle of April 1908; No. 3, June 26, 1910; No. 4, June 27, 1911; No. 5, June 24, 1911; and No. 6, May 20, 1912. None of these dredges carry the name of the maker. The cost of the dredges was as below:

No.	F.o.b. Tagil, without custom duties.	Custom duties.	Construction pontoon and transportation.	Total.
7	\$38,248	\$15,993	\$34,600	\$88,841
4	37,744	19,008	32,628	89,380
5	37,744	19,008	33,941	90,693
6	38,835	16,118	37,620	92,573
No. 1 and No. 2 paid no custom duties.				142,266

Putiloff Works dredge.

Dredge built by the Neviansk Works, 1903.

Dredge built by the Neviansk Works, 1907.

Dredge built by the Neviansk Works, 1911.

Dredge built by the Neviansk Works, 1905.

Dredge built by the Neviansk Works, 1907.

Dredge built at the Neviansk Works, 1907.

These dredges (26 and 26a) work jointly, one removes the top dirt to one side; the other follows and excavates and washes the exposed gravel. Made by Werf Conrad in 1906.

Small dredge, not over 30 or 35 hp. Upper portion of soil and stumps removed by hand. Made by Tatz, 1905.

Close-connected buckets. Putiloff Works, 1911.

Own dredge, made in 1907.

Own dredge, made in 1908.

Own dredge, made in 1909.

The following factors may be found useful in converting Russian statistics into English standards.

One pood = 36.113 pounds.

One pood pure gold = 21.157 rubles = \$10,886.72.

One zolotnik = 0.137 Troy ounces = 2.835 of pure gold = 5.5961 rubles.

One dolya = 0.0014286 Troy ounces = \$0.029532 of pure gold.

One 2000-lb. ton = 55.382 poods.

One pood = 0.0180564 tons.

One ruble = \$0.514567 = 25.375 pence.

One ruble per cubic sagene = \$0.04053 per cubic yard.

One ruble per pood = \$28.50 per ton, \$0.01125 per pound, \$0.00977 per Troy ounce.

One zolotnik per cubic sagene pure gold = \$0.223 per cubic yard.

One zolotnik per cubic sagene = approximately for placer gold \$0.29 per cubic yard.

One dolya per cubic sagene pure gold \$0.0023215 per cubic yard.

One dolya per cubic sagene of placer gold approximately \$0.002 per cubic yard.

One zolotnik per 100 poods pure gold = \$1.57 per ton, 2000 pounds.

One dolya per 100 poods = \$0.0164 per 2000-lb. ton.

One zolotnik per 100 poods of placer gold = approximately \$2 per cubic yard.

One dolya per 100 poods of placer gold = approximately \$0.02 per cubic yard.

One cubic yard of gravel is reckoned as 3000 pounds.

Own dredge, made in 1910.

Own dredge, made in 1912.

Close-connected buckets. Putiloff Works, 1904.

Besides the washed sand, 13,929 cu. ft. of surface soil was removed.

Shaft work.

Dredge of New Zealand type, made at own works in 1909; cost \$31,000.

The measurement of the worked ground is given by the advance of the dredge along the fixed head-line by the direct measurement of the depth (by sounding rod), and of the width of the excavation. Werf Conrad dredge, 1900.

In this total the 230,759 cu. yd. of top dirt excavated by dredge 26a of the Platina company is not included.

PRODUCTION OF URAL AND SIBERIAN DREDGES FOR 1912

Name of company	Date of beginning	Date of closing	Size of buckets in ft.	Days worked	Cu. yd. washed	Gold and platinum oz.	Average yield per cu. yd.
I. I. T. Akshentsev							
1. Dredge No. 2	May 30	Oct. 13	5.0	91	49,124	1,843	18.1
II. Alexandro Co.							
2. Dredge No. 1	May 3	Oct. 23	5.0	165	184,912	3,186	8.3
III. Amursk Gold Mining Co.							
3. Dredge No. 1	Oct. 14	Oct. 13	no information		86,131	971	5.4
4. Dredge No. 2	Oct. 14	Oct. 13	no information		195,184	5,011	12.4
IV. Borovinsk G. M. Co.							
5. Dredge 'Mechta'	May 6	Oct. 19	4.5	158	148,107	1,785	5.8
6. Dredge 'Nadezhda'	May 6	Oct. 19	5.0	167	193,421	2,835	7.1
V. Heirs of P. P. Demidoff, Prince San-Bonato.							
7. Dredge No. 1	Jan. 14	Jan. 14	7.0	175	283,115	2,275	3.8
8. Dredge No. 2	Jan. 14	Jan. 14	7.0	306	427,520	4,102	4.9
9. Dredge No. 3	Jan. 14	Jan. 14	7.0	241	155,041	7,879	8.3
10. Dredge No. 3	Jan. 14	Jan. 14	7.0	282	428,930	7,094	7.9
11. Dredge No. 4	Jan. 14	Jan. 14	7.0	264	329,844	2,574	3.7
12. Dredge No. 5	Jan. 14	Jan. 14	7.0	269	334,276	2,822	4.9
VI. Druza G. M. Co.							
13. Dredge No. 1	June 3	Nov. 3	4.5	148	168,021	1,284	3.7
14. Dredge No. 2	Apr. 22	Oct. 21	4.5	165	179,692	2,195	5.9
15. Dredge No. 3	Apr. 16	Oct. 25	4.5	182	179,628	1,891	5.1
16. Dredge No. 4	Apr. 21	Oct. 25	6.0	181	276,250	2,341	4.9
17. Dredge No. 5	Apr. 21	Oct. 26	7.0	182	307,150	2,892	4.5
VII. Zaural Mining Co.							
18. Dredge No. 10 ¹	May 20	Nov. 22	5.5	187	221,590	1,056	2.3
VIII. Moscow Forest Co.							
19. Dredge No. 5 ¹	Apr. 11	Oct. 27	3.5	194	238,633	1,195	2.4
IX. Neviansk Works.							
20. Dredge No. 10 ²	Mch. 26	Nov. 22	4.0	162	222,148	821	1.8
21. Dredge No. 12 ²	Mch. 26	Nov. 22	7.0	176	459,926	1,529	1.6
22. Dredge No. 26 ²	Mch. 26	Nov. 22	7.0	166	266,548	1,460	2.6
23. Dredge No. 1 ¹	Mch. 26	Nov. 22	4.0	193	233,337	1,562	3.2
24. Dredge No. 2 ²	Mch. 26	Nov. 22	4.0	140	131,839	514	1.8
25. Dredge No. 3 ²	Mch. 26	Nov. 22	4.0	175	312,661	1,852	2.8
X. Platina Co.							
26. Dredge—washing ¹	Oct. 14	Oct. 14	5.0	152	63,030	1,338	10.2
26a. Dredge—stripping	Oct. 14	Oct. 14	7.0	142	230,759	...	...
27. American claim ¹	Oct. 14	Oct. 14	3.0	162	55,321	824	7.2
28. Yurevsk claim ¹	Oct. 14	Oct. 14	5.5	167	359,715	2,816	3.8
29. Naxodka claim ^{1a}	Oct. 14	Oct. 14	5.0	179	130,442	828	3.0
30. Blagosloven claim ¹	Oct. 14	Oct. 14	5.0	181	195,009	1,100	2.7
31. May claim ¹	Oct. 14	Oct. 14	5.0	181	197,079	1,555	3.8
32. Pokrovsk claim ¹	Oct. 14	Oct. 14	5.0	176	210,833	1,583	3.6
33. Fereiro claim ¹	Aug. 7	Oct. 14	5.0	54	57,747	250	2.1
34. Brown claim ¹	Oct. 14	Oct. 14	3.0	171	151,460	1,540	4.9
XI. Russian Gold Co.							
35. Dredge No. 3 ^{2b}	May 1	Dec. 3	3.0	216	120,377	2,156	8.6
XII. Heirs of A. A. Savvinik.							
36. Dredge 'Anglia' ^{2b}	Apr. 18	Oct. 22	7.0	179	279,400	2,759	4.7
36a. Mary Magdalen claim	Nov. 14	Nov. 14	..	308	227,292	1,463	3.2
XIII. Savelev & Sons.							
37. Pokrovsk claim	May 2	Oct. 27	4.5	...	173,228	1,870	5.2
XIV. Spassky Co.							
38. Dredge No. 1	May 14	Oct. 21	5.0	159	175,832	1,338	3.7
XV. Sisert Mg. Dist. Co.							
39. Dredge No. 1, 'Staretel' ²	May 4	Dec. 9	2.5	193	127,749	1,705	6.4
XVI. Northern Yenesei Gold Co.							
40. Dredge No. 1	May 14	Oct. 21	7.0	137	175,717	1,114	3.0
XVII. Fedorovsk Gold Co.							
41. Dredge No. 1	Aug. 11	Oct. 24	5.0	75	76,429	358	2.3
42. Dredge No. 2	May 4	Oct. 18	7.0	168	283,032	1,252	2.1
43. Dredge No. 4	Apr. 30	Nov. 1	7.0	185	307,454	1,986	3.1
44. Dredge No. 5	July 27	Oct. 20	7.0	86	120,574	629	2.6
45. Dredge No. 6	May 22	Oct. 25	7.0	157	218,250	1,001	2.2
46. Dredge No. 7	May 22	Oct. 25	4.5	157	118,428	1,869	7.6
47. Dredge No. 8	May 26	Nov. 4	7.0	163	284,333	2,326	3.9
48. Dredge No. 9	May 16	Oct. 26	7.0	164	252,628	2,323	4.4
49. Dredge No. 10	May 27	Nov. 3	7.0	161	267,348	2,708	4.9
50. Dredge No. 11	May 17	Nov. 4	7.0	172	160,884	1,167	3.5
XVIII. Shuvaloff Heirs.							
51. Dredge No. 1 ²	May 2	Dec. 30	6.0	175	139,802	2,967	10.2
52. Dredge No. 2	June 7	Dec. 1	7.0	101	79,375	817	4.9
Total amount of sand washed and product of gold and platinum ^{2a}					11,312,780	106,911	
Total for 42 dredges from which full statistics have been received					7,337.00	8,964,390	88,016
Whence the average for one dredge is					174.69	213,438	2,096
Average for 1911 (48 dredges)					168.54	212,268	2,021
Average for 1910 (39 dredges)					162.60	182,488	1,792
Average for 1909 (41 dredges)					164.18	186,892	1,811
Average for 1908 (48 dredges)					149.54	166,363	1,434
Average for 1907 (46 dredges)					137.74	139,260	1,142
Average for 1906 (32 dredges)					173.00	159,540	1,746

The Pyritic Ore Deposits of Kyshtim, Russia

By A. W. STICKNEY

*This deposit is a compact, dense, massive aggregate of granular pyrite, barite, and quartz, carrying irregular blotches, streaks, and minute grains of chalcopyrite, sphalerite, and tennantite. The evidence indicates that the ore is the result of the metasomatic replacement of alternating bands of a sheared and broken schist by a rather fine grained, cracked, and broken pyrite, anhedral barite, and quartz. This granular aggregate contained considerable open interstitial space, which was later filled by contemporaneous chalcopyrite, sphalerite, and tennantite. Tennantite probably also marks a slightly later stage in the primary mineralization, and with it are contemporaneously associated chalcopyrite and quartz of a second generation. The paragenesis of the sulphide minerals is one of decreasing iron and increasing copper content.

The orebodies, as viewed in a vertical section, normally show four distinct, roughly horizontal and parallel zones. From the outcrop downward they may be designated as: (1) the gossan zone, which extends from the surface to a maximum depth of 60 ft.; (2) the zone of loose baritic sand, extending from the bottom of the gossan to a maximum depth of 150 ft., the greater portion of which lies beneath the level of the ground-water; (3) the loose, leached sulphides, which reach from the bottom of the baritic sand to a maximum depth of 180 ft., where they gradually pass into (4) the underlying, firm, massive, mainly unaltered sulphide ore.

The evidence indicates that the gossan is the result of normal processes of oxidation acting upon the massive sulphide ore, since the gossan (*a*) displays the honeycomb skeleton form of the primary ore with the metallic sulphides removed; (*b*) overlies a much narrower zone of loose baritic sand, which carries only about one-fourth as much iron as the gossan, and is strikingly distinguished from the gossan zone by a broken and caved hanging wall; and (*c*) this broken hanging wall reaches the surface in the case of the one lode of which the outcrop is predominantly baritic sand. It is believed that during a period in the remote past the rate of denudation has been much faster, as the result of a steeper gradient or of glaciation, whence the massive pyritic ore was kept so near to the surface that an excess of oxygen was always immediately available to convert into limonite the iron of any ferrous sulphate formed. Since that time these conditions have ceased to exist, owing to long continued erosion or to climatic changes. The baritic sand is regarded as the result of leaching by surface waters, which probably contains sulphuric acid, but were deficient in oxygen; the iron sulphate and much of the copper sulphate

thereby generated were lost by diffusion into the relatively more permeable wall-rock.

As this leaching has occurred to as great a depth as 110 ft. below the ground-water level, which apparently has been stationary for a long period, it is inferred that the upper portion, at least, of the ground-water is not so stagnant as some have supposed. A distinct circulation of this water, both vertically and horizontally, is suggested. There is no evidence to support the hypothesis that the gossan was formed by iron sulphate solutions, ascending through the underlying extensive zone of baritic sand, the iron being fixed as limonite in the gossan by descending surface waters heavily charged with oxygen. There is nothing to suggest that gossan is being formed at the present time; on the contrary, it is inferred that all the present gossan is a remnant of that formed in a previous period, which has not as yet been removed by erosion except in the case of one lode, where topographic conditions appear to have been and are still favorable to rapid denudation. Here the underlying zone of baritic sand outcrops.

Downward enrichment of secondary sulphide does not occur in the form of a shallow, well developed, commercially important, horizontal zone, typical of many other localities, but has taken place to a relatively slight degree along the immediate walls, especially the hanging wall, to the greatest depth yet attained in exploration, which is 600 ft. below the ground-water level.

The massive pyritic ore of a given lode shows a progressive longitudinal variation in relative mineralogical character, from a condition of maximum intensity of mineralization near the longitudinal centre of the lode, which continues downward to the greatest depth yet reached.

The character and composition of the ore, and the nature of the hydrothermal alteration of the wall-rock indicate that the deposits have been formed through metasomatic replacement, along a sheared zone of the schist, by pyrite and barite, molecule by molecule, band by band, thus preserving the original banding of the schist; also, that the deposition took place during a distinct mineralizing epoch, marked by solutions progressively changing in composition and depositing a series of sulphide minerals in transitional order. From the absence of characteristic ore minerals in the adjacent altered country rock, and the presence of sericite, barite, and quartz, it is concluded that the mineralization was effected by hot alkaline solutions at a temperature and pressure corresponding to what Lindgren in his 'Mineral Deposits' calls the zone of intermediate depth.

Diamonds exported from Antwerp to the United States in 1913 were worth \$13,374,474, against \$10,903,894 in 1912. Antwerp is now the centre of the diamond industry of Europe. Exports from Amsterdam were \$11,070,862. The new international carat weight for diamonds is 200 milligrams.

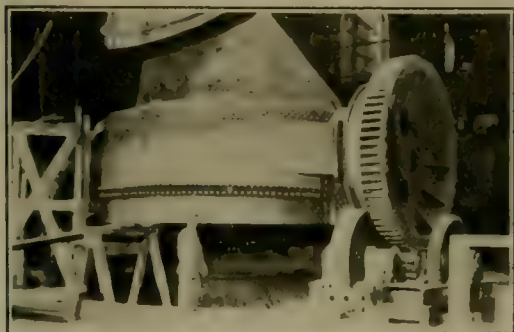
*Abstract from *Bulletin* 70 of the Min. & Met. Society of America.

The Boston & Montana Plant

By C. W. Goodale

*At a meeting of the Society in New York on March 19, 1914, Mr. Goodale gave the following information about the work being done at this plant:

It was some time ago decided by the Anaconda Copper Mining Co., the operating Company, that concentrating should no longer be done at Great Falls. Up to the present time there has been treated about 3000 tons per day, and soon the Anaconda concentrator will



BASIC CONVERTER AT BOSTON & MONTANA PLANT.

be so increased in capacity that it can treat a larger tonnage and then ship concentrate, about 1000 tons per day, to Great Falls. It is easy to see where that is the logical thing to do, as the concentrator at Great Falls is old, some of the plant dating back 23 years, and the cost of building a concentrator on modern lines would mean a large expenditure. Furthermore, the cost of hauling ore from Butte to Great Falls is about 75c. per ton, against 14c. from Butte to Anaconda, 25 miles. The management at Great Falls will be sorry to see an important department of its operations taken away, but that is the logical outcome of conditions.

An expenditure of more than \$2,000,000 was authorized in 1912 for replacing the main smelter building at Great Falls with a higher and stronger structure, and for new and modern furnaces and converters. Last year the old main smelter building, 51 by 704 ft., with a height of 23 ft. 7 in. to the crane rails, was removed, and the new building occupying the same site was completed. It is 824 ft. long, with a width of 56 ft. and a height of 42 ft. to the crane rails. Three old cranes of 40-ton capacity were replaced by three new ones of the same capacity, but with modern improvements. The walls of the building are of brick.

The three new basic-lined converters, 20 ft. diameter, are in place, and the old one, 12 ft. diameter, are set aside. One of these bowls had a record of 20,000 tons of copper blown without relining, and when discarded it was in condition for indefinite further use. The converters which were originally installed

in 1891 were 7 ft. diameter; then came the 12 ft. and finally the 20-ft. converters.

The new reverberatory furnace has been built, and results show such an improvement over the work done by the old gas-fired furnaces that another one is now being built. The hearth is 102 ft. long and 22 ft. wide, and the firebox is really a large gas-producer, in which can be gasified more than 100 tons of coal per day, while the old producers could only handle 10 or 12 tons per day. No provision has yet been made for pre-heating the air used in combustion, but hot-blast stoves will soon be built for the purpose, and it is expected that the present capacity of 250 tons of charge per furnace-day will be increased to more than 300 when these stoves, which will use the waste-heat of the furnace, are in action. The present ratio of coal to charge is about 1 to 2½, the fuel being of rather inferior quality (22% ash). There are some new features in the construction of the furnace, particularly in the binding, the usual buckstays and the rods across the top of the furnace being avoided by the use of a heavy steel-plate shell with a number of angle-braces on the sides, provision being made for expansion and contraction.

The old McDougall roasters, 16 ft. diameter, will be discarded as soon as the 24-ft. furnaces are built. The present blast-furnaces are 15 ft. long, but in the new plant E. P. Mathewson's lead will be followed and they will be built longer. At Anaconda, preparations are being made to use pulverized coal in the reverberatories, and, judging by results obtained in other places where coal-dust firing is in use, a considerable saving will be effected in costs of smelting.

India possesses large water-power resources, which are gradually being utilized. The Cauvery Falls scheme, in Mysore, is being enlarged from 10,000 to 17,000 hp. This supplies the Kolar group of gold mines at \$48 per horse-power year. By far the most important hydro-electric undertaking that has ever been projected in India is being carried out at an estimated cost of \$8,000,000 in the Bombay Presidency by the Tata Hydro-electric Power Supply Co., Ltd. It will provide about 60,000 hp. and will be supplying energy by February 1914. Contracts have already been signed for supplying power to 31 cotton mills and 3 flour mills in Bombay. The financing of this enterprise, to which nearly \$1,000,000 was contributed by the royal families at Hyderabad, Mysore, and Boroda, was largely assisted by the wealthy Parsee community in Bombay. Two reservoirs will have capacities of 380,000,000 and 2,800,000,000 cu. ft. respectively. Later on a third reservoir with a capacity of 7,000,000,000 cu. ft. will be constructed. The transformers for this plant are being supplied from Schenectady, New York; the insulators, transmission lines, underground cables, etc., from both England and Germany; the pipe lines from Switzerland, and the Pelton type wheels from California.

*Abstract from *Bull. 71. Min. and Met. Soc. of America.*

Discussion

Readers of the MINING AND SCIENTIFIC PRESS are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment. Insertion of any contribution is determined by its probable interest to the readers of this journal.

Relative Efficiency of Sodium and Potassium Cyanide

The Editor:

Sir—I read in your issue of April 18 C. M. Eye's criticism of Mr. Butters' article on the above title in which are incorporated detailed figures by Mr. Hamilton. At this writing Mr. Hamilton is in Salvador, Central America, and it will be some little time before the matter can be called to his attention for his comment on it. Mr. Butters is in the hospital in this city. Therefore, I take the liberty of stating that I have checked over the figures in question and, assuming that the prices of 17c. and 22c., for potassium and sodium cyanide respectively, as given in Mr. Hamilton's table, are correct, I quite agree with Mr. Eye that the loss per ton of ore due to using sodium cyanide is between 21 and 22c., instead of 16c. per ton.

G. W. SHEPHERD.

New York, April 28.

The Simplification of Gold Ore Treatment

The Editor:

Sir—I am indebted to John B. Stewart for a criticism¹ of my article² on the simplification of gold ore treatment, which dealt with the suggested abolition of amalgamation in favor of complete cyanidation.

Mr. Stewart draws attention to an alleged avoidance, in my article, of essential simplifications which may result from such a change of policy; and, referring to the question of the statement of costs, he says: "The advantages of detailed cost data are now too generally recognized, and applied, by competent metallurgists, to warrant the assumption that the practice of cyaniding without amalgamation is only fashionable." I cannot see that this sentence has any significance whatever in connection with the matter under review. The advantages of detailed cost data are just as obvious where amalgamation is practised; and, under such circumstances, they may be recognized and applied by competent metallurgists with equal facility as in the instance where amalgamation has been abolished.

Mr. Stewart continues: "It should scarcely be necessary, at this date, to reiterate the various arguments regarding the evils attending all attempts to cyanide after previously crushing in water * * *." A reply to such a sweeping generalization is not an easy matter. The practice of 20 years' standing can hardly

be termed an attempt; and as regards the alleged evils of milling in water, my experience has been that they are not noticeable when compared with the complications liable to arise and the economic disadvantages which invariably result from the practice of milling in cyanide.

While on this subject, I would draw attention to an interesting comparison which may be made between two plants, in the same district, in one of which milling in cyanide has been adopted and in the other milling in water. The figures are taken from H. A. McGraw's articles which appeared in *The Engineering and Mining Journal* of November 23 and December 21, 1912, and from the same authority I learn that the ores are identical in character:

Treatment.	Hollinger Mill. (Milling in cyanide)	Dome Mill. (Milling in water)
Solution precipitated per ton of ore....	4 tons	2 tons
Zinc consumption per ton crushed	0.80 lb.	0.25 lb.
Cyanide consumption per ton crushed....	not stated	0.80 lb.
Cyanide added	before precipitat'n	before agitation
Total recovery	93%	95% with "no difficulty in recovering 98 or 99% if desired to do so."

The question of the milling in cyanide of an amalgamable gold ore is a side issue in the present discussion, but since Mr. Stewart has whetted our interest by a reference to the arguments which might be brought forward in support of the method, I have prepared some notes on the subject for a future issue of the *Press*, and I look forward to comments and criticisms with expectant interest.

Reverting to the question of the abolition of amalgamation, the letter continues: "All schemes have had satisfactory trials, and the present custom of dispensing with amalgamation has been established through good results." Here again Mr. Stewart indulges in an avoidance of actual fact. Amalgamation is not as dead as he would have us believe; neither is it the custom to dispense with its obvious advantages. It is, as a process, still responsible for about half the world's output of gold; and my article on the subject was an effort to counteract the effect of statements which are periodically made by extremists, and whose recommendations have an influence both on the younger members of the profession and on those whose lack of technical training and experience prevents them from estimating the true value of advice on metallurgical matters.

As regards what Mr. Stewart terms the general abandonment of amalgamation in conjunction with the cyanide process, I would draw attention to the fact that the principal mines in the world are still using amalgamation, in conjunction with cyanidation, as the chief method of gold recovery. On the Rand over 60% of an immense annual output is due to amalgamation. At the Homestake the monthly yield

¹*Mining and Scientific Press*, September 20, 1913.

²*Mining and Scientific Press*, August 16, 1913.

is in the neighborhood of \$500,000, and three-fourths of this is the result of amalgamation treatment. Further figures showing the importance of amalgamation can be found in connection with the statement of output of the principal mines in Australia and New Zealand, as well as America.

With regard to the good results which Mr. Stewart assures us have been instrumental in the general abandonment of amalgamation, I append a few figures adapted from *The Mining Magazine*, dealing with the work of amalgamation-cyanidation plants on a group of properties known as the Rand Mines, Ltd., during 1912:

	Reduction cost per ton.	Av. val. ore.	Extraction, %.
Modderfontein B.....	\$0.87	\$9.05	96.20
New Modderfontein	0.87	9.27	97.59
Rose Deep	0.94	7.14	93.98
Goldenhuis Deep	1.09	7.45	95.68
Nourse Mines	0.90	7.38	95.89
City Deep	0.89	8.75	96.73
Village Main Ref.....	1.10	9.71	95.09
Village Deep	0.83	7.20	96.17
Ferreira Deep	1.07	9.99	95.97
Robinson	0.96	10.48	96.38
Crown Mines	0.86	7.94	95.32
Bantjes	0.98	7.27	96.40
Durban Roodepoort Deep...	0.97	7.50	95.04

At the Homestake the average value of the ore is about \$4. The extraction amounts to about 94%, and the cost per ton for reduction treatment amounts to about 20 cents.

For the purpose of comparison, the figures upon which Mr. Stewart bases his remarks on the subject would be of interest.

Mr. Stewart next deals with what he terms " * * * mechanical considerations, based on the relative efficiency, indicated by comparing the cost of operations with recovery, * * *." He also says that my article seems confined to the question of recovery. As a matter of fact, I made the direct statement that amalgamation was the most economical method of gold recovery. It was for Mr. Stewart to directly controvert this statement with argument or figures. In the absence of either, I retain my position.

The abolition of amalgamation often necessitates an expensive fine-grinding equipment. An increase in the grade of ore cyanided involves an increase in capital expenditure on other parts of the plant which is far in excess of the cost of copper plates. At the Homestake, as at the Great Fingall, the amalgamation treatment is so successful that the cost of slime agitation, both as regards cost of plant and cost of operation, is entirely obviated, and the fine material is treated direct in the presses. Depreciation on copper plates, when milling in water is practised, is the lowest charge of this kind as compared with the other parts of the plant; and a large proportion of the original sum expended is realizable at the conclusion of operations. This is far from being the case with regard to cyanide plant equipment.

Mr. Stewart next deals with the question of theft, and his contentions cannot be disregarded. On the other hand, and if there is an open possibility for loss from such a source, then direct smelting of the ore with litharge and the production of a base bullion would ultimately displace cyanidation as a process.

The criticism then returns to the question of milling in cyanide, and we read: "The one objection which appears to have outlived all others is that it has deprived its operators of their justly prized screen sample, upon which the original value of the ore, and all subsequent calculations, are based. Indeed, for this reason alone, it has frequently been debated in South Africa whether it might not be wise to resume crushing in water once more for the sake of the accuracy of the head sample obtained from the battery screens." Mr. Stewart's ideas as to South African practice form a fitting sequel to his remarkable pronouncements about amalgamation. I have only recently returned from the Rand, and I saw no indication that milling in cyanide would ever be seriously considered, much less generally adopted, as an alternative to present practice.

Mr. Stewart then says: "But I doubt whether the exasperating details attending the need of eliminating the water, to preserve the economical bulk of stock solution, etc., will ever be compensated for by this [a reliable head sample] and the slightly improved extraction to which our attention has just been called." The spectacle of the metallurgist tearing his hair at the idea of having to dewater his mill pulp is of too Gilbertian a conception to justify serious argument. Dewatering must precede filtration in any case, and it is a far more practicable operation before cyaniding is commenced. It is, of course, imperative that the equipment for the purpose should be designed to dewater to within a few percentages of moisture contained in the discharged residue. If this is impossible, then milling in water is either impracticable or inadvisable.

'Float values' are next discussed, and we read: " * * the millman is far more often financially embarrassed by the 'float values' than is the cyanide man by coarse gold." Financial embarrassment is a universal complaint, but why any millman should be so encumbered on account of 'float values' passes my comprehension. There is certainly no need for him to worry because float gold is undoubtedly the easiest gold to dissolve in the cyanide plant. Mr. Stewart continues: "In fact, I think that the ultimate gain in recovery due to the 'float values' recovered only by crushing in cyanide, has of itself often decided the question in favor of abandoning amalgamation." I should be interested to learn how Mr. Stewart proposes to induce his 'float values' to get any benefit from the crushing machinery; or to point out how the solution of the gold could be more effectively insured in the mortar box than in a properly designed agitation vat. 'Float gold' is likely to escape from the battery at the earli-

est opportunity to find its way, together with classifier overflow, direct to the cyanide plant. The fact that 'float gold' is not easily amalgamable is no argument against the practice of amalgamating coarse gold.

The next paragraph contains an inquiry dealing with the question of additional cyanide strength and also cyanide loss as a result of increased metal content. It is, I think, common knowledge that necessary cyanide strength bears a definite ratio to the amount of metal to be dissolved and precipitated. This is an experience which covers gold ores and concentrates from 1 dwt. to 10 oz. per ton, and silver ores and concentrates from 3 oz. to 250 oz. per ton. With every increase in cyanide strength there is an increase in cyanide loss due to (1) the solution of the metal and lack of regeneration, (2) from the formation of hydrocyanic acid, and (3) from the solution of excess zinc during precipitation. When milling in cyanide is practised, the custom of precipitating a part of the mill solution is general and obligatory; but whether or not a large proportion is precipitated, depends on a number of circumstances, chief of which arises from the fact that an increase in the amount precipitated generally means an increase in the zinc content in the solution and an increase in cyanide loss. When operations are being conducted at an economic disadvantage from either cause, then the amount of mill solution to be precipitated must be reduced, and this has often to be done in order to obtain good precipitation, and prevent undue fouling. In the cyanidation of silver ores a much larger bulk of the mill solution may be precipitated daily without interference with the efficiency of a process which leaves an appreciable amount of dissolved metal in the 'barren' solution. The low value of silver, as compared with gold, makes the operation an economic success. On the other hand, the percentage of precipitation in silver cyanidation is exceptionally good even with a high zinc content. This may be due to the increased bulk of metal or possibly to improved electrolytic action; in any case it is helped by a high cyanide strength and a high zinc and cyanide consumption which would be economically impossible to justify in the treatment of a low-grade gold ore. One method of avoiding this excess consumption is indicated in a description of the Mexican Esperanza mill.² In this plant the sodium cyanide consumption is given as 0.5 kg. and the zinc consumption as 0.195 kg. per wet ton. What a wet ton is, I do not know, but I take it that the actual consumption expressed in a rational manner would not be materially different from these figures. The obvious economy which ultimately affects a number of items beyond those mentioned is in a great measure due to the fact that the Merrill process limits the amount of excess zinc which is exposed to the solvent action of the cyanide. A second point to be noticed is that one of the chief disadvantages of milling in cyanide is overcome in this installation. The

milling dilution, with Huntington mills, is only 4 to 1, as against 10 to 1 in most other mills; and the amount of solution precipitated amounts to only 3 tons per ton of ore, as against twice or three times that amount in cases where ordinary stamp-milling is practised. The degree of dilution when milling in cyanide is practised, largely affects the ultimate economy of operations. In the great majority of cases a high dilution is necessary to maintain tonnage and prevent a low mechanical efficiency. On the other hand, the cyanider's paradise is indicated in some ingenuous charts in recent circulation, with involved mathematical calculations, showing the ease and simplicity with which a recovery of dissolved gold and silver may be made by the aid of a special method dependent for its success on a total milling and sliming dilution of from 1.8 to 1!

Reverting again to the comparison made earlier in this letter to the schemes of treatment at the Dome and Hollinger mills at Porcupine, it is interesting to note that, in the case where milling in water is practised the cyanide make-up is added before agitation, the total cyanide consumption is, if anything, below the average, and the zinc consumption is exceptionally small. On the other hand, and in the case where milling in cyanide is practised, the cyanide for make-up is added before precipitation, the zinc consumption is high, and the cyanide consumption is not stated. My own opinion is that the necessity for the addition of fresh cyanide to the solution to be precipitated is, almost invariably, one of the first indications of fouling; and this is generally due to the fact that a large tonnage of solution is being precipitated, coupled with a too complete retention of undesirable by-products in the circuit. The former is the result and the latter is the concomitant of the practice of milling in cyanide.

I regret that Mr. Stewart should have considered that a definite statement to the effect that zinc precipitation was never complete could be interpreted as a hasty implication that the gold in the so-called barren solution was irrecoverably lost. The fact that the solution after precipitation does carry gold, and that the amount is generally in direct proportion to the original value of the solution, was purposely mentioned because such gold content is an important factor in the ultimate dissolved gold loss in the residue.

Mr. Stewart continues: "The cumulative effect [of part precipitation] tends to approach perfection rather than any such loss as has been too hastily implied." The incompleteness of zinc precipitation is an imperfection, however trifling and unimportant, and how the cumulative effects of an imperfection can approach perfection is beyond my powers of reasoning, and outside the scope of logical criticism.

Mr. Stewart has, during his criticism, referred to what he considers the best practice for medium-sized plants. I cannot see what the size of the plant has to do with the main outline of treatment decided upon for a given class of ore, and based upon metal-

²McCann, Ferdinand, 'Cyanide Practice in Mexico,' p. 49.

lurgical results and economic considerations. If the scheme of treatment bore any relation whatever to the size of the plant, then the erection and operation in units would be unproductive of good results unless the scheme of treatment were altered to suit the gradual increase in tonnage. The contention is obviously untenable.

In reviewing the situation, it is interesting to note that the larger gold mines of the world retain a conservatism in method which is the subject of much adverse comment; and at the same time results are produced which are the envy of those who profess no sympathy with any method not of recent innovation. Improvements are being constantly made with regard to the mechanical handling and crushing of the ore, the mechanical displacement of solution from residue, and in other details of operation. I do not refer to such innovations of obvious merit, but rather to fundamental principles affecting the broad outline of treatment.

To quote the editor of *The Mining Magazine*: "In the sphere of mining and metallurgy, as in other branches of science and industry, a feverish desire to be considered up to date is prevalent." In cyanidation the desire has reached the proportions of a mania.

In considering the excellent results obtained by the Homestake plant and also on the mines of the Rand, it is difficult to overestimate the importance of amalgamation. The exceptionally low cyanide residue is in some measure at least due to the low grade of material which is left after amalgamation has removed by far the greater proportion of the gold. The low consumption of chemicals is due to a similar cause coupled with the advantages arising from a restricted limit to cyanide operations, involving a minimum of solution in circuit. And the low cost of treatment is largely due to the fact that there is no necessity to grind the whole of the ore to a slime in order that a minute percentage of gold may be ground and re-ground and so made amenable to cyanidation. The main lines of treatment in the most successful gold-reduction plants in the world are the result of skilled metallurgical control, in design as well as operation, coupled with a disregard of 'up to date' practice when the latter fails to result in either an increase in recovery or a decrease in the cost of treatment.

Since replying to John B. Stewart's criticism of my article on the above subject, I have, thanks to the courtesy of the secretary of the Chemical, Metallurgical, and Mining Society of South Africa, obtained actual figures relating to matters dealt with. One of the points mentioned by Mr. Stewart was to the effect that the advisability of abandoning milling in cyanide in South Africa has been the subject of frequent discussion. Such a remark is obviously misleading, and I am glad to be able to publish the actual figures for 1912 dealing with the Witwatersrand:

Tonnage milled in water	25,317,711
Tonnage milled in cyanide solution	168,650

Milling in cyanide was adopted at two large plants several years ago. At one of these a change was made to milling in water soon afterward, and for sound economic reasons. At the present time there is only one plant running on the Rand where the ore is milled in cyanide solution, and even in this instance a change would be made to rational and proved practice were it not for the fact that limitations of space in the mill preclude the possibility of alteration. In no instance has the question of the reliability of the head sample been the paramount cause for the adoption of milling in water, although the question when raised can be used as one of the many arguments in favor of the practice.

A second point raised by Mr. Stewart was to the effect that amalgamation in conjunction with cyanidation had been generally abandoned. As South Africa produces such a large proportion of the world's output of gold, the following figures, which are approximately correct and refer to 1912, are of more than local interest:

Value of yield by amalgamation	\$117,110,000
Value of yield by cyanidation	67,011,000

A. W. ALLEN.

Lonely Mine, Rhodesia, December 13, 1913.

[It is entirely too common to take things for granted, and the rapid increase in the use of cyanide has, possibly, made metallurgists too ready to give up the older process of amalgamation. Mr. Allen's further contribution to the discussion of the relative advantages of the process is, therefore, worth while. We regret that circumstances have prevented its earlier publication, but technical information does not rest alone on timeliness for its value.—EDITOR.]

Leaching of Copper Tailing

The Editor:

Sir—I noticed in your issue of May 9 an abstract of a paper presented by me at the last meeting of the American Electrochemical Society. In figure 3 of the advance copies, some of the arrow-heads point in the wrong direction, which is the case with the corresponding figure of your abstract. As this error may easily cause a misunderstanding, I take the liberty of bringing it to your attention.

RUDOLF GAHL.

Miami, Arizona, May 15.

[The figure referred to corresponds to Fig. 2 of the abstract, and the flow between S_1 , S_2 , S_3 , S_4 , and S_5 , as represented by the dotted line, should be the reverse of that indicated by the arrows.—EDITOR.]

A directory, Bulletin 585, of the useful minerals of the United States, totaling 400, has just been published by the U. S. Geological Survey. It was compiled by Samuel Sanford and Ralph W. Stone, and may be obtained free on application to the director of the Survey, at Washington, D. C.

Concentrates

Most of these are in reply to questions received by mail. Our readers are invited to ask questions and give information dealing with the practice of mining, milling, and smelting.

The personnel of the U. S. Bureau of Mines at June 30, 1913, numbered 391 people.

Carbon used in 20,000 ft. of diamond-drill work at the Dome mine in Ontario, cost 52c. per foot.

Slime-settling capacity of the Belmont 60-stamp mill, Tonopah, designed for treating clean quartzose ore, is 5.65 sq. ft. of settling area per ton milled per day. This is low for talcose material.

Stamp-mills in Queensland, Australia, total 156, with 2040 head, for gold ores; and 30 with 355 head for tin ores. In 1913, 1140 and 115 head, respectively, were idle, 672 and 158 worked part of the time, and 219 and 45 worked continuously.

Stamps, their weights, efficiencies, and costs, are being investigated by a leading metallurgist on the Rand, according to *The South African Mining Journal*. There are 1380 stamps weighing over 1750 lb. each, of which between 1100 and 1200 are at work.

By a strange freak of nature the lowest point of dry land in the United States is less than 80 miles from the highest. The lowest point is in Death Valley and is 276 ft. below sea-level. It is said that from this point Mount Whitney, 14,501 ft. above sea-level, can be easily seen on a clear day.

Silver ores of Ontario contain cobalt, and research work has been done at the Queen's University, Kingston, by H. T. Kalmus and others for its economic recovery. The aluminum reduction method is the most satisfactory; 1 lb. of aluminum will reduce a little over 2 lb. of metallic cobalt.

The value of mineral products exported from the Argentine Republic amounts to about \$500,000 per year. The geological survey of the country is still incomplete and nothing has yet been published. Tin mining is likely to become an important industry, but the condition of mining generally in the republic is stationary.

The construction cost of water-power plants in Norway varies from 100 to 200 crowns (\$26.80 to \$53.60) per horse-power for large plants, and from 100 to 500 crowns (\$26.80 to \$134) per horse-power for small plants. The rate at which the power is sold to consumers varies from 30 crowns (\$8.04) for large enterprises up to 50 crowns (\$13.40) for small ones, per horse-power per year, 24 hours per day service.

Gibs used in stamp tappets should be turned to a diameter slightly smaller than that of the stem which

they are meant to grip. In addition to this, the tappet on the opposite side to the gib should be counter-bored or channelled so as to give two further points of contact between tappet and stem.

Hydraulic mine filling is useful for sealing-off mine fires, putting out fires, arresting squeezes, and supporting the surface, and incidentally improves ventilation by filling old workings where gases are formed from many different causes. In Pennsylvania and Europe, culm, ash, crushed slate, and bone from breakers, sand, gravel, clay, loam, crushed rock, and granulated slag are used.

'Gopher' blasting of overburden at the Chino Copper Co.'s mine, New Mexico, according to R. I. Kirchman, resulted as follows: In six holes were placed 7725 lb. of black powder, 38,500 lb. of Judson powder, and 4100 lb. of 40% gelatin; a total of 50,325 lb. This was tamped, and exploded by electric current. A total of 118,660 cu. yd. of ground was broken, so the powder used was 0.425 lb. per cubic yard, and each cubic yard broken required 2.36 lb. of powder.

Cost of treatment at the Nipissing low-grade mill in 1913, when the 40-stamp mill and cyanide plant handled 77,240 tons of 27.18-oz. silver ore, was as follows:

Per ton.	Per ton.
Crushing at mine.....\$0.163	Treatment .....\$1.021
Aerial tram 0.100	Filter and discharge... 0.186
Surface tram 0.117	Precipitation 0.301
Picking plant 0.217	Refining 0.127
Crushing 0.081	Heating 0.113
Battery 0.267	Water supply 0.031
Tube-mills, classifiers.. 0.547	Construction 0.286
Slime collecting 0.448	
Intermediate filter 0.127	Total .....\$4.132

In handling gold precipitate after acid treatment, it has been shown that roasting is only necessary in the case where a material amount of metallic zinc is left in the precipitate. Roasting should be avoided wherever possible, and no improvement in the fineness of bullion produced follows its adoption. When zinc shaving is used as the precipitant there are few difficulties in the way of an almost complete removal of the zinc by acid, followed by filtration and washing with hot water. On the other hand, and where zinc dust is used, there is sometimes a considerable percentage of metallic zinc left after acid treatment, and an alternative method of removal of this base metal, such as smelting with litharge, is indicated as advisable. When the ore being treated is high grade, a simple method of clean-up is practicable. This consists of screening the precipitate from the boxes through 40 or 60 mesh, filter-pressing the fine product, and smelting direct. The latter method is often employed after the cyanidation of silver ores, and was also in use for some time at the Oroyo-Brownhill mill, at Kalgoorlie.

Special Correspondence

LONDON

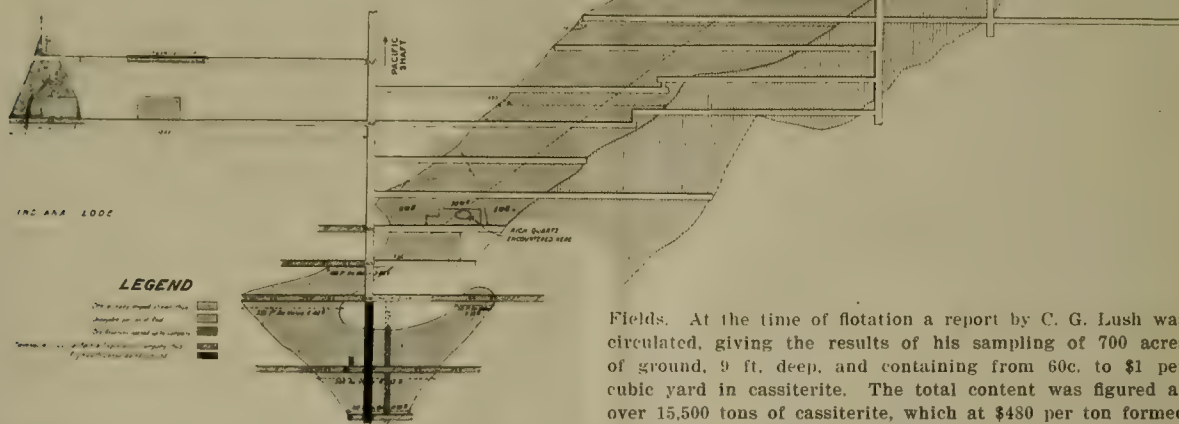
PROGRESS AND PROSPECTS OF THE PLYMOUTH MINE, CALIFORNIA.

—A NIGERIAN TIN FIASCO. FAULTY ENGINEERING AND THE RESULT—CRITICISM OF THE NATIONAL CONSOLIDATED CONSULTING ENGINEER'S REPORT FOR 1913.

Progress of development of the Plymouth mine in Amador county, California, is being followed with unusual interest in London. It will be known to many readers of the *Mining and Scientific Press* that at the end of 1911 the California Exploration Co. was formed to acquire and reopen the mine, on the report of Albert Burch, a report that was backed by W. J. Loring, of Bewick, Moreing & Co. The unwatering of the mine was completed in October 1912. The exploration work has proved the nature of the mine on the 950, 1140, 1500, 1600, 1850, and 2000-ft. levels. At the 1600-ft. level an important piece of work was done in sinking a winze to the 1850 and 2000-ft. levels. Both the last levels have been extended in highly profitable ore. Mr. Loring has stated that many of the mines in the district have proved three profitable zones, that dividends are being paid from the second and third zones, lying at depths of 2000 to 4000 ft. on the underlie, and that the most profitable mine in Amador county today is the deepest, over 4000 ft. on the underlie. The mine was closed down in 1888 on account of fire underground, at a time when 160 stamps were being supplied with ore and the monthly dividends distributed amounted to \$48,000. The reopening by the California Ex-

level downward, and in order to expedite the work it was attacked at three points, at the 1600, 1850, and 2000 ft. levels. At the time of writing, there still remains 80 ft. of timbering to be placed in the shaft to effect its completion. In driving southward from the shaft on the 950 and 1140 ft. levels, a large amount of valuable ore has been found. This part is in fact practically a new mine, and is to be developed from the 1500 and 1600-ft. levels. Conditions are favorable for low working costs, and it is calculated that any ore above \$3.50 per ton will be profitable. The milling plant is to have a capacity of 8000 to 9000 tons per month, and should earn a profit of \$250,000 per year. It is expected that it will be ready earlier than the end of September, the date originally mentioned in the prospectus. As Mr. Loring says, the mine is situated, not in an uncivilized or uninhabited part of the world, but in the middle of a settled state which has a record of the best mining practice in the world.

A particularly bad case of blundering by engineers and queer methods on the part of company promoters is presented by the Jaga (Nigeria) Tin & Power Co., which was formed four years ago as a subsidiary of the Champion Tin



LONGITUDINAL SECTION OF THE PLYMOUTH MINE, AMADOR COUNTY, CALIFORNIA.

ploration Co. was accomplished in the time originally estimated and within the amount provided for the purpose. When the bottom was reached—that is, the 1600-ft. level—exploration was started vigorously. An old winze below the 1600-ft. level was continued on the lode to the 1850-ft. level, where 334 ft. of driving proved a width of lode of 4½ ft. and an assay-value of \$6.32 per ton. The winze was then continued to 2000 ft., where a cross-cut exposed 21 ft. of ore averaging \$6.18 per ton. Driving north and south for 120 ft. exposed 7¼ ft. of lode averaging \$15.86 per ton. In this mine the second pay-zone had been entered, and with good fortune there should be 800 to 1200 ft. of profitable ore before reaching the bottom of this zone. The shaft has been turned into an incline from the 1600-ft.

Fields. At the time of flotation a report by C. G. Lush was circulated, giving the results of his sampling of 700 acres of ground, 9 ft. deep, and containing from 60c. to \$1 per cubic yard in cassiterite. The total content was figured at over 15,500 tons of cassiterite, which at \$480 per ton formed a big asset. Now comes the official statement by the board that the yield to date has been only 256 tons and that the ground contains only 360 tons more. The present directors complain of other undependable reports written by L. H. L. Huddart and A. W. Hooke, and state that it was not until July 1913, when J. J. Hunter assumed the management, that the real state of things was discovered. The method of formation of the Company was not above suspicion, for the directorates of the vendor and subsidiary companies were practically identical, and the purchase price was no less than \$480,000 in cash and 125,000 shares of \$4.80 each. These three directors have since resigned and have been lying low and saying nothing. Efforts have been made by their successors on the board to recover part at least of the purchase price, but the authorities on company law advise that legal pressure would be futile. The present chairman has uttered a sad wail about the undependableness of reports by mining engineers. There have been of course, unreliable reports

from pseudo-engineers, but I must say that many people here share the pained surprise of the chairman that two members of the profession whose names are not unknown should apparently have made such a bad break as this. It is to be hoped that they have some explanation or answer.

The report of Natomas Consolidated for the year ended December 31, 1913, has just been issued. The report seems mainly an attempt on the part of the consulting engineer, C. M. Rolker, to the London agency to justify discrepancies between the estimates made in his original report for the English investors and the results of actual operation. The salient feature in the profit and loss account is that the profit for the year, before writing off depreciation or bond discount, amounted to only \$107,841. The following sentence in the report gives the gist of the situation as regards the dredges: "On the whole the dredging results have been disappointing." On page 916 of this issue will be found an abstract of the Company's report. According to the president of the Company, as stated in Mr. Rolker's report, "The gold recovery has been about 15% less on the gross gold, and about 27% less on the net than the bore-holes indicated."

On account of the negotiations for re-financing Natomas at present pending, the following is of interest. According to the report, the current liabilities are: notes payable, \$1,578,646; accounts payable, \$1,036,071; vouchers payable, \$242,923; accrued interest, \$40,502; a total of \$2,898,142. The bonds issued are \$17,375,000, and bonds pledged, \$5,326,000; making a total of \$22,701,000. The engineering department estimates the cost of the work remaining to be done in the reclamation districts, irrigation lands, etc., at \$1,703,185, and reference is made to a note at the end of the report: "Since the above was written, general but not detailed figures have come to the writer's knowledge, from which it appears that the indicated omissions in the schedule represent something like \$1,000,000 in addition to the quoted schedule as far as the writer knows at present."

In July 1909 the president of the Natomas Consolidated approached the Hirsch Syndicate, Ltd., to procure for Natomas by January 15, 1910, \$5,000,000 to complete its dredging fleet and finish the reclamation and irrigation project. He laid before the Syndicate the report of the Natomas' general manager. The Syndicate asked for and received from W. P. Hammon, also an interested party in the property, a cable endorsing the report that the net dredging profit exceeded \$20,000,000. The consulting engineer was asked in August 1909 "to proceed to California to examine the data on which the report was based; he was not asked to re-drill the property." The report was favorable, and at the time of the flotation of the \$5,000,000 worth of the Natomas bonds, this report was published. The report just published emphasizes the facts that C. M. Rolker, as consulting engineer, relied upon Messrs. Cleaveland and Hammon for the estimated yield from the gravel, and evidently for the dredging costs also. The original report states that he depended upon agricultural experts for the value and profit to be derived from the farm lands and lands to be reclaimed. The present report says he is not an expert on reclamation. He also states that the estimate of the cost of the "new dredges were made between the Company's Californian engineers and the Yuba Construction Co. The writer did not make any estimate of the cost of the dredging or other plant."

Mr. Rolker says: "To those who may ask why the writer did not bore some test-holes to check the accuracy of the general manager's statement, the reply is given that it would have been futile and misleading to attempt to do this by a few test holes." It is hardly conceivable that the examining engineer of a property the size of the Natomas, and one involving the expenditure of \$5,000,000, would have been limited to a few holes had he desired to obtain first-hand knowledge of the ground under examination. The statement is made that when extraction results did not bear out expecta-

tions, Mr. Rolker notified F. W. Griffin, then the president of the Company, of this fact. Mr. Griffin, who was evidently surprised, "took immediate steps to satisfy himself as to the correctness of the writer's assertion." A special dredging engineer was engaged by the Company "to test this question with instructions to do check boring."

While it would have been good business had a special and competent dredge engineer been engaged in the first instance, it was hardly necessary to hire one simply to prove that the dredge recovery was not up to the estimate when the values indicated on the drill-maps furnished by the vendors, compared to actual returns from the dredges, would be sufficiently plain to establish this discrepancy.

Mr. Rolker emphasizes the fact that the gold contents indicated by the different bore tests were reduced by 15% in order to make them representative of actual extraction. The customary practice of independent engineers, familiar with the examination of dredging propositions at that time, was to reduce the value indicated in prospecting by 25%. The present report on the whole is a weak affair, and does not strengthen Mr. Rolker's position. It would seem that if his engagement was simply to go over maps and statements furnished by the vendors, and to adopt same with slight modifications, his report would have had the same technical value had he remained in his London office during the whole period. It could hardly be expected that he would correctly appraise the ground under the conditions that obtained as stated in the present report.

BUTTE, MONTANA

'SAFETY-FIRST' PRIZES.—NEW COAL MINES.—ANACONDA LEACHING PLANT.—COAL DUST FOR REVERBERATORY FURNACES.—ELM ORLU MILL.

The foreman of the Original mine in Butte, Dan P. Sullivan, is winner of the first annual prize of \$750 offered by the Anaconda company to the foreman who has the least number of serious accidents during the year. Karl P. Krueger, foreman of the West Colusa mine, won the second prize of \$250. A serious accident is considered to be one which keeps a man from work 30 days or more. The percentage is calculated on the number of man-shifts worked underground during the year under each foreman. The Company is convinced that this policy of a reward for guarding against accidents is yielding good results, and that the money spent in prizes is saved many times by the avoidance of damage suits.

The Great Northern Railway is opening a new coalfield at Windham, in Fergus county. Its old mines at Belt are nearly exhausted, and the grade of coal mined from there was never satisfactory. The new mines contain a better grade of coal, and it occurs in thicker purer seams.

The manager of the Washoe plant, E. P. Mathewson, expects the tailing leaching plant to be in operation by next spring. Excavation for the buildings is now under way, and the steel is being ordered. This leaching plant bids fair to be the most important advance of recent years in copper metallurgy.

The coal-grinding plant at Anaconda for feeding coal to the reverberatories in the form of dust will be ready for use by July 1. The furnaces are to be remodeled one at a time, so that they will be adapted to the new fuel. In addition to the important saving in fuel expense, the new method of firing will do away entirely with clinkers and ash. Credit should be given the Portland cement industry for the development of this form of fuel for high-temperature furnaces.

The new 500-ton concentrating plant for the Elm Orlu mine is about ready to start. The technical crew is being employed, and June 1 is the date set for starting. Considerable interest is being shown in the operation of the new

mill, as it has evidently been the ambition of the management to have the mill as nearly perfect as possible to start with, and thus avoid the vexatious and expensive delays attendant on the usual changes and revisions. Considerable expenditure and effort were made in preliminary testing, and advantage was also taken, naturally, of the experience of the Butte & Superior mill. The ore to be treated, however, is different in important respects from that of Butte & Superior. The copper content is of commercial value and must be saved, and the iron content is not so uniformly low. The Elm Orlu is adopting the flotation equipment of the Minerals Separation company, and the plant has been installed.

AUSTIN, TEXAS

FAILURE TO PRODUCE PIG IRON FROM EAST TEXAS ORES AT A PROFIT.—HIGH FREIGHT RATES AND FOREIGN COMPETITION. — COSTS OF PRODUCTION.

Another effort to develop the iron ores of east Texas, through the use of the state's iron-ore furnaces at Rusk, has failed. D. M. Barringer, of Philadelphia, president of the Texas Iron Association, which recently leased the furnaces at Rusk and made extensive improvements, has notified Governor Colquitt of its intention to cancel its contract and abandon its plans for manufacturing pig iron at Rusk from ores shipped from its holdings in Cass county. Notwithstanding the extent of the east Texas orebodies, the high freight rates on the raw material to the furnace, the low rates available for Birmingham pig iron, and the product of foreign furnaces have made it impossible to operate the plant profitably. The Association will lose the \$20,000 invested on improvements and repairs to the Rusk furnaces, and other large sums sunk in developing the Cass county ore-beds and in equipment for handling the ores. To attempt to operate the plant under present conditions, however, would entail an even greater loss, according to Mr. Barringer. Under the terms of the agreement with the state, the Association was given the right to cancel its contract whenever Birmingham pig iron should be less than \$11 per ton. In his letter to Mr. Colquitt announcing the Association's intention to cancel the contract, Mr. Barringer pointed out that pig iron is now \$10.50 at Birmingham, with little prospect that it will go higher. Figures have been compiled by Mr. Barringer showing that in order to operate the Rusk furnaces under present freight rates, without either loss or profit, pig iron should sell for \$18.38 per ton at common points. Pig iron from Rusk can be laid down at Houston and Marshall at an actual cost of \$17.50 per ton by taking advantage of a special freight rate to those places. Because of the low interstate freight rates, Birmingham pig iron can be laid down at Marshall and Houston for \$16, and at all other points in Texas for \$17 per ton. It is also claimed by Mr. Barringer the removal of the duty on pig iron permits the foreign product to be sold for less than \$16 per ton. In a letter to Mr. Barringer, Mr. Colquitt said: "In your statements, you show the cost of producing pig iron at Rusk, which you estimate at \$17.38 per ton, over \$6 which, according to your figures, is cost of freight on the raw materials to the furnace. One of the principal reasons you give for not being able to operate the furnace is high rates fixed by the Texas Railroad Commission as compared with the rates for similar service on raw materials to Birmingham. I did all I could to secure a lower rate for you. One of the purposes of the administration in leasing this property to you was the hope it had of demonstrating the value of east Texas iron ore. I believe, if this could be done, that there would be a large sum of money invested in east Texas for the development of this industry, and I am very sorry that the commission and the railroads did not give you a rate which would encourage the development of the enormous wealth dormant in east Texas which has so long remained undeveloped."

PORCUPINE, ONTARIO

PROSPECTS OF THE DISTRICT.—DEVELOPMENTS IN THE PORCUPINE CROWN.—MCINTYRE, NORTH THOMPSON, ACME, HOLLINGER, DOWD, AND PORCUPINE GOLD MINES.

Conditions in Porcupine continue to improve, and indications point to the coming season being one of great activity. The older properties are developing well and giving excellent results, and several new properties which are being opened show considerable promise. The main centre of activity is in the Pearl Lake section, where the greatest distribution of profitable veins in the Porcupine district seems to occur.

The Porcupine Crown has been in the limelight recently on account of the rapid decline in the stock from about \$1.30 to 80c. per share. The chief reason for this decline seems to be the general impression that the vein has been cut off by a fault below the 400-ft. level, and that the management has not yet succeeded in finding it, although considerable development with this end in view has been accomplished. As a matter of fact, the position of the Company is much better than is generally believed. In the underground workings, there are two ore-shoots known as the north and south shoots. The former is narrower than the south shoot and not of so high grade. On the 400-ft. level, it was found to be much shorter than at 300 ft. A winze was sunk to the 500-ft. level, and the vein was found to dip out of the winze at 450 ft. It is understood that from the 500-ft. level a cross-cut was driven to try and find the vein, but was not successful. Operations were then resumed at the 450-ft. level, where a drift is now being run on the vein. On the south shoot, which is much wider and larger than the other, the vein at 400 ft. is approximately the same as on the upper levels. A drift is being driven to the southern boundary of the shoot, and when this is finished a winze will be sunk on the ore. So far there is no reason to expect any sudden change in this shoot below the 400-ft. level. There is, however, a fault at the southern boundary of the south shoot, the existence of which has been known since the early days of the property. Diamond-drill holes were bored south of the fault, and the results of this work indicated the continuation of the vein. A considerable amount of development has been done on this portion of the property, but so far has not been successful in developing any commercial ore. The possibilities are, however, by no means exhausted. In March the production was over \$80,000, and costs were \$4.60 per ton. This production is considerably in excess of the amount necessary to pay the dividend.

Results from the McIntyre mine have been satisfactory, and during March the mill treated 4325 tons averaging \$12.68 per ton, and made a recovery of 97.8%. Shipments of bullion for the month were valued at \$52,661. During the past year a total of 4171 ft. of development was done, and the ore available for stoping is estimated at \$1,245,000. Gold production to date amounts to \$400,868. The management hopes to increase the capacity of the mill, and additional machinery is being installed. The cross-cut under Pearl lake, on the 600-ft. level of the Pearl Lake shaft, had to be abandoned on account of the dangerous condition of the ground.

On the North Thompson, which is under control of the Huronian Belt Syndicate, the shaft has reached a depth of 90 ft. At this point the vein is between 4 and 5 ft. wide, and is said to carry satisfactory gold content. It is also reported that good results have been obtained in the deep diamond-drill holes.

If development on the Acme gold mine continues to be as satisfactory in the future as it has been in the past, the indications are that this property will develop into a large

producing mine and should be nearly as large as the Hollinger. It is altogether probable that the Company will eventually be amalgamated with the Hollinger, as it is controlled by the same people, and some of its operations are on the extensions of Hollinger veins. Thirteen drills are at present being worked, and as soon as more power is available this number will be increased. It is understood that the intention of the owners is to develop the property to a point where they have sufficient ore in sight to justify them in asking a substantial price for it.

The Hollinger mine is operating 43 drills, and has not sufficient air capacity to permit of gaining any substantial reserve of broken ore in the stopes. It is said that the present reserve of broken ore amounts to only about 12,000 tons.

Good progress is being made on the new mill at the Dome and this should be in operation by the end of May. The annual meeting will be held at Toronto on May 26, and it is understood that a full and detailed report will be submitted. The March production shows a bullion recovery of \$87,657 from 14,970 tons of ore having an average value of \$5.85 per ton.

Arrangements have finally been made for the reopening of the Porcupine Gold property, formerly known as the Vipond. A new company, known as the Porcupine Vipond Mines, Ltd., with a capital of \$1,500,000 in shares of \$1 par value, is purchasing the property of the Porcupine Gold Mines, Ltd., which has a capital of \$2,000,000, for 750,000 shares in the former Company, which will be divided among the present shareholders of the Porcupine Gold Mines, Ltd., on the basis of three shares in the new Company for eight shares in the old Company. The new Company has also underwritten 300,000 shares of treasury stock at 30c. per share, leaving 450,000 shares in the treasury. The \$90,000 realized from the sale of treasury shares is estimated to be sufficient to pay off the debts of the Company and to provide a cyanide plant which is absolutely essential to profitable operation and treatment of the ore.

NEW YORK

GRANBY'S NEW SMELTER.—UTAH METAL MINING CO.—BUTTE & SUPERIOR.—MICHIGAN COPPER MINES.—AMERICAN INSTITUTE OF MINING ENGINEERS' MEETING.

The shareholders of Granby have voted to borrow \$3,000,000, as needed, for additional working capital in its largely increased operations. At Anyox (Hidden Creek district) two of the smelting furnaces have been blown in, and a third is ready but has not been started, as difficulties in the mechanical operation of the converters and crane have rendered the converters incapable of handling all the matte produced. Smelting operations have been satisfactory, and it is reported that experience shows that pyrite smelting can be practised, and the coke consumption will be less than one-half that originally expected.

The Utah Metal Mining Co. is being reorganized, and the new Company will have a capital of \$500,000 in \$1 shares. Of these, there will be issued 396,176 shares to take up the outstanding shares of the old Company, on the basis of one of the new shares for four old shares, plus a payment of 10c. per share on the old stock. It is stated that, of the new shares, 120,000 will be issued to take care of the floating debt. Just how this will be accomplished is not clear, since only 103,000 shares will be left in the treasury when the exchange is completed; nor is it clear how these can be made to provide 134,000. It is hard to determine the price of the shares, though, since there have been no recent transactions in them. The story of this Company is merely another page in the history which began with the driving of the Sutro adit on the Comstock, and the moral is that long adits driven for

drainage and exploration purposes are not good investments, for they rarely develop much of value, and by the time they are completed the mining boom which caused them to be started is commonly past. While speaking of companies in the Bingham District it may be noted that W. O. Allison has begun a campaign to get control of the Ohio away from F. A. Heinze. Considering its modest production of a little over 500,000 lb. of copper per month, the Ohio makes a tremendous amount of stir in the world.

The Butte & Superior report for the first quarter of this year makes a fair showing. The Company's interests are said to be negotiating for the Success mine, in the Coeur d'Alene region, Idaho.

Calumet & Hecla has declared a quarterly dividend of \$5 per share, instead of the \$10 which used to be the rule before the strike last year. The Osceola Consolidated has made a good recovery from the strike and is now crushing at the rate of 100,000 tons per month, its normal capacity. The ore now being milled yields a little over 11 lb. of copper per ton. The Allouez now has 330 men at work and is mining 1000 tons per day. As the labor supply in the Lake district is now good, it is expected that the working force will be considerably increased soon. The New Arcadian shaft is to be continued from the 750 down to the 900-ft. level. The long record of unsuccessful work of the Arcadian makes the persistence of the management worthy of admiration. The Isle Royale is increasing its output, and should be producing 2600 tons per day soon.

The New York section of the American Institute of Mining Engineers held its annual business meeting on May 21. Departing from the usual practice, the meeting was held at Browne's Chop House instead of at the Institute headquarters. The usual reports of officers were presented, and then the section officers for next year were elected, as follows: L. W. Francis, chairman; Willard S. Morse, vice-chairman; P. L. Mosman, treasurer; T. T. Read, secretary. Following the business meeting, a beefsteak supper was held, over which E. F. Roeber presided. Dr. Kohlbeck, who has come to this country to be present at the celebration of the fiftieth anniversary of the Columbia School of Mines, was the first speaker of the evening and made a brief address, in which he expressed his pleasure at being present, and complimented the mining profession of America on the wonderful growth which has resulted in so short a period in this country. The next speaker was T. A. Rickard, who represents the Royal School of Mines of London at the Columbia celebration, who spoke of the influence of the Cornishmen in the development of the mining industry in America and throughout the world. B. B. Thayer, the president of the Institute, was next called upon, and after expressing his pleasure at the successful meeting, stated that he relied upon his friend, John C. Montgomery, to tell German stories for him. Mr. Montgomery related amusing anecdotes of the early days of mining in America, the absence of the German accent in his stories being marked. James F. Kemp was next called upon to speak of the influence of Germany on geology, and kept his listeners in laughter by an account of his student experiences in Germany and the rendition of some German mining songs with a faultless Milesian accent. Henry S. Drinker, the president of Lehigh University, spoke of early days in the Institute, he being the only charter member of the Institute present. In addition to referring to the early days of mining in this country, Dr. Drinker also told of his boyhood in China and Japan and the influence of Americans in the early development of those countries. Charles F. Chandler, emeritus professor of chemistry in Columbia, and the only one of the original faculty of the School of Mines present, gave a most interesting account of the difficulties of early development of the School and related amusing anecdotes from his wealth of experiences gained during his long period of service as dean of the School of Mines at Columbia.

General Mining News

ALASKA

JUNEAU

The Alaska Mexican, Treadwell, and United companies paid dividends No. 74, 106, and 27, of 20c., \$1, and 20c. per share respectively on May 28. The outputs of these properties in April were as follows:

	Alaska Mexican.	Alaska Treadwell.	Alaska United.
Development feet	6	50	1,668
Stock of broken ore, tons . . .	14,581	52,793	4,671
Stamps working	120	540	240
Ore crushed, tons	19,845	80,724	36,687
Concentrate produced, tons . .	353	1,584	794
Gold by amalgamation	\$22,830	\$104,624	\$38,811
Gold by cyanidation	24,116	84,421	34,093
Realizable value	46,477	187,155	72,175
Net profit	18,873	103,952	13,317

Considerable work was also done by the Mexican company in the United company's 700 Ft. Claim for the purpose of handling Mexican ore through the central shaft. The Treadwell company also did a good deal of work in the 700 Ft. Claim for the benefit of the Mexican, United, and Treadwell companies, the cost of which is charged out proportionately.

ARIZONA

COCHISE COUNTY

A 200-ton per hour rock-crusher plant is being assembled at the Junction shaft of the Calumet & Arizona mine. It should be complete by July. On Sacramento hill at Bisbee, the Copper Queen company has three drills at work. Creditors of the Tombstone Consolidated Mining Co. have asked that the property be sold. Engineers of the Copper Queen company have examined the mine, and the Company will probably bid for it. The Murphy interests may also enter the bidding. In the Shattuck-Arizona mine, silicious gold ore at 300 ft. assays from \$8 to \$170 per ton. At 400 ft., 10 ft. of oxidized ore contains 18% copper. Rich gold ore is also being opened at 200 ft. Work at 900 ft. is promising.

GILA COUNTY

(Special Correspondence.)—Riveting has been started at the Inspiration concentrating building with 32 men. In all, the American Bridge Co. will have to drive 140,000 rivets. The forge shop at the mill is nearly finished, and several machines are already working. The Oscar Daniels Co. has 40 men at work at the smelter site. The concentrate receiving pocket is completed, and steel is being erected on the 12,000-ton bedding bins, also on the boiler house of the power-plant, which is to contain seven units of Stirling boilers, using waste heat from the reverberatory furnaces. Excavations are completed for the two oil-storage tanks, situated on the top of the hill just to the east of the power-plant site. These tanks will have a combined capacity of 30,000 bbl., or nearly 1,000,000 gallons.

Miami, May 22.

CALIFORNIA

During the first 4½ months of its operations, the State Compensation Insurance Fund has written premiums aggregating \$350,000. On January 1, the estimate of probable business for the entire first year was \$250,000. These premiums of \$350,000 represent an estimated annual payroll of \$50,000,000, and about 55,000 workers are thus affected by insurance in the state fund. During the period referred to, the number of accidents reported and covered by these fund policies was 980. Of this number there were only four cases necessary to be submitted

to the Industrial Accident Commission for adjudication. In three of these, hearings were necessary to establish the extent of disability or extent of dependency, and one claim was disputed as to its validity, in which case it was proved that in July was not sustained in the service of the employer. This means that out of every one hundred claims for compensation, over 99½% have been handled promptly, and to the entire satisfaction of the workers, and that less than 0.5% of the cases have been submitted for hearing.

AMADOR COUNTY

It is said that an engineer representing Eastern capital has been examining the old Eureka mine (Hetty Green property) at Sutter Creek. A large tonnage of profitable ore is said to have been opened years ago.

BUTTE COUNTY

Rich gold ore has been opened in the Little Joe mine near Hurleton, in which Oroville people are interested.

LASSEN COUNTY

A mineral belt near Doyle is said to have great possibilities for profitable working.

MERCED COUNTY

(Special Correspondence.)—The Yosemite Dredging & Mining Co., operating at Snelling, on the Merced river, has just completed and started a new dredge. It was constructed by the Yuba Construction Co. from parts of the old one and a



NEW DREDGE OF THE YOSEMITE DREDGING & MINING COMPANY.

considerable amount of new material. The buckets are of 2.75-cu. ft. capacity, and the gravel is disintegrated by a shaking screen. Everything is driven by electric motors.

Snelling, May 17.

NEVADA COUNTY

The Oustomah shaft is being deepened from the 1050-ft. level. At 400 ft. the west cross-cut has cut a rich shoot. An option on the Murchie mine, near Nevada City, has been acquired by H. W. Miller of New York. The property has been mixed up with the Myers-Wisner swindle, and is in debt. Henry Fitter is to be in charge. Work has been resumed at the Gaston mine. The Cassidy mine is to be unwatered, and George St. John, of the Alaska mine, Sierra county, is head of a new company to reopen the property. A contract for the construction of a 15,000,000-gal. reservoir has been let by the trustees of Nevada City. This will be constructed in the old McCutchan hydraulic diggings near Canada hill. The water supply will come from Little Deer creek, this water right having been acquired by the city many years ago.

PLACER COUNTY

The Occidental and Weber properties near Iowa hill are to be opened by an adit by the McGleachin company. A. Rose is in charge of the work.

SIERRA COUNTY

The Balaklala mine is producing 300 tons of copper ore per day, most of which is going to the Mason Valley company's smelter at Thompson. At the mine and idle Coram smelter 145 men are employed. No more experiments with the Hall process will be made at the smelter, according to the general manager, Frank M. Leland; but will be tried at the smelter at Garfield, Utah.

SIERRA COUNTY

Two shifts are working at the White Bear gravel mine. A large body of quartz has been opened in the Monarch mine, and 10 stamps are to be added to the mill. Dan McGonigal is manager.

TRINITY COUNTY

(Special Correspondence.)—W. A. Boyce, who has a bond and option on the Ozark mine, expects to have his new arrastre ready for work about May 25. He has several tons of good ore on the dump and plenty in sight. Mr. Boyce expects the results will be good enough to justify him in taking over the property, which has been practically idle for several years, but has produced some high-grade ore, and is considered a good property. Jack McGinn discovered a small rich vein, in Rich gulch, which proved to be on ground belonging to H. L. Knowles of Helena. He expects to open it soon. Charles Myers is making good progress on his cross-cut adit, which will cut his orebody at considerable depth. This is a promising prospect. A drift from the lower adit on the Golden Chest has reached the ore-shoot beneath the old workings, and cut ore which shows free gold and high-grade galena. The vein is 4 ft. wide and improving. T. J. Rochford is in charge. The Enterprise mine is employing 12 men. The 10-stamp mill is running full time on good ore, and there is plenty of it in sight. R. A. Skinner is in charge.

Helena, May 10.

The reports of the Trinity Gold Mining & Reduction Co. and the Trinity Consolidated Hydraulic Mining Co. for the year ended November 30, 1913, have just been published. The reports of the general manager, at Douglas City, D. W. Shanks, contains the following information, the first named being covered first: Owing to lack of funds to do further drilling, development was stopped about the end of March 1913. The orebody found at a depth of 150 ft. by drilling, and opened later by drifts, is 8 ft. wide and 60 ft. long, and dips at an angle of 70° from the horizontal. The drill had passed through the richest part, assaying \$34, but 10 ft. away the value is only \$10, and farther on \$5 per ton. Results of drilling prove that other bodies of sulphide ore exist, and large shoots of such ore should be developed. There are outcrops of oxidized ore in the gulches of the property. The Headlight orebody is similar to the copper deposits of Shasta county. Various processes have been tested to treat the sulphide ores, but they failed to give commercial results. The mill was built for oxidized ore, but will not treat these ores. Owing to the presence of copper in the ore, cyaniding is unsuitable. There is a large tonnage of ore opened averaging 0.75 to 1% copper, and \$4.50 per ton in gold and silver. Power was sold during the year to the Alta Bert Dredging Co., near Trinity Center, and other small consumers. As soon as the snow has melted on the property, it will be examined by an English mining engineer. After this report is complete, and those on ore treatment from the metallurgists engaged, a plan for providing funds for future work will be formulated. Development will cost \$25,000, according to the president, Henry W. Miller, and plant remodeling may be only \$50,000. There was no revenue from the mill in 1913, it being shut down. Gross earnings from electric power, etc., were \$5175, and there was a deficit of \$12,455 on mine operating account. The surplus at the end of November 1913 was \$78,598, and the previous term \$104,797. Assets include, a 40-stamp mill, hydro-electric plant, 200-ton cyanide plant, buildings, tramway, etc., worth \$177,128; other equipment, \$12,132, and supplies, \$7350.

Operations at the gravel mines of the Trinity Consolidated company were, in common with others in California, reduced on account of shortage of water. A large body of clay also interfered with sluicing at the Union Hill mine. It required powder to loosen it before the water would cut it out. Results by hydraulicking at the three properties were as follows:

	Brown.	Hupp.	Union Hill.
Gravel moved, cubic yards.....	31,920	60,000	326,481
Gravel moved, cubic yards per day	1,850	1,900	4,285
Water, miner's inches		62,500	189,000
Duty per inch, cubic yards.....		0.96	1.60
Value per yard, cents.....	14.8	19.3	5.73
Operating cost per yard, cents....	10.7	9.3	3.90
Total value of gold from three mines.....			\$35,414
Average operating cost, cents per cubic yard.....			6.0
Average total cost, cents per cubic yard.....			7.7
Operating profit			\$ 3,087
Bond and borrowed money interest.....			14,063
Deficit for year.....			10,976

A large deposit of gravel owned by the Company, over which water for the Union Hill mine is conveyed, was given a preliminary examination, and pannings averaged 5c. per yard. This could be cheaply worked under the pressure of 193 lb., and the tailing discharged into the Trinity river. Only the gravel owned by the Lagrange company and that at Duton creek in Trinity county are larger than this deposit.

COLORADO

LAKE COUNTY (LEADVILLE)

The 'down-town' group of mines at Leadville, which have been flooded since 1896, are to be unwatered, Jesse McDonald, ex-governor of the state, having called for bids for the pumping plant. This will cost about \$100,000.

SAN MIGUEL COUNTY

At a depth of 300 ft., \$15 to \$25 ore has been opened in the Fourth of July and Nancy Hanks claims in the old Sawpit district. During April the Tomboy mill treated 12,000 tons of ore yielding \$39,500 and \$39,500 from 960 tons of concentrate shipped. The estimated profit, including \$3050 from the tramway company, was \$30,050. The Humboldt mine, near the Smuggler-Union in the Telluride district, has been optioned to the Breitung Mining Co. of New York. It was recently examined by F. G. Farish, and is to be checked by R. E. Cranston. Reserves are estimated at 104,261 tons, worth \$1,860,454.

TELLER COUNTY (CRIPPLE CREEK)

A car of coarse rock and one of screenings from Korff, Heith, and Bruington, lessees on the Isabella property, averaged \$30 and \$55.40 per ton respectively. This lease produces from 9 to 12 cars of ore per month. Bailing water with two buckets under cages in the Granite company's Gold Coin shaft, 950,000 gal. was removed in 12 hours recently, recovering No. 11 level. The properties of this Company produced 2600 tons of \$25 ore in April. Probably the Portland mill on Battle mountain will receive custom ore for treatment.

IDAHO

BLAINE COUNTY

The Wilbert Mining Co.'s report for the ten months ended May 1, 1914, shows that there is 10,000 tons of ore in the old stope, No. 2, and the Quarry workings; and 15,000 tons between No. 3 and 4 levels. Owing to the low price of lead, ore production was stopped on January 15. During the period, the mill treated 11,193 tons of ore assaying 30.5% lead and 2.69 oz. silver, producing 5301 tons of concentrate containing 5,546,118 lb. lead and 24,080 oz. silver. Recoveries were 81.23 and 79.98% of the lead and silver respectively. The revenue was \$160,463, and net profit \$29,733. Development is to be continued.

SHOSHONE COUNTY

Copper ore from the new North Fork district is to be transported 18 miles on flat-boats down the North Fork river to Prichard, where it will be loaded on railroad cars for the smelters, according to *The Wardner News*. The ore is high grade, up to \$100 per ton in copper and gold. The first

shipments will be from the Mayday group owned by J. Stout, E. Williams, and C. Feshan. Another well developed property is owned by G. Morrison, S. Murray, G. Allen, B. Kincaid, and J. Wright. Ferman Bros. have promising claims. This new mineral belt has extended the Coeur d'Alene district 20 miles farther north. Beyond this prospectors have not done any work.

The holdings of the Aeolian Consolidated Copper Mining Co., Marguerite Mining Co., and others, totalling 32 copper claims and fractions, have been acquired by the Columbia Copper Co. This has a capital of \$2,500,000, and is controlled by Idaho, Spokane, and French people. The National Copper Co.'s lower adit runs through the claims and will probably be used in mining operations.

MICHIGAN

Michigan participated in the general increase in coal production in 1913, mining 1,231,786 short tons, valued at \$2,455,227, according to figures compiled by E. W. Parker, of the U. S. Geological Survey, in coöperation with the State Geological Survey. The increase over 1912 was 25,556 tons in quantity and \$55,776 in value.

HOUGHTON COUNTY

Between No. 1 and 2 regrinding plants, the Calumet & Hecla company is preparing to erect the first unit of a large leaching plant. There will be eight vats of 1000-ton capacity each. A recovery of 70% is expected by the metallurgist, Mr. Benedict.

MONTANA

LEWIS AND CLARK COUNTY

The U. S. Assay Office at Helena has been the subject of a good deal of discussion in Congress, some senators alleging that it is being maintained for large mine operators. This is not so, as 96.7% of the depositors of bullion returned less than \$10,000 each. Since 1903 there have been 10,270 deposits, valued at \$21,455,654.

LINCOLN COUNTY

A bond has been secured on about 2000 acres of placer ground on Big Cherry creek, in the Libby district. The property is owned by Howard Bros., and the new men interested are J. E. L. St. Clere, Charles L. Monsch, and C. A. Chapman of Los Angeles, and E. E. Mellander, of London. Prospecting has been under way for several weeks.

SHAWNEE COUNTY

The Butte & Superior Copper Co. reports as follows for the first quarter of 1914:

Ore milled, dry tons	97,590
Average zinc content, per cent.....	18.546
Average silver content, ounces per ton.....	10.3913
Zinc concentrate produced, pounds.....	62,560,288
Ratio of concentration, tons of ore producing 1 ton of concentrate	3.07
Average zinc in concentrate, per cent.....	51.73
Average silver in concentrate, ounces per ton.....	26.41
Mill recovery, per cent.....	90.84
Cost of mining, per ton.....	\$3.244
Cost of milling, per ton.....	2.175
Total cost	5.45

There was also produced 887 tons of lead concentrate assaying 49.24% lead and 45.34 oz. silver. The net-value of all products was \$869,216, and net operating profits \$337,242. Development in the mine totaled 4361 ft. and was charged to operation. A good development was made on the 1400-ft. level of the Black Rock and Four Johns claims. At the end of March the cash on hand amounted to \$810,467, and the directors have decided to start the payment of quarterly dividends immediately.

The North Butte mine is reported as being in excellent

shape. At 2400 and 2600 ft. the Edith May vein shows improvement. At 2400 ft. the Snowball vein is opening well.

The Anaconda company has ordered two additional 150-hp. induction motors from the General Electric Co. The East Butte company will install 35-hp. and 100-hp. induction motors recently ordered from the same firm.

NEVADA

The U. S. Geological Survey is planning to continue exploratory drilling for potash in the West during the coming season, and will probably have the work done by contract under the direct supervision of the Survey, if favorable bids can be obtained for sinking to at least 1200 and possibly 2000 ft. Among other plans for the potash search for this year, the Survey expects to sink one or more deep wells in the Black Rock desert of this state. The site proposed for further work by the Survey lies in the 'sink' or low part of the desert, which was one of the principal arms of the prehistoric Lake Lahontan. This is northeast of Gerlach, and only four or five miles from the main line of the Western Pacific railway, north of a station called Trego in Washoe county. Bids for the drilling contract will be called for at an early date. Conditions seem favorable for the occurrence within the desert of a well defined saline deposit.

CHURCHILL COUNTY

During April the Nevada Hills mill treated 4820 tons of ore averaging \$8.90 per ton and yielding a net return of \$9891. The total resources of the Company are worth \$218,199, with no liabilities.

ESMERALDA COUNTY

After June 1 the Jumbo Extension company will cease sending ore to the Bonnie Claire mill, south of Goldfield, and ship to the Goldfield Consolidated mill. The respective milling costs are \$3.16 and \$3 per ton. Good ore is being mined at 200 ft. in the Sandstorm-Kendall mine.

HUMBOLDT COUNTY

The National Mines Co. is increasing its working force. P. G. Harrison is manager. High-grade ore is being mined by the Heines-Baldwin lessees. The Indian Valley vein has been cut in a lower level of the Highland Mary. In the Buckskin National, the high-grade streak is now 4 to 5 in. wide, averaging \$40 per pound.

STOREY COUNTY

A. M. Walsh, of the United Comstock Pumping Association; T. F. McCormick, of the Ophir and Consolidated Virginia mining companies; James M. Leonard, of the Virginia & Gold Hill Water Co., and T. S. Higgins, foreman for the last Company, inspected the Sutro adit and its branches on May 19, according to *The Virginia Chronicle*. The main adit throughout its full length was found in first-class condition, many new sets of timbers having been placed during the past year. The engineers then went through the south lateral branch of the adit to the Alta shaft connecting drift, and found the timbering in as good condition as in the main adit. The Alta drift, which was recently reopened and repaired, and a new drain constructed, was also found to be in a most satisfactory condition. At the Crown Point connection with the south lateral, the water being pumped from the Gold Hill mines by the Sturges management at the joint Crown Point-Belcher incline, is being discharged into the adit drains, and is being handled with ease and with ample capacity for a much greater volume of water from that part of the lode. The Ward shaft connecting drift was also carefully inspected from the south lateral adit to the adit level of the Ward shaft, and it was found to be in a good state of preservation. The officials next returned to the junction, and examined the north lateral branch to the Ophir connecting drift, which was found in splendid condition. The ventilation throughout the adit was found

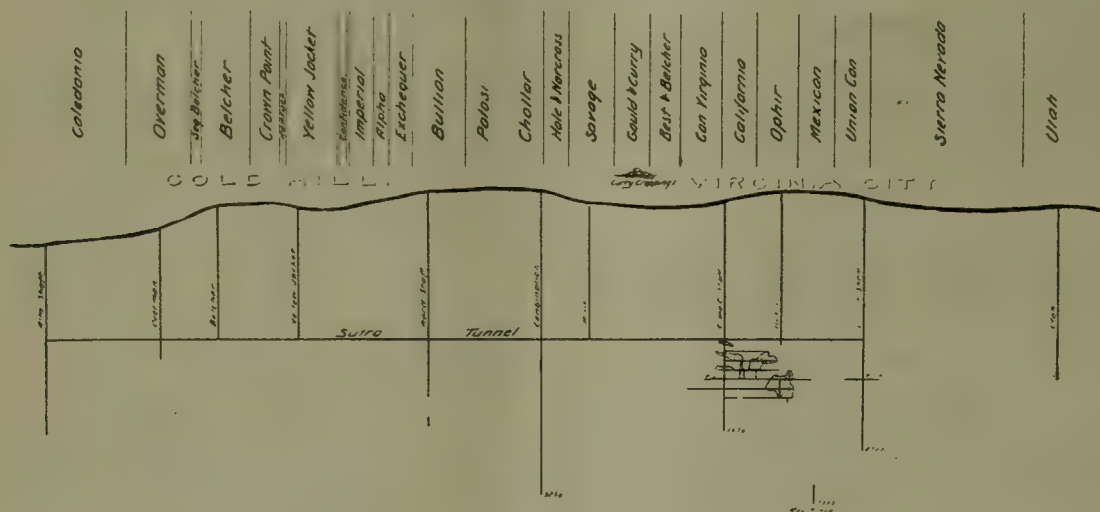
to be good, with all the air connections working satisfactorily. They then returned to the surface through the C. & C. shaft. It is of interest to know that the United Comstock Pumping Association is now pumping into the Sutro adit at the C. & C. shaft, a volume of water that is estimated at about 4,000,000 gal. per day; and at Gold Hill the mines are discharging nearly 1,500,000 gal. additional per day, making a total of 5,500,000 gal. per day that is being removed through the adit. The adit is thus performing most effectively one of its primary duties, and is a most important feature of the deep-level drainage of the Comstock lode.

During the past week, 237 tons of \$15.55 ore was extracted

or an average of \$4.01 per ton, compared with 1,528,923 tons, \$6,600,953 in bullion, and an average of \$4.31 in 1912. In 1913 a considerable tonnage was mined by 'glory-holing', and by caving above the 700-ft. level.

LAWRENCE COUNTY

The Miners' Union building at Lead, of four stories, 75 by 125 ft. in area, and erected some years ago for the union miners, was sold last week to Charles H. Moyer for \$43,992. Judgments were held against the Lead City Miners' Union by the Butte City Miners' Union and the Western Federation of Miners. Mr. Moyer represented the two last organizations. The building originally cost about \$100,000.



SECTION OF THE COMSTOCK LORE, SHOWING SUTRO TUNNEL.

from 2350 and 2400 ft. in the Ophir mine. Forty-six feet below the 2500-ft. level the Sierra Nevada has 30 in. of \$60 ore. The Yellow Jacket mill treated 1148 tons of ore, half from the Crown Point mine and the balance from the Jacket dump. The Mexican company will pay a dividend of 75c. per share, totaling \$141,750 on June 4.

SOUTH DAKOTA

The value of the gold, silver, copper, and lead produced in South Dakota in 1913, as reported from 30 productive mines, 10 of which were placers, amounted to \$7,424,333, compared with the record yield of \$8,019,370 in 1912, according to Charles W. Henderson, of the U. S. Geological Survey. This state has produced in the 37 years from 1876 to 1913, inclusive, \$177,954,132 in gold and 5,656,027 fine ounces of silver, with a commercial value of \$4,115,991, a total of \$182,070,123. The gold output in 1913 was 354,071 fine ounces, valued at \$7,319,294, nearly 99% of the total value. The decrease in gold for the year was 27,674 fine ounces in quantity and \$572,076 in value. The production of silver also decreased, from 206,460 to 172,702 fine ounces. Smelting ore from South Dakota in 1913 contained 10,205 lb. of lead, against 22,845 lb. in 1912. The output of placer gold decreased from 664 oz. in 1912 to 67 oz. in 1913. A total of 1,899,167 short tons of ore was mined and treated in 1913, compared with 1,901,726 tons in 1912. Of this total, 1,895,445 tons was treated in the mills of the state, yielding \$7,219,399 in gold and 163,359 fine ounces of silver, with an average recovery per ton of \$3.81 in gold and of 5.2c. in silver. The output of smelting ore, 3722 tons, averaged 1.28 oz. of gold and 2.51 oz. of silver per ton. The Homestake mine and mills were operated continuously throughout the year and made an output of 1,540,961 tons of ore, which yielded bullion of the value of \$6,186,652.

UTAH

BEAVER COUNTY

The annual report of the Horn Silver Mining Co., W. H. Hendrickson, manager, contains the following information: The property is in good condition. Development was hindered by the bad order of the shaft at No. 9 and 11 levels. This and other mine work cost \$25,000. The revenue from 25,183 tons of lead-zinc ore tailing, ore dumps, concentrate, and slag was \$149,380. The profit was \$2930. It is hoped that the old tailing can be profitably treated. There has been a rush to a new goldfield in this county, but little has been published regarding its prospects so far.

SALT LAKE COUNTY

Uranium ore amounting to 600 tons has been shipped to Europe during the last twelve months by David Taylor & Co., of Salt Lake City, buyers of rare metal ores. The ore averages 2% uranium, and is sampled in Denver prior to export. Cost of handling the ore from the Pack Creek mines to Europe is about \$40 per ton.

WASHINGTON

OKANOGAN COUNTY

(Special Correspondence.)—Motor-trucks are now hauling ore from the Peacock mine to the Great Northern railway at Okanogan, from where it will be sent to smelters. A 50-ton mill may be built. The Reco mine is producing gold ore. A claim producing wolfram near Cathedral peak has been bonded for \$20,000. The United Mines has been organized with a capital of 1,200,000 \$1 shares, to operate the Owasco, Golden Chariot, Portal, and Oro de Madre groups of claims on Kruger mountain. The last mine produces a smelting

ore containing 2 to 4% copper and \$8 to \$60 gold, and a good percentage of iron. From 50 to 100 tons of ore per day will probably be shipped over the new road to Oroville on the Great Northern railway. Senator Jonathan Bourne, of Portland, Oregon, may construct an electric railway from the Ruby district to Okanogan, on the Victoria, Vancouver & Eastern line, to develop the mines properly. The Duluth-Toroda Mining Co.'s claims have been purchased at a sheriff's sale by Arthur H. Perkins. Important work is under way at the Chesaw, Reco, Lucky Strike, Gold Leaf, and Phil Sheridan mines.

Chesaw, May 14.

PEND OREILLE COUNTY

(Special Correspondence).—The Gray Copper Mining Co. has opened ore containing \$1.56 silver, \$12.50 gold, and \$19.80 copper per ton.

Urk, May 15.

CANADA

MANITOBA

The gold yield of Canadian mines last year was \$16,216,131, to which this province contributed very little, according to *The Rice Lake Gold Miner*. This is published at Winnipeg and deals with mining in the Rice Lake district, which is 100 miles northeast of that town and is the starting point for several different routes. Properties being prospected are the Goldfield, Winnipeg, Gabrielle, the first staked; Rice Lake, Emperor, Manitoba, and others. A 5-stamp mill will be erected at the Big Four during the summer. About 1000 claims have been staked, and wide veins of good value are said to be opened in several properties.

ONTARIO

Under the McKinley-Darragh company's option, the Jupiter mine at Porcupine is developing well. At 300 ft. the ore-shoot is 300 ft. long, 42 in. wide, and averaging \$15 per ton. From the winze to 400 ft. a cross-cut has cut 5 ft. of \$6 ore. During the first quarter of 1914 the McKinley-Darragh mine, at Cobalt, produced 411,954 oz. silver. The mill is now treating 220 tons per day. At the Miller Lake O'Brien mine, at Gowganda, 20 tons of 5000-oz. silver ore has been mined from the 250 and 300-ft. levels.

COSTA RICA

The Abangarez Gold Fields company treated 6755 tons of ore in March, yielding \$24,896 at a cost of \$47,428.

KOREA

The Oriental Consolidated mills produced \$155,770 in April.

PERU

The Peruvian Exploration Co. at present has a working staff of nearly 300 men, with fifteen Californians and Canadians with expert knowledge of hydraulic operations. About 1500 'cargos' of machinery (250 lb. equal 1 cargo) have been delivered on the ground, and 3000 more have reached Cerro de Pasco. Raymond McCune returned from the property to Lima on April 25. He came from New York to consult with his men and decide on future policy of working, and it has been decided to install a central electric plant with an ultimate capacity of 2000 hp., which for the time being will be limited to 600 hp. Hydraulic operations, it is hoped, will commence in the fall of the present year with 10,000 cu. yd. per day of 24 hours. The point chosen for this installation is Uchapampa, and operating from this central station there will be at least five different points of working with hydraulic elevators capable of a total daily production of 50,000 cu. yd. The costs are estimated not to exceed 6c. per cubic yard. The gravel averages 81c. per yard. Work has just been commenced on the power ditch, and Mr. McCune is returning to New York to place orders for further equipment. He will return to Peru in about three months.

PHILIPPINE ISLANDS

Gold mining is very promising. The ore mined assays from ₱20 to ₱50 and the cost of mining and milling is about ₱12 per ton. Dredging offers a great field for future development. There are hundreds of square miles of alluvium which contain from 15 to 30 centavos (7 to 15c.) in gold which are as yet untouched. The placer ground being worked at present yields from 30 centavos to ₱1. No silver ore is mined separately. There are a few silver-bearing galena deposits in various parts of the islands, but they are small and irregular, and have never been profitably worked.

The following statistics of mineral production in the Philippine Islands for the year 1913 have been compiled by the division of mines of the Bureau of Science:

	1912.		1913.	
Metallic:	Quan.	Value.	Quan.	Value.
Iron, metric tons.....	141	₱ 49,272	227	₱ 64,471
Silver, fine oz.....	7,121	8,664	(¹)	(¹)
Gold, fine oz.....	27,582	1,140,424	42,011	1,736,724
Non-Metallic:				
Coal, metric tons.....	2,720	20,200	(¹)	(¹)
Clay products		453,000		460,000
Lime, metric tons		92,026		110,500
Sand and gravel, cu. m.		468,750		689,011
Stone, cu. m.....		651,049		197,039
Salt, metric tons.....	19,147	574,511	19,500	575,000
Mineral water, litres....	264,871	55,849	270,000	60,000
Total		₱3,513,745		₱3,944,581

¹Mineral products mined or manufactured, but not sold at the end of each year, are not included.

²The statistics for iron represent the quantity and value of iron castings, mostly plowshares.

³No silver is mined separately, but a small amount is alloyed with the gold.

⁴The figures for gold include about ₱200,000 estimated production by natives.

⁵No economic production. Several hundred tons was mined in the exploration of the Cebu coalfields.

Production of gold by districts in 1913.

Mancayan Suyoc, estimated Igorot production....	₱ 50,000
Benguet	83,281
Ambos Camarines	643,443
Masbate (estimated)	840,000
Mindanao, estimated Filipino production	60,000
Nueva Ecija, estimated Filipino production.....	20,000
Pangasinan and lower Benguet, estimated Filipino production	30,000

Total

Production of gold by dredging, 1913.

Guamus Placer Company	₱386,352
Pañacale Bucket Dredging, Ltd.	101,232
Maximelo Gold Dredging	75,404
Philippine Dredging Syndicate	80,253

Total

At present there are seven dredges operating in Ambos Camarines, and two more are being built. One dredge is operating in the Umaeri district, Tayabas province, and one dredge is to be built soon on the Mariquina river, near Manila. Three mills are operating in Masbate—the Colorado, Syndicate, and Keystone. In Benguet, the Camote is the only mill in operation, but two other small mills are being built, one by Calvin Horr, and one by Clinton Hulberts. In lower Benguet, Lubang district, a small mill has recently been installed. The Cansuran Placer Mining Co. is installing sluicing plant at Cansuran, Surigao. Members of the Bureau of Science are: Alvin J. Cox, Warren D. Smith, Frank T. Eddingsfield, Wallace E. Pratt, Paul R. Fanning, and Percy D. Kincaid.

Personal

S. R. GUGGENHEIM has gone to Europe.

COURTENAY DE KALB is in San Francisco.

JOHN W. MERCER was in San Francisco this week.

COREY C. BRAYTON has left San Francisco for Alaska.

J. B. TYRRELL is in British Columbia inspecting mining properties.

E. D. BARNETT, from San Luis Potosi, Mexico, was in San Francisco last week.

JOHN S. BITLER has left Mexico and is spending a few weeks at his old home at Indianapolis, Indiana.

JOSEPH STRUTHERS is now with the Johnson Electric Smelting, Inc., of New York, as second vice-president.

JOSEPH W. BOYLE, president and general manager for the Canadian Klondyke company, is in the Klondike.

F. C. MOORE, of Katanga, Central Africa, is visiting some of the large copper properties of the United States.

WILL C. HIGGINS, editor of *The Salt Lake Mining Review*, visited the mines of the Eureka, Juab county, district last week.

CHARLES ENDERLE, for many years engaged in the sale of Harrisburg engines in New York, is now with L. Copleston, Inc., 39 Cortlandt street, representing Ball Engines exclusively.

D. C. JACKLING and GALEN L. STONE were in Salt Lake City last week. After inspecting the Utah Copper mine at Bingham, they went to Butte to inspect the Butte & Superior mine and mill.

HENRY H. ARMSTEAD has been in Virginia making an inspection of the copper deposits of the Virgilina district. All of the properties operated by the Armstead United Companies, Inc., in Mexico are closed and in charge of Mexican watchmen. All of the American employees of this company who have been on duty in Mexico landed at New Orleans by steamer from Puerto Mexico on May 15.

OFFICERS elected at the last annual meeting of the Chamber of Mines of Western Australia, at Kalgoorlie, are as follows: President, Richard Hamilton, of the Great Boulder Proprietary; vice-presidents, R. S. Black of the Kalgurli, W. A. Macleod of Bewick, Moreing & Co., R. B. Nicholson of the Ivanhoe, and J. W. Sutherland of the Golden Horse-Shoe; executive council, R. S. Black, Lloyd Bloxsome of the North Kalgurli, C. E. Crocker of the Kalgoorlie Electric Power & Lighting Corporation, P. Fitzgerald of the Oroya Links, R. Hamilton, W. A. Macleod, D. F. McAulay of the Associated, John Morgan, R. B. Nicholson, E. T. Randall, solicitor for the Chamber, G. M. Roberts of the Associated Northern, H. E. Vall of the Lake View & Star, and R. A. Varden of the Perseverance; sealholders, G. M. Roberts and R. A. Varden.

Obituary

J. T. LEMPIERE, another well known Australian mining man, died as the result of an accident at Geebong, Victoria, on March 26.

JOHN DARLING, managing director for the Broken Hill Proprietary Co., and well known in Australian mining and grain circles, died in Melbourne on March 27.

J. E. STUBBS, president of the University of Nevada, died suddenly on May 27. Mr. Stubbs was born in Ashland, Ohio, in 1850, and during his life was noted as a scientific agriculturist and reformer.

CHARLES G. LATHROP, treasurer of Stanford University, died after an operation on May 23. He was the brother of the late Mrs. Leland Stanford, and when Stanford University was opened, he and his brother, Ariel Lathrop, assumed the business management.

MICHAEL O'ROURKE, pioneer mining man, died in Salt Lake City, May 12. He came West to Blackfoot, Montana, in 1869, and was identified with the Drumlummon company at Marysville, Montana, for many years. He later was superintendent successively of the Mammoth mill, Utah; Camp Bird mill at Ouray, Colorado; and Gold King mill at Gladstone, Colorado.

ALBERT ARENTS, after an illness of a year, died on May 13. He was born at Clausthal, Germany, March 14, 1840, and came to America in 1865, having been engaged to treat ores in Massachusetts. He came West in 1866, settling first in Nevada, where he invented and introduced many improvements in lead smelting, including the rectangular, large sized lead furnace, and the lead well or siphon cap. He later came to California and has lived in Alameda for the past 35 years.

Schools and Societies

STANFORD UNIVERSITY conferred degrees on 423 graduates on May 18.

THE INDIANA ACADEMY OF SCIENCE is holding its spring meeting at South Bend on May 28, 29, and 30.

THE COLORADO SCHOOL OF MINES held its fortieth commencement on May 22. An address was given by Dr. Rossiter W. Raymond.

COLUMBIA UNIVERSITY has issued its program for the fortnight May 25 to June 7. The 160th commencement will be on June 3.

THE AMERICAN INSTITUTE OF MINING ENGINEERS, Chicago section, has a membership of 58. An informal dinner and meeting was held on May 12.

THE FARADAY SOCIETY held its 72nd meeting on April 22 in London. The following papers were read: 'Recording Pyrometers,' by Charles R. Darling (this was discussed by a number of members); 'Diffusion and Membrane Potentials,' by E. B. R. Prideaux; 'The Acidic and Colloidal Properties of Aluminum Hydroxide,' by R. E. Slade and W. G. Polack; 'Negative Adsorption,' by A. M. Williams; and 'The Embrittlement of Iron by Caustic Soda,' by J. H. Andrew.

THE SCHOOL OF MINES OF WESTERN AUSTRALIA, at Kalgoorlie, has issued its syllabus for 1914, and annual report for 1913. The calendar for the current year runs from February 12 to December 5. The various departments are fully equipped with apparatus and machinery. There is also a large museum attached. Good scholarships are offered every year by the Government, Chamber of Mines, and others. There were from 140 to 179 students during 1913, who took up 40 different courses. In the examinations there were 40, 57, and 98 first, second, and third-class passes respectively. Save a few small charges, tuition is now free at this school, as it is at the new university at Perth.

THE U. S. Civil Service Commission, Washington, D. C., announces an open competitive examination for mining draftsmen, for men only, on June 17 and 18, 1914. From the register of eligibles resulting from this examination, certification will be made to fill a vacancy in this position in the Bureau of Mines, Pittsburgh, Pennsylvania, at an entrance salary of from \$1080 to \$1200 per year, and vacancies in positions requiring similar qualifications as they may occur, unless it is found to be to the interest of the service to fill any vacancy by reinstatement, transfer, or promotion. The subjects of examination are: (1) mining engineering; (2) drawing; and (3) training and experience.

THE COLORADO LOCAL SECTION of the American Institute of Mining Engineers, with the Colorado Scientific Society, the Colorado chapter of the American Mining Congress, and the Denver Chamber of Commerce, entertained Dr. Rossiter W. Raymond at a luncheon on May 21, at Denver.

The Metal Markets

LOCAL METAL PRICES

San Francisco, May 28.

Antimony	9 — 9½c
Electrolytic copper	15½—15¾c
Pig lead	4 15— 5 10
Quicksilver (flask)	\$39.00
Tin	40½—42 c
Spelter	6½— 6¾c

Zinc dust, 100 kg zinc-lined cases, 7½ to 8c per pound

EASTERN METAL MARKET

(By wire from New York.)

NEW YORK, May 28. The metal market is generally quiet. Copper is quiet but firm, lead is active, and spelter dull. Regular dividends have been declared by Chino, Nevada, Ray, and Utah copper companies. April copper yields are as follows: Utah Copper, 13,133,770; Calumet & Arizona, 5,450,000; Shattuck-Arizona, 1,386,591; Ohio, 692,100; Tennessee, 1,370,800; Cananea, 2,044,000; Arizona Copper, 3,570,000; East Butte, 1,178,000; Chino, 6,109,888; and Ray, 6,277,690 lb. Bar silver is steady in London at 26¼d. (52.5 cents).

SILVER

Below are given the average New York quotations in cents per ounce, of fine silver.

Date.	Average week ending
May 21	57.62
" 22	57.50
" 23	57.25
" 24 Sunday	59.14
" 25	56.50
" 26	56.75
" 27	57.12

Monthly averages.

	1913.	1914.		1913.	1914.
Jan.	63.01	57.58	July	58.70	
Feb.	61.25	57.53	Aug.	59.32	
Mch.	57.87	58.01	Sept.	60.53	
Apr.	59.26	58.52	Oct.	60.88	
May	60.21		Nov.	58.76	
June	59.03		Dec.	57.73	

In view of the certainty of a reduction of silver supplies in the near future, the fall of 0.5c. per oz. in London during the first week in May was rather unexpected; but the weakness throughout has been the paucity of buyers, according to Pixley and Abell. However, Bombay is for the moment fairly well stocked, and the bazaars, knowing that China is unlikely to buy much on this market at present, may be content to wait until their supplies are further reduced. Stocks in Bombay have fallen during the week to 1800 bars, but \$570,000 is on the water. Although at the moment quiet, the undertone of the market is a strong one, and even a moderate demand would quickly affect rates. Supplies from Mexico have been practically cut off.

COPPER

Quotations on copper as published in this column represent average wholesale transactions on the New York market and refer to electrolytic copper. Lake copper commands normally 1-5 to 1-4c. per lb. more. Prices are in cents per pound.

Date.	Average week ending
May 21	14.00
" 22	14.00
" 23	14.00
" 24 Sunday	14.02
" 25	13.93
" 26	13.95
" 27	13.95

Monthly averages.

	1913.	1914.		1913	1914.
Jan.	16.54	14.21	July	14.21	.....
Feb.	14.93	14.46	Aug.	15.42	.....
Mch.	14.72	14.11	Sept.	16.23	.....
Apr.	15.22	14.19	Oct.	16.31	.....
May	15.42	.....	Nov.	15.08	.....
June	14.71	.....	Dec.	14.25	.....

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.	Average week ending
May 21	3.90
" 22	3.90
" 23	3.90
" 24 Sunday	3.90
" 25	3.90
" 26	3.90
" 27	3.90

Monthly averages

	1913	1914		1913	1914
Jan	4.28	4.11	July	4.35	
Feb	4.33	4.02	Aug	4.60	
Mch	4.32	3.94	Sept	4.70	
Apr	4.36	3.86	Oct	4.37	
May	4.34		Nov	4.16	
June	4.33		Dec	4.02	

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery in cents per pound.

Date.	Average week ending
May 21	4.93
" 22	4.93
" 23	4.93
" 24 Sunday	4.93
" 25	4.93
" 26	4.93
" 27	4.93

Monthly averages

	1913	1911		1913	1914
Jan	6.88	5.14	July	5.11	
Feb	6.13	5.22	Aug.	5.51	
Mch	5.94	5.12	Sept.	5.55	
Apr.	5.52	5.18	Oct	5.22	
May	5.23		Nov.	5.09	
June	5.00		Dec	5.07	

Mineral exports from Broken Hill, New South Wales, in March were valued at \$376,257, made up as follows: Silver-lead concentrate, 27,539 tons, value \$264,568; zinc concentrate, 10,308 tons, value \$104,812; silver-lead crude ore, 2754 tons, value \$6225; and silver-lead slime, 863 tons, value \$652. During the first quarter of 1914 the total was: Silver-lead concentrate, 83,646 tons, value \$781,812; zinc concentrate, 109,175 tons, value \$278,032; silver-lead crude ore, 7207 tons, value \$17,152; silver-lead slime, 2019 tons, value \$1515; and zinc slime, 11 tons, value \$17; making the total for the three months of \$1,078,528 (\$5,175,000).

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending	May 11	May 11
Apr. 30	39.00	39.00
May 7	39.00	39.00

Monthly averages.

	1913.	1914.		1913.	1914.
Jan.	39.37	39.25	July	41.00	.....
Feb.	41.00	39.00	Aug.	40.50	.....
Mch.	40.20	39.00	Sept.	39.70	.....
Apr.	41.00	38.90	Oct.	39.37	.....
May	40.25	.....	Nov.	39.40	.....
June	41.00	.....	Dec.	40.00	.....

TIN

New York prices control in the American market for tin, since the metal is almost entirely imported. San Francisco quotations average about 5c. per lb. higher. Below are given average monthly New York quotations, in cents per pound:

Monthly averages.

1913.		1914.		1913.		1914.	
Jan.	50.45	37.85	July	40.70	.....	.....	.....
Feb.	49.07	39.76	Aug.	41.75	.....	.....	.....
Mch.	46.95	38.10	Sept.	42.45	.....	.....	.....
Apr.	49.00	36.10	Oct.	40.61	.....	.....	.....
May	49.10	.....	Nov.	39.77	.....	.....	.....
June	45.10	.....	Dec.	37.57	.....	.....	.....

The incessant liquidation by the chief bull interests, together with the continued eagerness of the Straits smelters to market their product, and some additional selling pressure by bears, produced acute weakness in the tin market early in May, according to Henry R. Merton & Co. of London. The rapid decline in the price at the beginning of the week alarmed some of the weaker holders to such an extent that they gave orders to clear out at any cost, with the result that prices dropped to the equivalent of £148 for cash. Thanks to the timely intervention of some of the leading operators, the market was, however, saved from demoralization, and steadier conditions began to prevail. These brought back some confidence to consumers who sent buying orders, which were followed by bear covering and ultimately led to a substantial improvement in prices as well as in sentiment. Prices rallied quickly to £151 for three months, and maintained the best part of the advance to the close, which is steady at £151 5s. cash and £153 3s. for three months. The considerable drop in prices, and the shake-out of many weak positions, has put the market on a healthier basis, but pending an improvement in general trade, or a falling off in production, there is evidence of an increasing surplus of metal during the summer months. The total transactions during the week amounted to about 2900 tons.

The Stock Markets

SAN FRANCISCO STOCKS AND BONDS

(San Francisco Stock and Bond Exchange.)

May 27.

BONDS

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Associated Oil 5s.....	97 1/2	98	Natomas Consol. 6s.....	11	—
Natomas Con.....	33	—	Pac. Port. Cement 6s.....	100	—
Unlisted.			Santa Cruz Cement 6s.....	85	—
General Petroleum 6s.....	—	40	Union Oil.....	86 1/2	87 1/2

STOCKS

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Amalgamated Oil.....	77 1/2	—	General Petroleum.....	3 1/2	4 1/2
Associated Oil.....	39 1/2	40 1/2	Noble Electric Steel.....	50c	—
Giant.....	81	—	Natomas Consol.....	1	—
Pac. Port. Cement.....	—	57 1/2	Pac. Port. Cement.....	60	94
Sterling O. & D.....	—	11	Riverside Cement.....	—	63
Union Oil.....	71 1/2	72 1/2	Santa Cruz Cement.....	40	—
West Coast, pld.....	—	112 1/2	Stand. Port. Cement.....	—	19 1/2

NEVADA STOCKS

(By courtesy of San Francisco Stock Exchange.)

May 28.

Atlanta.....	\$ 17	Montana-Tonopah.....	\$ 77
Belcher.....	29	Nevada Hills.....	33
Belmont.....	72 1/2	North Star.....	33
Con. Virginia.....	505	Ophir.....	—
Florence.....	50	Pittsburg Silver Peak.....	28
Goldfield Con.....	145	Round Mountain.....	35
Goldfield Oro.....	31	Sierra Nevada.....	14
Hallfax.....	70	Tonopah Extension.....	272
Jim Butler.....	107	Tonopah Merger.....	56
Jumbo Extension.....	24	Tonopah of Nevada.....	680
MaeNamara.....	503	Union.....	56
Mexican.....	105	Victor.....	40
Midway.....	26	West End.....	87
Mizpah Extension.....	29	Yellow Jacket.....	30

CALIFORNIA STOCKS

(Latest Quotations.)

Bid.	Ask.	Bid.	Ask.
Argonaut.....	\$2 85	Kennedy.....	750
Brunswick Con.....	\$1 05	Mountain King.....	0 15
Bunker Hill.....	1 90	South Eureka.....	1 25
Central Eureka.....	\$0 15		0 16

COPPER SHARES—BOSTON

(By courtesy of J. C. Wilson, Mills Building.)

May 28.

Bid	Ask	Bid	Ask
Allouez.....	41 1/2	Mohawk.....	41 1/2
Ariz. Commercial.....	41	Nevada Con.....	14 1/2
Butte & Superior.....	39 1/2	North Butte.....	26 1/2
Calumet & Arizona.....	67	Old Dominion.....	47 1/2
Calumet & Hecla.....	423	Osceola.....	77
Copper Range.....	37	Quincy.....	57
Daly West.....	1 1/2	Shannon.....	61
East Butte.....	10 1/2	Superior & Boston.....	21
Franklin.....	4 1/2	Tamarack.....	36 1/2
Granby.....	82 1/2	U. S. Smelting, com.....	34 1/2
Greene Cananea.....	33	Utah Con.....	10 1/2
Isle Royale.....	21	Winnona.....	31
Mass Copper.....	4 1/2	Wolverine.....	40 1/2

NEW YORK CURB QUOTATIONS

(By courtesy of E. F. Hutton & Co., Kohl Building.)

May 28.

Bid.	Ask.	Bid.	Ask.
Beaumont Copper.....	7 1/2	McKinley-Dar.....	7 1/2
B. C. Copper.....	1 1/2	Mines Co. Am.....	3 1/2
Con. Cop. Mines.....	2 1/2	Nipissing.....	6 1/2
Davis-Daly.....	1 1/2	Ohio Copper.....	3 1/2
First National.....	2 1/2	Stand. Oil of Cal.....	330
Hollinger.....	16 1/2	Tri Bullion.....	1 1/2
Iron Blossom.....	1 1/2	Tuolumne.....	5 1/2
Kerr Lake.....	1 1/2	United Cop. com.....	3 1/2
La Rose.....	1 1/2	Yukon Gold.....	2 1/2
Mason Valley.....	2		

ORE TREATED by all gold mines in Western Australia in 1913 totaled 2,787,361 long tons, averaging \$9.50 per ton, against \$9.62 in 1912.

NEW YORK STOCK EXCHANGE

(By courtesy of J. C. Wilson, Mills Building.)

May 28.

Bid	Ask	Bid	Ask
Amalgamated.....	\$ 72 1/2	Miami.....	\$ 22 1/2
Anaconda.....	32	Nevada Con.....	14 1/2
A. S. & R. com.....	6 1/2	Quicksilver, com.....	14 1/2
Calif. Pet. com.....	20 1/2	Ray Con.....	21 1/2
Chino.....	41 1/2	Tenn. Copper.....	34 1/2
Guggenheim Ex.....	53 1/2	U. S. Steel, pld.....	109 1/2
Inspiration.....	17	U. S. Steel, com.....	61 1/2
Mexican Pet. com.....	61	Utah Copper.....	57 1/2

Mineral Production of Great Britain

The output during 1913 was as follows:

	1913.	1912.
Men employed.....	1,155,302	1,193,456
Fatalities in coal mines, per thou-		
sand.....	1.54	.....
Fatalities in metal mines, per thou-		
sand.....	0.88	.....
Arsenic and arsenical pyrite, tons.....	1,727	3,971
Barytes, tons.....	48,018	42,767
Bauxite, tons.....	6,055	5,790
Coal, tons.....	287,411,869	260,398,578
Copper ore, tons.....	2,705	1,912
Gold ore, tons.....	4	170
Gypsum, tons.....	238,494	243,811
Iron pyrite, tons.....	11,427	10,522
Ironstone, tons.....	9,591,477	8,420,126
Lead ore, tons.....	24,265	25,383
Limestone, tons.....	363,841	355,569
Manganese, tons.....	5,893	4,170
Oil shale, tons.....	3,280,143	3,184,826
Tin ore, tons.....	6,942	6,822
Uranium ore, tons.....	95	42
Wolfram, tons.....	182	189
Zinc ore, tons.....	17,294	17,704

ORE TREATED from five of the principal gold mines at Kolar, India, in 1913 amounted to 808,507 tons, worth from \$7.52 to \$15.76, and costing from \$5.56 to \$6.88 per ton for all operations. Owing to a shortage of water for the Cauvery river power scheme, 90 miles transmission, during the current month, work at all the mines has been curtailed.

MICA PRODUCTION of the United States in 1913 was 1,700,677 lb. of rough trimmed and cut, worth \$353,517, and 5322 short tons of scrap, worth \$82,543, against 845,483 lb., \$282,823, and 3226 lb., \$49,073, respectively, in 1912. Imports were worth \$943,018. The outputs in Canada and India were valued at \$170,112 and about \$480,000, respectively.

COAL PRODUCTION of Wyoming in 1913 was 7,393,066 short tons, with a spot value of \$11,510,045, according to the U. S. Geological Survey. This production showed an increase of 24,942 short tons over 1912 in quantity, but a decrease of \$138,943 in value. There were 8331 men employed, with 34 fatalities.

THE WAIHI MINE, New Zealand, produced 14,136 tons of ore yielding bullion worth \$123,000 during the period March 14 to April 11. The output to date is \$50,400,000, and dividends paid, \$22,080,000.

COAL PRODUCTION of Washington in 1913 was 3,877,891 short tons worth \$9,243,137, increases of 516,959 tons and \$1,200,266 over 1912. There were 5794 coal miners employed, with 22 fatalities.

OIL PRODUCTION of California in April averaged 284,701 bbl. per day from 6002 producing wells. Stocks on April 30 were 49,625,570 barrels.

Company Reports

STANDARD SILVER LEAD MINING COMPANY

Operations of this Company, which owns a mine and mill in British Columbia, resulted as follows in 1913:

Ore treated, tons	13,959
Silver produced, ounces	1,081,849
Lead, pounds	17,988,805
Revenue	\$1,069,247
Net profits	731,225
Dividends	650,000
Surplus for year	81,225
Surplus at end of 1913	246,348

TRONOH MINES, LIMITED

This Company operates a tin property in the Malay States, southeastern Asia. Results during the past financial year were as follows:

Black tin sold, tons	2,187
Revenue (tin ore realized £122 10s. per ton.)	£268,001
Profit after allowing for depreciation	59,806
Balance from 1912	54,169
Dividends	60,000
Balance to 1914	40,061

There was a considerable decrease compared with 1912, when the profit was £157,798. This was mainly due to the lower yield per cubic yard of tin drift.

BUTTE & SUPERIOR COPPER COMPANY, LIMITED

The work of this Montana company has attracted considerable attention during the past year or two, on account of the success of flotation as applied to its ores, its zinc production, and its litigation over the process with the Minerals Separation company. The reports of the president, N. Bruce MacKelvie, and D. C. Jackling, consulting engineer, contain the following information: Construction work is now practically completed. Spelter averaged 5.6c. per pound in 1913. The Company had a cash balance of \$225,294 at the close of the year, with shipments in transit to the smelter worth \$502,443. A dispute arose between this Company and the Elm Orlu Mining Co. concerning the Black Rock and Elm Orlu claims; but it was agreed that each Company could do what work it wished in the disputed area to settle the question of geological formation. A report is expected in a short time.

Development in the mine was confined to current mining operations, and principally to workings above the 1300-ft. level. No attempt was made to block out further reserves. A good deal of new ore was opened between 900 and 1300 ft. Ore reserves are estimated at 1,050,000 tons, compared with 1,200,000 tons in 1912, and average 21% zinc and 7 oz. silver per ton. There was 293,706 tons of ore mined at a cost of \$3.12 per ton. The mine is in excellent condition in every way, and above 1600 ft. several years' reserves are blocked out for the mill.

The mill treated 296,940 tons, at a cost of \$2.69 per ton, at an average recovery of 86.43%, this increasing from 58.79% to 90.15% during the year. Costs in December were \$2.05 per ton. The flotation plant yielded 104,174 tons of concentrate averaging 49.005% zinc and 24.19 oz. silver per ton; also 2269 tons of lead concentrate averaging 39.41% lead, 19.72% zinc, and 43.28 oz. silver per ton. The gross value of the product was \$3,526,661, and net income \$942,988. Out of this profit, \$761,414 was spent in acquiring further property and in mill improvements. Total costs were 4.45c. per pound of zinc contained in concentrate. An initial quarterly dividend of 75c. per share was declared during the current month, and will be paid on June 30.

TONOPAH MINING COMPANY OF NEVADA

This is one of the most important companies operating in Nevada, and the report covers the year ended February 28, 1914. The reports of the superintendent, W. H. Blackburn, the consulting engineer, J. E. Spurr, and the acting superintendent of the mill, E. F. Heydenfeldt, contain the following data: Development amounted to 17,924 ft., including sinking the Sand Grass shaft 448 ft. The Last Chance vein, developed from the Red Plume shaft, showed a considerable tonnage of high-grade ore. This vein has been opened from No. 4 level or capping to the No. 7 level. Its eastern boundary seems to be the West End rhyolite. This is to be proved by drifts and cross-cuts on the No. 5 and 7 levels. This vein had just been cut at the beginning of the year. The West End vein was opened during the year on No. 6 level between the buried fault and the property line. Where first found the metal content was high, but the average has been about \$15 per ton. Development work on No. 6 and 7 levels of the Sand Grass shaft exposed the contact of the West End rhyolite and Tonopah rhyolite breccia in several places, but no ore



GENERAL VIEW OF TONOPAH MINING CO.'S PROPERTY AT TONOPAH.

was opened. No. 10 level is now in the heavy quartz of the above contact. This body has a much more favorable appearance than the contact quartz encountered in the levels above. Considerably more development remains to be done from the Sand Grass shaft.

The estimated value of the total ore assets on March 1, 1914, were \$2,475,795. The estimated tonnage on March 1, 1914, was 172,761 tons, and includes assured, probable, and possible unbroken ore, ore on the dump, and ore stored at Millers, Nevada. The estimated value is \$14.33 per ton.

Total mining cost was \$3.278 per ton. Freight on ore to the mill was 74c. per ton.

The 100-stamp mill at Millers operated continuously 95.9% of the time, with an average duty of 4.65 tons of ore per stamp per 24 hours. Preparatory to some extensive changes, which are now being made to the mill, to provide for an all-slime product for final cyanidation, the monthly tonnage to be milled each day was reduced from 500 to 400 tons on November 1, 1913. With these changes completed, the sand product, which does not yield to cyanidation readily, will be eliminated, and as a result a better extraction is expected to be obtained.

Milling costs, \$2.81, were 14c. higher than the previous year, which is accounted for by a lower tonnage milled during the last four months and a higher consumption of chemicals on account of the copper contained in the Red Plume ore. The consumption of cyanide during the year was 0.54 lb. more per ton than during the previous year. This increased consumption added 10c. per ton to milling costs. The combined extraction of both gold and silver for the year was 87.52%. Upon comparison with the previous year this shows metallurgically an increase of 1.65% gold and a decrease of 1.90% silver, or decrease in the total extraction of 1.82%, and in value the extraction was only 0.66% lower than during the previous year. The average gross value per ton of the ore milled was \$17.79, as compared with the previous year of

\$18.16 per ton. Including marketing mill products, total costs were \$7.41 per ton. Financial results were as follows:

Ore treated, dry tons (ore contains 2.6% moisture)...	163,387
Gold, ounces per ton	0.247
Silver, ounces per ton	21.61
Total revenue, including bullion, dividends, interest, loans, etc.	\$3,860,322
Total expenditure, including costs, stock purchased, patents, loans, etc.	2,560,322
Dividends paid	1,300,000
Surplus	63,441
Total net surplus	3,975,353

The Company holds bonds in thirteen different industrial companies, and stock in six subsidiary companies. The latter include the Tonopah & Goldfield Railroad Co. and Tonopah Placers Co., which is operating three dredges at Breckenridge, Colorado. An option has been taken on a mining property in Nicaragua. Litigation over the Brown 'patent' process cost \$9345.08 during the year, resulting in a complete victory for the Tonopah company.

NATOMAS CONSOLIDATED OF CALIFORNIA

Reports of this well known dredge and land company are always read with interest, especially during the last year or two, when it has come in for a good deal of discussion. The report under review covers the year ended December 31, 1913. The profit and loss account shows the following:

PROFIT

Natoma dredges	\$ 632,254
Feather River dredges	360,112
Water department	17,949
Rock-crushing department, Natoma and Oroville....	73,945
Discounts interest on investments	7,970
Interest on Reclamation District 1000 warrants and bonds	72,212
Total profit	\$1,164,442

LOSS

Loss on crop season 1913	\$ 12,556
Interest on bonds	980,534
Miscellaneous	63,512
Total	\$1,056,602
Net profit before writing off depreciation or bond discount	\$ 107,840
Balance at January 1, 1913	1,300,520
Profit for 1913 as above	107,840

Total	\$1,408,361
Deduct loss on No. 7 dredge	129,394
Balance	\$1,278,967

The report of the consulting engineer, Charles M. Rolker, contains the following information, among a number of explanations and discussion of past work: The dredging time of the whole fleet was 82.3% in 1913, similar to 1912 and 1911. Work in the Natoma division was disappointing, as the yardage handled was 2,576,915 cu. yd. below the estimated amount. In the Feather River division, 69,163 cu. yd. more was dredged than had been estimated. At Natoma, No. 1 boat was digging in hard clay and gravel, and shallow classes of ground at different times, and worked 78.58% of the possible time. No. 2 and 3 operated satisfactorily. No. 4 encountered large quantities of clay and gravel, 6 to 10 ft. of hardpan overburden, and some bedrock, and worked 79.8% of the time against 84.87% in 1912. No. 5 sank in June and started again in November. This was due to a sudden lurch of the boat when digging very hard formation, which lurch shook the stack ladder and caused it to pull loose one of the guys that was attached to an eyebolt below water-line, allowing water

to enter through a hole made in the planking. Repairs cost \$2,180. No. 6 dredge had to dig a good deal of cement and clay. No. 7 sank in May 1912, and was reconstructed and started again in May 1913. The new boats, No. 8 and 9, worked 80.61 and 84.03% of the time. Both were troubled with clay sticking to the buckets, which could not discharge the sticky material. No. 10 encountered irregular surface, big boulders which stuck in the buckets, had to cross a road, and suffered from loss of water in the pond on account of configuration of the ground. Repairs cost \$50,000, which is high for a boat 15 months old.

No. 8, 9, and 10 dredges have 15-cu. ft. buckets, and No. 5 and 6, 9-cu. ft., and the reduction of costs with the larger buckets against the smaller should theoretically be 12% in every department save power. This was not the case. The comparative cost per yard, excluding power and reconstructing cost, was as follows: No. 8, 5.05c.; No. 9, 5.39c.; No. 10, 4.09c.; No. 5, 3.67c.; and No. 6, 4.08c. per cubic yard. These dug 273.1, 322.9, 359.7, 250.7, and 229.1 cu. yd. per hour, respectively. The following table shows the work of the dredges in 1913:

	Oroville.	Natoma.	Total.
Dredges working	3	10	13
Gravel dredged, cu. yd.	5,499,163	18,907,985	24,407,148
Recovery, cents per yard....	11.26	8.88	9.42
Total gold	\$619,102	\$1,680,158	\$2,299,261
Cost, cents per yard.....	4.71	5.54	5.35
Profit, cents per yard.....	6.55	3.34	4.07
Total profit	\$360,112	\$632,254	\$992,367

The net dredging profit for 1914 is estimated at \$1,300,000. The rock-crushing plants produced 425,143 tons of finished



ROCK-CRUSHING PLANT AT OROVILLE.

rock and 346,492 tons of screenings, yielding a gross return of \$259,129. Crushed rock on hand amounted to 89,501 tons at the end of 1913.

The report deals with reclamation lands leased, amounting to 20,349 acres, and 9636 acres of irrigation lands leased. In the Bear River garden tract, 500 acres was leased at \$5 for general agriculture, and 305 acres for beans at \$6 per acre. The Company proposes to cultivate 3100 acres on its own account.

In district No. 1000 the engineering department estimates the work remaining to be done to cost \$808,186, exclusive of irrigation; district No. 1001, \$926,730; and work on irrigation lands, \$1,703,185. This includes the Company planting 1000 acres with rice. The total land holdings of the Company, including the dredging area, is 96,213 acres. The estimated income for 1914, exclusive of discounts and interest, is \$1,406,325. The capital stock of this Company amounts to \$16,068,800, par value \$100 each; and bond issues for all purposes, \$17,375,000.

Assets are valued at \$43,213,899, the dredging properties being worth \$14,433,532. Since January 1, 1909, and up to December 31, 1913, the dredges have recovered gold worth \$9,716,479, at a profit of \$5,115,829.

Book Reviews

COMPRESSED AIR. By Theodore Simons. McGraw-Hill Book Co., New York. P. 160. Index. For sale by the *Mining and Scientific Press*, San Francisco. Price \$1.50.

This work has been prepared primarily for the use of students who desire to obtain an insight into the natural laws and physical principles underlying the production, transmission, and use of compressed air. Examples for practice are interspersed among the reading matter for the use of the student. Practically all of the modern types of air-compressors are illustrated and the characteristics of each discussed. An appendix is also given of tabulated data for the assistance of the reader in making quick calculations.

COMPRESSED AIR PRACTICE. By Frank Richards. McGraw-Hill Book Co., New York. P. 319. Index. For sale by the *Mining and Scientific Press*, San Francisco. Price \$3.

In the author's preface Mr. Richards draws attention to the fact that the cost of power and fuel for the compressed air now used is not more than one-third as great per quantity unit as it was twenty years ago. This statement in itself is significant of the wonderful changes that have been made during the last two decades in the design of compressed air apparatus. Mr. Richards' work, while not voluminous, deals in general with all of the more prominent applications of compressed air, as well as giving a brief discussion of the elementary principles and fundamentals involved. The matter of the design of the compressors themselves is not taken up and, as Mr. Richards says, "Catalogue literature and auctioneer talk have their places, but not here." As a book of reference to the busy man this work is of exceptional value and blazes the trail for those who desire to undertake a detailed investigation of any specific application.

STEAM TURBINES. By James Ambrose Moyer. John Wiley & Sons, New York. P. 368. Index. For sale by the *Mining and Scientific Press*, San Francisco. Price \$3.50.

The author draws attention to the remarkable progress that has been achieved in steam-turbine design during the last few years and brings out the fact that the steam turbine is the oldest and at the same time the most modern steam motor. This is the second edition of Mr. Moyer's work, the first having been published in 1908. Since the first edition was published the evolutionary tendency in the adoption of types of steam turbine has been toward a concentration upon practically four instead of the many designs in vogue at the time the first edition was published. A tendency toward the installation of increasingly large sizes is also pointed out. An instance is cited of the largest turbo-generator now installed rated at 35,000 kw. in comparison with a maximum size of 14,000 kw. only three years ago. This concentration of power in large units shows an extension of the principle of consolidation that has made itself manifest in many other directions and has resulted in a great reduction in the cost of power of this kind per kilowatt installed. New chapters have been added on bleeder or extraction turbines and on mixed pressure turbines. The chapters on heat theory, steam flow, nozzle, blade, and reaction turbine design have been rewritten with the addition throughout the text of many illustrative examples. The appendix has been enlarged by the addition of many practical exercises and problems illustrating important parts, thus increasing the usefulness of the book as a classroom text. A new entropy total heat chart has been calculated and engraved, which embodies the most recent and reliable data on the properties of super-heated and saturated steam.

Recent Publications

FATALITIES IN COAL AND METAL MINES OF BRITISH COLUMBIA. Quarterly statement compiled by Thomas Graham. P. 3. Department of Mines, Victoria, 1914.

COLORADO SCIENTIFIC SOCIETY. Report for 1913. Also Systematic Testing in the Evolution Mill Practice. By George E. Collins. P. 28. Denver, April 1914.

FIRST ANNUAL INDUSTRIAL SAFETY CONFERENCE. Proceedings. P. 140. University of Nevada bulletin. Reno, 1914. Full details of this meeting were given in this journal of February 7.

CANADIAN MINING INSTITUTE. Bulletin No. 25, edited by the secretary, H. Mortimer-Lamb. P. 141. Ill. Montreal, Quebec, 1914. Details are given of the sixteenth annual meeting, the addresses, excursions, statistical matter, and papers.

ELECTRIC FURNACES FOR MAKING IRON AND STEEL. By Dorsey A. Lyon and Robert M. Keeney. Bulletin 67, U. S. Bureau of Mines. P. 142. Ill., index. Washington, 1914. This is a valuable compilation on the practice in Europe and America, past results and possibilities.

MINERALS OF THE BLACK HILLS. By Victor Ziegler. Bulletin 10 of the department of geology and mineralogy, South Dakota School of Mines. P. 254. Ill., maps, plans, charts, index of minerals. Rapid City, 1914. A description of this publication was given in this journal of May 16.

FUELS USED IN TEXAS. By William B. Phillips and S. H. Worrell. Bulletin 307. P. 287. Ill., index. University of Texas, Austin, 1913. There is plenty of cheap fuel in this state. The total area of coal and lignite is 58,000 square miles. Petroleum production of the state since 1889 totals 168,721,719 bbl., worth \$82,754,292.

COAL MINING PRACTICE IN DISTRICT VIII (Danville). By S. O. Andros. Field work by R. Y. Williams and S. O. Andros. Bulletin 2. Coal-mining investigations, cooperative agreement of Illinois Geological Survey, University of Illinois, and U. S. Bureau of Mines. P. 47. Ill., map. Urbana, 1914. A useful compilation for coal miners.

PENN STATE MINING QUARTERLY. P. 46. Ill. State College, Pennsylvania, April 1914. Contains besides school notes the following papers: 'Application of Central Station Power to Coal-mining Work,' by Thomas R. Hay; 'Excursions of the International Geological Congress,' by E. S. Moore; and 'Methods of Working, Ventilation, and Transportation in Bituminous Coal Mining,' by Thomas A. Mather.

EDUCATION OF MINE EMPLOYEES. By H. H. Stoek. Bulletin 1. Illinois Miners' and Mechanics' Institutes. P. 136. Urbana, Illinois, 1914. Welfare work by mining and industrial corporations among its employees is attracting considerable attention. With better surroundings and conditions of work, better efficiency is sure to result. This publication covers the work done in foreign countries as well.

CONSERVATION OF COAL IN CANADA. By W. J. Dick. P. 212. Ill., maps, plans, index. Commission of Conservation, Toronto, 1914. Practically all of the most populous portion of Canada lying between Montreal, Quebec, and Moose Jaw, Saskatchewan, relies solely on the United States for its supply of anthracite coal. Further, there are indications that the United States may, in the comparatively near future, prohibit the export of anthracite, and, as the only anthracite deposits so far discovered in Canada are confined to the area near Banff, Alberta, it is of great importance that suitable substitutes be found as soon as possible. Such a situation makes it clear that Canada should carefully husband her coal resources and, so far as possible, check all wasteful methods of mining and handling coal. With this end in view, the recommendations in this report are of great value.

Industrial Progress

Oil-Driven Air-Compressors

The increased use of low-grade oil fuel for power purposes has led to the design, by the Ingersoll-Rand Co., of the oil-engine-driven air-compressor. This is of the direct-connected straight-line type and somewhat resembles in this respect, as well as in the design of the air end, the Company's standard line of small compressors. The main frame is designed for a splash system of lubrication, is of the wholly enclosed type, and provided with removable covers.



OIL-DRIVEN AIR-COMPRESSOR.

The feature of greatest interest in this machine is the design of the driving end. This, as can be seen from the illustration, consists of a single oil-engine cylinder set behind the air cylinder, and directly connected, by means of an extended piston-rod, to the air piston. It follows in general design a type known as the 'hot bulb' engine, which combines a high thermal efficiency with simplicity of construction. The power cylinder is of the single-acting two-cycle type. It is water-jacketed, provided with an efficient system of lubrication, and of sturdy design. It is fitted with a torch for heating the ignition bulb preliminary to starting. After the compressor is under way this torch is dispensed with.

The fuel is automatically injected into the combustion chamber by means of a small pump, on the side of the frame, operated by the main shaft. It enters in the form of a finely atomized spray and is immediately ignited by the hot bulb, dispensing entirely with the electric spark and batteries. The stroke of the fuel pump is regulated by a centrifugal governor in the fly-wheel, thus regulating the amount of fuel injected into the cylinder in proportion to the load. This is supplemented by a regulating device on the intake to the air cylinder of standard design.

The operation of this machine is accompanied, it is claimed, by none of the losses common to the average two-cycle gasoline engine, in which part of the incoming charge follows the exhaust gases through the outlet ports and is wasted. This is due to the fact that the fuel is not vaporized by an outside agency and introduced with the air used for scavenging, but is injected directly into the cylinder at the end of the compression stroke, as already mentioned.

This means that pure air is used during the scavenging period of the stroke, consequently the inlet and outlet ports can be so arranged that more thorough scavenging is afforded without any loss of fuel. The absence of carburetor, with its needle valves, springs, and adjustments which have to be changed to suit atmospheric conditions, is one of the features of the engine.

A small quantity of the water from the cylinder jacket is introduced into the combustion space. The water is said to regulate the temperature in the cylinder, thereby preventing an undue rise in temperature of the piston and causing dissociation of the fuel. It is claimed to reduce the maximum pressure in the cylinder, at the same time slightly increasing the mean effective pressure, making a smooth-running and highly economical machine. The amount of water injected is regulated according to the load on the compressor.

The whole machine is compact and self-contained. It is at present made in but one size with an actual capacity, when running at 325 r.p.m., of 66 cu. ft. of free air at 100 lb. pressure and 73 cu. ft. at 80 lb. pressure. The fuel consumption at this speed, and under average operating conditions, is about 2.2 gallons of kerosene per hour. It is adapted to run on either kerosene, fuel oil, or distillate. Its weight complete is 3000 lb., and occupies a floor space of 8 ft. 10 in. by 2 ft. 5 inches.

Cold water paint manufactured by H. W. JOHNS-MANVILLE Co., of New York, is claimed to render mine workings less dangerous, and is also useful as a fire retardant and medium for improving sanitary conditions. This paint can be utilized in the underground station; increasing the light in and about the pumps is not only a help to the men, but it lessens the possibility of accident. It can be used for a large variety of purposes about the mine or mill. J-M cold water paint comes in dry powder form, is easily mixed, and possesses unusual whiteness. It is durable and costs but little more than ordinary lime wash. This paint is highly fire retardant, and a heavy coating on timbers is an aid in preventing fire. As it is also sanitary, its use in the various buildings connected with the mine is desirable. The manufacturers of this paint have prepared a booklet on this product, a copy of which will be forwarded to anyone interested.

The first exhibit to be installed at the Panama-Pacific International Exposition will be an immense 500-hp. Diesel oil-burning engine, and will be exhibited by the BUSCH-SULZER DIESEL ENGINE Co. of St. Louis. The installation will cost \$70,000 and will require six months to complete. The Company manufacturing the Diesel engine commenced the preparation of foundations for the mammoth exhibit on April 1. That the first exhibit to be installed should be the Diesel engine and one of great interest to California, as it will open a large field for the marketing of crude oil, was considered especially appropriate.

The B. F. GOODRICH Co., at Akron, Ohio, has devised an important improvement in dredging sleeves. A fabric of special design has been used in the solution of the expansion problem in dredging sleeves, and the new Goodrich sleeve, as perfected, reduces expansion to an absolute minimum. The durability of dredging sleeves, no matter how good their other features, can be seriously impaired by excessive expansion. The improvement will apply to general engineering where the dredging sleeve is an important item.

The DEISTER CONCENTRATOR Co. has filed suit against the Deister Machine Co., in the United States District Court for the District of Indiana, for infringement of patent issued to Gustave Overstrom and purchased by the Deister Concentrator Co. The complaint cites that the Deister Machine Co. is using a certain feature on its concentrating tables called a 'plateau' and is also endeavoring to place this feature on tables of other makes. It is claimed that the so-called 'plateau' is an infringement on the Overstrom patent.

The ABENDROTH & ROOT MANUFACTURING Co., makers of the Root spiral riveted pipe, with works at Newburgh, New York, has its general sales office in the Hamburg-American building, 45 Broadway, New York City.

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EDITORIAL

ALBERTA has been the scene of an oil and gas excitement for some months, and this will be accentuated by the bringing in of a well last week which is reported to flow 2,000,000 cubic feet of gas and an important amount of high-grade oil. Near Calgary, where this well is situated, there is a wide stretch of territory that seemingly warrants exploration, and it is to be hoped that further drilling may give even better basis for the development now under way.

LIMITATION of diamond production is to be the subject of a conference by the leading producers of South Africa this month. While the De Beers Consolidated Mines and the Premier (Transvaal) Diamond Mining Company, have long been market rivals, the competition has produced no visible results in reduction in price. Last year's South African production of 5,163,545 carats, valued at £11,389,897, is evidence of the annual tribute exacted by vanity and the magnitude of the industry which it supports.

INTEREST in new processes is always keen, and we are glad to present an authoritative account of Murex by Mr. James M. Hyde, who recently investigated its operation in Germany and elsewhere. In our London letter, and various short articles, our readers have been informed of the development of this new aid to metallurgy, but this is, we believe, the first authoritative account presented in America of a Murex plant in actual operation. It is hoped that the process will find application in a number of directions where peculiar ores call for peculiar means.

STUDENTS of ore deposition are receiving new and welcome aid from the reflecting microscope. As yet the technology is simple, much as was that of the now ordinary petrographic microscope in the days of Zirkel's first work. The French mineralogists, working out the optical properties of minerals, gave Rosenbusch a basis for systematic petrography and doubtless in time a complex technic for the reflecting microscope will develop. In the meantime we take pleasure in presenting the article by Mr. James C. Ray, who shows by careful account of a specific set of specimens just what it is now possible to learn. Mr. Ray is at Stanford University, as always an active centre of research.

METAL MARKETS for May have been quiet, and a revival of business depends largely upon the pending freight rate decision, according to reports from New York. Stocks of railroad supplies are low and every effort is being made to avoid buying. The prices of all metals weakened in May and general trend has been downward. On another page of this issue will be found the monthly detailed analysis of the metal market in New York by our special reporter of the metal markets.

WORKMAN'S COMPENSATION is being considered by the state of Idaho and in a report recently submitted by the commission which was appointed about a year ago to investigate this subject, an outline of the proposed law is presented. It includes a number of features of constructive legislation based upon the experience of other states and foreign governments, together with a few radical departures. The administration of this proposed department will be in the hands of a board including the Commissioner of Labor and Immigration, the State Insurance Commissioner, and a third appointed by the Governor. In this manner a satisfactory administration is provided with but little added expense for operation. In order to eliminate disputes, beneficiaries are defined as including only the wife and children in the first instance, but in the absence of a family, the father and mother receive a less rate of compensation, and minor dependents, as brothers or sisters, still further reduced amounts. No compensation is allowed during the first two weeks. The compensation differs with the earning capacity of the workman, not, however, exceeding \$10 per week, nor is it to continue more than 300 weeks for temporary disability. In case of total disability the law provides for payment 400 weeks at the scheduled rate, after which payments of \$5 per week during the life of the workman. Specific schedules are provided for dismemberment, paralysis, loss of sight, and other injuries which are all properly related to a maximum of \$2000. Three plans of compensation are proposed. The first permits financially solvent employers, upon making a deposit of 3 per cent of their annual payroll, to settle and pay direct, but under supervision of the board. Another plan provides that the employer may insure his risk, where he does not care to exercise other options under the bill or his financial standing does not meet the approval of the board. The third plan is modeled after the law of the state of Washington, whereby occupations are divided into classes according to the hazard of the occupation and a varying rate is assessed each class. The bill shows that much study has been given to it and every effort has been made to profit by the experience of other states. Such careful and deliberate work by an executive body is to be commended and will undoubtedly redound to the benefit of both employer and employee. Workmen's compensation laws are, we believe, more than a fad. Some of them are crude, but the principle is sound.

Colorado Smelters

The effort, which is being made by the mining interests in the state of Colorado to resuscitate metal mining and give it a new lease on life has recently taken the form of proposed legislation for the establishment by the state of three smelters. When the federal government proposed to withdraw radium deposits from entry, development of this new industry was looked to by many to set prospectors and miners at work again, but with the failure of the radium bill to become a law, interest has seemingly waned and the smelting situation has come in for renewed discussion resulting in the proposed constitutional amendment.

The petition as prepared provides for a \$4,000,000 bond issue which will be used to build smelters and treat ores under state supervision. The plan, as reported, is to construct and operate smelters at Denver, Pueblo, and Durango. It is planned to equip the Denver plant with machinery for the reduction of ores containing radium and other rare and precious metals. This plant will cost \$2,000,000 according to specifications. The plants at Pueblo and Durango will cost \$1,000,000 each. The proposed bonds for financing these smelters will be known as 'state smelting bonds' and will bear three and a half per cent interest payable semi-annually. The bonds are redeemable at any time after five years and must be paid off within 50 years. The object of the proposed enactment is, of course, to foster the mining industry. Whether this putting the state into industry is the correct solution of the difficulty may well be doubted. It is not smelters but mines that Colorado needs, and you do not grow crops by buying threshing machines. To our way of thinking, there is a radical difference between proposal to enter smelting wholesale for the sake practically of furnishing work and the more modest proposal that the federal government should reduce radium ores, primarily to supply its own hospitals. Colorado did not take kindly to the latter suggestion, and we fail to see any good reason for supporting the more radical substitute now proposed.

It would seem that if there were any urgent demand for additional smelter capacity in Colorado, private capital would have found it out. In point of fact, there is excess capacity now. While an additional bonded indebtedness of \$4,000,000 is not a great amount for Colorado to assume, we question whether it might not be better employed in another field of the industry. The discovery and development of new ore-bodies and the treatment of low-grade and complex ores is the subject of importance to the Colorado miners and if the work of the State Geological Survey and the research work of the Bureau of Mines could be augmented, a greater return on the proposed investment might be possible. The value of the mineral production of Colorado for the past 20 years shows an increase from \$28,012,524 in 1894 to \$50,314,019 in 1900,

which is the largest production recorded. Since 1909 the general trend of the industry in the state has been downward with an occasional year which showed a slight increase until in 1911 the value of the production, as reported by the State Bureau of Mines, was only \$82 741 866. In 1912 the production increased to \$37,044 280 but whether this would indicate a general upward movement in the industry or is only a temporary fluctuation in production remains to be proved. A comparison of the production statistics for 1900 and 1912 show that a general decline has been experienced in most of the counties of the state, a few remaining stationary or showing a slight increase, these latter, however, are in the decided minority. The problem which Colorado miners face appears to be one of exploration for new and research into the economic treatment of known ores rather than increasing the present smelting capacity.

The Outlook

Everyone is necessarily interested in the prospects for an early revival of business activity. That the past year has been a dull one for general business is true without any possibility of question. It is equally generally hoped that before the end of this year a marked revival of business activity will ensue. Just when it may be expected is the crucial question. For this reason the views of men prominent in the world of affairs are of great general interest, since presumably they have available sources of information which are not within the reach of the ordinary man. The most optimistic of recent statements is that of Mr. E. P. Ripley, president of the Atchison, Topeka & Santa Fe Railroad. Mr. Ripley sees in the prospects of unusually large crops for this season the basis of a general injection of snap into business. Crops are not only among the largest direct items of business, but also are the source of a great deal of indirect business. Their transportation and manufacture from the raw state into food products and their retailing affords employment to a large proportion of our population. It follows directly, therefore, that large crops mean good business, and there is much justification for the belief that in the apparently assured unusually large crops for this year lies the germ of a marked increase of the volume of business. Another optimistic statement recently made is that by Mr. James A. Farrell, the president of the United States Steel Corporation, who has just returned from Europe and who has expressed himself as believing that business generally is emerging from an unsatisfactory condition into a satisfactory state of commercial confidence. Both in England and Germany strong efforts are being made to increase trade, and their lead is at last being followed in this country, the National Foreign Trade Convention held at Washington last week being a commendable, useful attempt to stimulate the export business of the United States. Mr. E. H. Gary, chairman of the United States Steel Corporation, in a recent address, while admit-

ting the present depressed state of business, is also confident that a marked revival will soon come and takes the cheerful view that the considerable period which has passed without its arrival means that we are that much nearer to it.

That not all business is depressed is shown by the report of the Westinghouse Electric & Manufacturing Company, which for the year ended March 31, 1914, declared a dividend of 10.7 per cent on its common stock, as compared with 8.2 per cent for the preceding year. Machinery such as this Company produces may be looked upon as, in a way, the semi-finished products of general business, since it goes into use by the general public and the large corporations. So favorable a report as this by an organization of such widespread activities indicates that business is fundamentally sound and that it is merely a question of time when the general condition will be more optimistic than at present. In the special field of mining, the unsettled state of Mexico has undoubtedly contributed greatly to cause a depression which otherwise would in all probability have scarcely been noticeable. Here again there is room for optimism, however, for there is ground for belief that the present condition in Mexico may possibly be satisfactorily remedied at a not too distant date. It is unquestionable that when a peaceful and stable government is restored to Mexico, a decided boom in mining in that country, with reflex action throughout the mining world, will follow.

It is gratifying to note that the administration is taking steps toward the development of the foreign markets for American products and increasing the merchant marine. It was announced at the Foreign Trade Convention in Washington that Mr. Wilson authorized the statement that he would devote personal attention to procuring legislation for upbuilding the American merchant marine. This is an important but difficult task, and as to means, there is no agreement as yet. Greater foreign markets will stabilize the home industries, as pointed out by Mr. Farrell, and this is of vital interest to the American people. The importance of the matter is shown by the immensity of the present foreign trade of the country, which amounts to \$2,500,000,000 annually, of which about eighty per cent represents labor. It has been pointed out that it is not only essential that the American people should make an effort to extend their foreign markets to enhance their prestige and wealth, but it is also becoming a necessity in order that the domestic consumption of the country, now recurrently insufficient to absorb the whole output of our mills and workshops, be stabilized. The subject is most important to American industry, and in that we have been lagging in this respect in the past, the concerted effort which is now being made by the producers and backed by government aid should be productive of results. Sentiment is generally optimistic regarding the success of the proposed extension of the lines of trade, and we are hopeful that the increase may come rapidly.

The Reflecting Microscope in Mining Geology and Metallurgy

By JAMES C. RAY

In 1873 Ferdinand Zirkel published his first paper¹ giving the results of a study of rocks in thin sections with the polarizing microscope. Prior to this all attempts toward the systematic classification of rocks were based on megascopic examination and geologic relations as observed in the field. By these earlier methods a true understanding of the relations of rocks to each other, as now grouped in petrographic provinces, as well as the relation of the constituent minerals and their alteration products, was not known; the resulting classifications being faulty as well as inconsistent.

At this early date petrography was considered a pure science only and its application to the study of ore deposits were not appreciated. A brief review of the development of microscopic petrography from the introduction of the polarizing microscope and its general acceptance in the iron and steel industry to its later application in the field of economic geology may be timely.

Microscopic Study of Rocks

The appearance of Zirkel's first paper gave great impetus to the microscopic study of rocks and the rapidity with which this science was developed is most striking. With the identification and understanding of rock alterations came the discovery that often these alterations are connected genetically with ore deposits. As mineral synthesis and physical chemistry developed, the microscope came into greater demand for a study of the wall or country rocks in connection with the examination of ore deposits.

The majority of ore deposits occurring in veins fall into the class developed by hydrothermal processes (ascending hot solutions). Propylitization, sericitization, greisenization teach us much regarding the chemistry of ascending ore forming solutions. Many of the mineral alterations caused by cold descending solutions are distinct from those just mentioned and if a definite idea of the type of alteration accomplished by the ore depositing solutions be discriminated, the type of solution which produced any given ore deposit may be stated with some certainty. This and many other phenomena help to a clearer understanding of the genesis of ore deposits and can be recognized and worked out only by the use of the microscope. These points are of such vital value that today the mining geologist gives considerable time to a study of the associated rocks in connection with his examination of ore deposits.

In the study of thin sections of rock with the polarizing microscope, however, the source of light is from

below and does not illumine the surfaces of the opaque minerals. For this reason until recently little has been known of the intimate relations existing in sulphide (or other opaque mineral) mixtures, and the manner of their enrichment. These are of much importance in the true determination of the value of a deposit, as when these relations are known, the periods of mineralization and enrichment can be clearly followed, as will be later demonstrated.

In 1863 Sorby began the study of meteorites² and artificial irons³, and some years later this work was carried on by other investigators; but the economic application of the work was not generally recognized. It is only within the last 15 years or so that the importance of metallography to the steel manufacturer has been recognized and the gradual advance of this branch of microscopy has been resisted at every step by the old guard of foundrymen.

The steel chemist had a hard fight to gain recognition but after his final acceptance it was thought that little more remained to be learned regarding the internal properties of steel. It soon became evident, however, that the ultimate analysis of a steel left much in doubt regarding the structure which controlled to a large degree the physical properties of this material. Howe⁴ brought out clearly in 1890 that even the proximate analysis was not the final word in an understanding of the properties of steel, as the structure was still in doubt. Finally, with the introduction of the reflecting microscope this also was made possible. The recognition of this fact has brought about the establishment of metallographic laboratories in connection with all of our large steel plants. Special courses are also given in most of the larger universities, dealing with this phase of the metallurgy of steel.

Examination of Opaque Substances

In 1906 William Campbell published two papers dealing with the application of the reflecting microscope to opaque substances other than steel. The first of these papers⁵ described methods of grinding, polishing, development of structure, mounting, etc., of specimens to be studied, also the explanation and use of the reflecting microscope. The second paper⁶ was accompanied by microphotographs and gave a detailed description of the study (with the reflecting microscope) of the nickel arsenides and silver deposits of Temiskaming, Canada. These two papers directed anew the atten-

¹Proc. Royal Soc., XIII, 333; British Assoc. Report, 1865, I, 139.

²British Assoc. Rept., 1864, 11, 189. Iron and Steel Inst., 1886, 140; 1887, 1, 255.

³Sauveur, 'The Metallography of Iron and Steel,' p. 2.

⁴Economic Geology, Vol. 1, p. 751.

⁵Loc. Cit., p. 767.

⁶Ferdinand Zirkel, 'Die Mikroskopische Beschaffenheit die Mineralen und Gesteine.' Prior to the above date Sorby had done considerable microscopic work on sedimentary rocks but I am unaware that he attempted systematic classification.

tion of economic geologists to the possibilities of this means of studying the occurrence of opaque ore minerals and gave new impetus to the development of this hitherto neglected branch of economic geology.

In the preparation of polished sections, each investigator soon develops his own method of procedure. The one given below I have found to give excellent results from the point of speed and production of a polished surface, free from scratches.

Preparation of Specimens

The equipment should consist of the following: two iron discs such as are used for the preparation of thin rock slides, one heavy wooden or iron disc covered with lapidaries cloth, and one iron disc covered with a good grade of broadcloth. These discs revolve horizontally at about 250 revolutions per minute. The equipment should also include a diamond or disc saw. The abrasives are, No. 50, No. 100, and No. 200 carborundum powder, tripoli powder, and gold rouge. The discs must be carefully separated by partitions high enough to prevent the powder from flying from one disc to another.

The specimens to be polished should be about one inch square and one-half inch thick and can be broken from the larger samples or accurately sawed if it is desired to examine some particular part of the specimen. The trimmed specimens are roughly surfaced on the first disc with No. 50 carborundum powder, next they are more carefully ground on the second disc with No. 100 carborundum. When all the specimens on hand to be polished have been put through the second stage of preparation the disc should be carefully cleaned and a false lining set in the compartment. The specimens are now carefully ground down with the No. 200 carborundum to eliminate all scratches visible to the naked eye. With some minerals it is necessary to finish the grinding with a few turns on a glass plate.

Next make up a thin paste with water and tripoli powder and proceed to the first polishing on the lapidaries cloth. Great care must be exercised to keep the cloth free from hard particles as any scratches contracted at this stage can not be eliminated without re-grinding. The final brilliant polish is produced on the fourth disc covered with broadcloth. A thick paste of the gold rouge is sparingly applied to the broadcloth and the specimen lightly held on the wheel for only a few turns.

Running water should be handy and the specimens washed frequently during the entire process. The hands of the operator should be carefully scrubbed after each part of the process has been completed that no particles of powder may be carried to the disc using a finer grade of powder. With the above method the average time per polished section is ten to fifteen minutes.

If a table microscope is used the specimens are most conveniently mounted temporarily as examined. The most effective mount is the cylindrical metallic cup, $\frac{1}{2}$ to 1 inch deep and $1\frac{1}{2}$ inches in diameter. To

mount, the specimen is placed face downward on a smooth piece of glass covered with a thin sheet of paper. A plastic wax is put in the cup which is inverted and placed over the specimen and pressed down until the sides of the cup are firmly in contact with the glass plate. The polished section is thus held parallel to the microscope stage when the cup is placed on it. Most of the large metallographic microscopes are arranged so that the specimen is placed directly on the stage face down and mounting is unnecessary.

In the study of thin rock sections the source of light is from below, the light rays being transmitted upward through a condensing lens and are polarized before passing through the transparent rock section.

In the study of opaque minerals, metallic alloys, etc., the light must be thrown down upon the polished surface. This is accomplished in two ways: by a small right angle prism set in the objective and by a thin glass plate set either in the objective or below it at an angle of 45° with the optical axis of the microscope. Light, either natural or artificial, is thrown upon either of these reflectors and is directed downward to the polished surface of the specimen. If the polished surface is exactly normal to the optical axis of the microscope the light rays are again reflected vertically upward through the lenses of the microscope and the image in the field is thrown against the eye.

Identification of Opaque Minerals

Opaque minerals are identified in five ways:

1. Natural color of the mineral.
2. Relief in polished section (hardness).
3. Structure, natural or artificially developed by reagents, acids, etc.
4. Tarnish films, developed artificially by reagents.
5. Microchemical tests. (A drop of reagent is applied to the polished surface in the field and its action on the minerals observed through the microscope.)

When a series of specimens is to be examined, the preliminary determination of the constituent minerals by the last three means of determination enables the detailed study of mode of occurrence, association, and replacement to proceed with little delay. The first two methods (color and relief) and natural structure are used to determine the constituent minerals. The systematic study of opaque minerals, by the reflecting microscope, is at present so young that no tables giving complete and reliable tests exist in published form.

Max Leo⁷ has published a paper giving some very satisfactory tests for the yellow sulphides. In many instances, however, his tests are inapplicable to minerals occurring in microscopically small particles. What promises to be a complete and satisfactory table of tests is looked for in the near future from Joseph Murdoch who has devoted much time to this subject in connection with the work of L. C. Graton⁸.

Since the appearance of the paper by Campbell and

⁷Max Leo. *Die Anlauffarben*. Dresden, 1911.

⁸See statement by Graton. *Trans. Amer. Inst. Min. Eng.*, May, 1913, p. 805.

Knight on the Temiskaming district (1906) most of the investigations have been made on the copper sulphides and titaniferous iron ores. The most important paper on the former by Graton and Murdoch,¹⁰ appeared last year (1913) and is of great interest to the mining geologist. Titaniferous iron ores have been exhaustively studied by Joseph T. Singewald¹¹. His work is of vital interest to the iron metallurgist as it shows titanium to occur as the mineral ilmenite and the structure of the ore has much to do with the successful magnetic separation of the useful iron minerals.

The present development of the study of opaque ore minerals by the reflecting microscope has accomplished the following results: (1) the identification of most of the common opaque minerals in polished sections; (2) the identification of mineralogical associations and physical structure of ores; (3) furnishing of means for following the processes of enrichment, replacement, and alteration of ore minerals; (4) identification and separation of different periods of mineralization in the same orebody; (5) identification of reopening or movements in orebodies; (6) the accurate genetic grouping of veins in any given district.

Micrographs

The following microphotographs of polished sections will serve to illustrate what may be learned by examination in a specific case. The specimens here collected are from the 1600-ft. level of the Leonard mine, Butte, Montana.

No. 1 shows quartz and pyrite in intimate intergrowth, surrounded by enargite. From field observations and study of many polished sections the quartz-pyrite intergrowth is known to belong to the first of several periods of mineralization. Petrographic study of the wall rocks shows these minerals to exist in two occurrences; (1) as a replacement of the normal quartz monzonite; (2) as primary minerals deposited in fractures. The replacement type is by far the most important in the Butte veins. Enargite is seen to be surrounding and apparently replacing the quartz-pyrite. It is seen that the contacts between the quartz and pyrite veins are continued out into the enargite. This is more clearly brought out in No. 2 which is an enlargement of a part of the field of No. 1 as indicated by the white dotted line. Here the contacts are clearly traced into the surrounding enargite. The dark spots seen in the enargite within the preserved contact lines are quartz or pyrite, depending on which of the two earlier minerals has been replaced.

No. 3 shows covellite replacing enargite, and, to a less degree, pyrite. No. 4 shows angular fragments of enargite cemented in a matrix of covellite. The covellite has subsequently been brecciated, and its cementing material is chalcocite. In this one photo-

graph two movements of the vein are clearly illustrated. The first fractured enargite which was cemented with covellite; the second brecciated covellite which was cemented with chalcocite.

No. 5 and No. 6 show the development of bornite in chalcocite. The peculiar meandering occurrence of the bornite is due to the inherited structure of the early quartz-pyrite mineralization (see No. 1 and No. 2). A careful study of the Butte ores leads to the opinion that the deep seated chalcocite here shown was deposited in colloidal form from ascending alkaline solutions. Where pyrite in small residual fragments remained from earlier periods of mineralization, it induced the formation of bornite and chalcopyrite (principally the former) by a reabsorption of the iron from the pyrite. This iron combined with the colloidal chalcocite *in situ* to form bornite, as seen in the accompanying microphotographs.

No. 7 shows chalcopyrite developing contemporaneously with chalcocite along the contact of enargite and covellite. In this case chalcocite is attacking the covellite which contains much finely disseminated residual pyrite. The replacing solutions being sluggish in the deep re-entrant angles of the enargite they failed to carry off the iron from the decomposed pyrite. This iron combined with the colloidal chalcocite to form chalcopyrite.

No. 8 shows chalcocite replacing enargite and covellite. The later mineral is clearly seen to be eating in along the cleavage plains of the covellite.

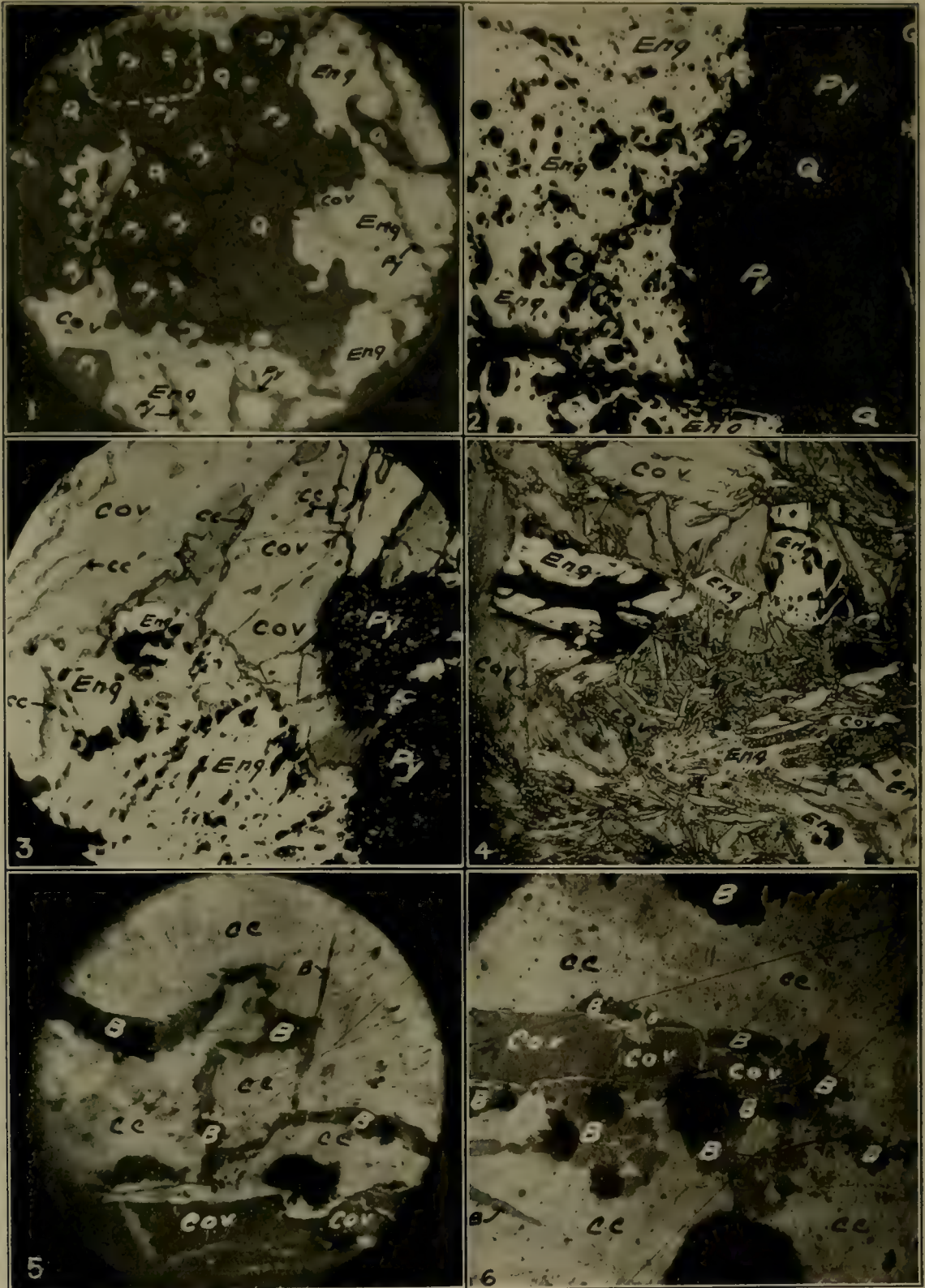
No. 9 and No. 10 show the two end points of the replacement of covellite by chalcocite. No. 9 shows the insipient stage of chalcocite replacement, which is eating in along the cleavage planes of the covellite. No. 10 the last stage of replacement; only narrow needles remain to mark the former positions of the covellite plates. The former outline of the covellite fragments is easily distinguished by the distribution of the residual needles.

No. 11 illustrates what I believe to be conclusive proof of the earlier colloidal condition of the chalcocite, and hence that it was derived from upward circulating alkaline solutions. The oblique systems of light parallel lines are not artificially developed but are the result of the action of moisture in the atmosphere. It will be observed that the main mass of the chalcocite exhibits a dirty spotted appearance. This is due to tiny specks of bornite and other impurities which are quickly tarnished by moisture. It will be observed that the larger of these spots are cut off or pushed aside by the lighter lines. These lines indicate the crystallographic planes of chalcocite and it is assumed that there was a tendency of the chalcocite to purify itself along these lines when crystallization took place. It is known that chalcocite crystallizes from the colloidal state by the release of hydrogen sulphide¹²; and the phenomenon here shown is the result of such action.

¹²Clark, J. D. Unpublished manuscript.

¹⁰Graton, L. C. and Murdoch, Joseph: "The Sulphide Ores of Copper," *Trans. Amer. Inst. Min. Eng.*, May, 1913, pp. 741-797.

¹¹Singewald, Joseph T. *Bull.* 64, U. S. Bureau of Mines; also *Economic Geology*.



B, bornite.

Cc, chalcocite.

Cov, covellite.

Eng, enargite.

Py, pyrite.

No. 12 shows the principal copper minerals of the several periods of mineralization: (1) enargite; (2) covellite; (3) chalcocite (also bornite and chalcophyrine); (4) a purer chalcocite which cuts through and replaces the first generation of this mineral¹².

The Scope of the Science

Only a few of the most important points have been touched in the foregoing descriptions, but it is hoped they may serve to illustrate some of the results which can be obtained. The application of the reflecting microscope to the study of ores will not act as a 'wiltow wand'. Results are not often casually obvious, but must be obtained by careful and often tedious study of many specimens. This growing science is not going to revolutionize mining geology and make it possible for the expert to sit in his office on the 18th floor and after examining a few chips of ore, give unerring advice as to the extent and richness of an ore deposit. It is confidently believed, however, that with this means of studying ore minerals the geologist has added another tool to his work chest. He may now square up the results of his field and petrographic study. He may know certainly what he previously only suspected regarding the relations of ore minerals; and may learn many valuable facts which he previously had to do without in deciding for or against a mining property.

This work is not going to solve problems for the successful ore treatment, but it will in many cases point out why a treatment fails. Much can be accomplished along the line of detailed metallurgical experimentation with individual ore minerals.

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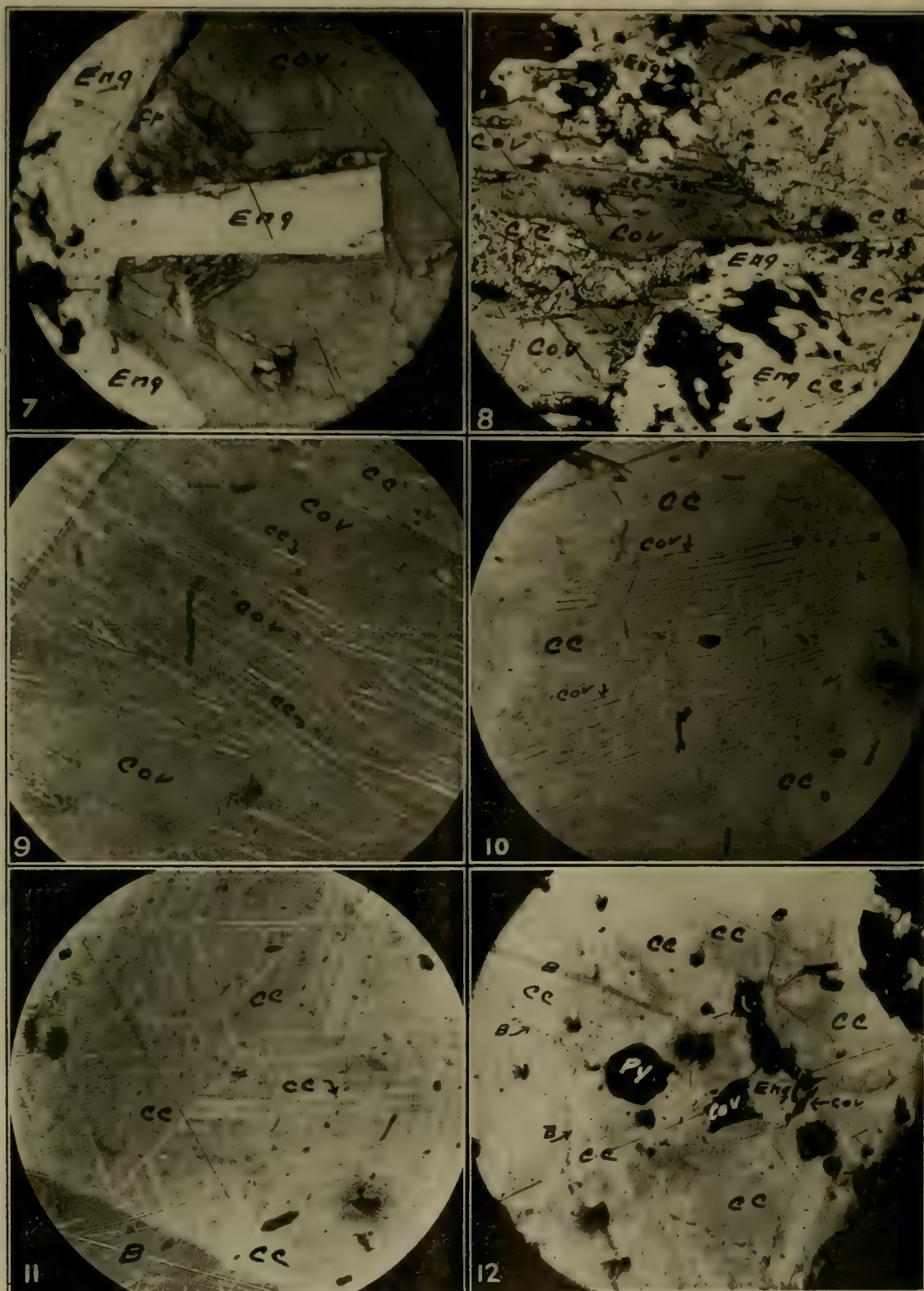
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Growth of the Brass Industry

Charles F. Brooker, president of the American Brass Co., the world's largest copper consumer, said in a recent interview by the *Boston News Bureau*: "As an illustration of the growth of the brass business, it may be pointed out that the Coe Brass Manufacturing Co., of Torrington, Connecticut, had an output in 1864, its first year, of finished material of about 75,000 lb. per month, or 900,000 lb. for the year, and in 1869 it ran up to 100,000 lb. per month or 1,200,000 lb. for the year. Forty-three years later, 1912, the same mill turned out over 50,000,000 lb. of finished material, or four and one-quarter times each month as much as the yearly product of 1869. The consumption of copper was fairly estimated as having been 25,000,000 lb. in this country in 1864; in 1870 it was reckoned at 30,000,000 lb.; and in the year 1913 the domestic deliveries in the United States aggregated 767,000,000 lb., or 64,000,000 lb. per month. I remember being told in my early days that we must look to Baltimore alone, in this country, and then to England for our supply of copper."

Sulphur produced in the United States in 1913, according to the U. S. Geological Survey, was 311,590 long tons, valued at \$5,479,849, the greatest output in the history of the industry. This output was 8118 long tons greater than that of 1912 and showed an increase in value of \$223,427. In 1913 three states produced sulphur, namely, Louisiana, Texas, and Wyoming. The United States is rapidly gaining on Sicily, which at the present time is the leading sulphur-producing country in the world, and whose output for the year ended July 31, 1913, was 346,213 long tons.

¹²Reno Sales has given almost uncontrovertible geologic evidence showing that the deep seated chalcocite of the Butte district is due to the agency of ascending solutions. This evidence is strongly corroborated by work which I have done on the wall rocks by petrographic methods and on the ore minerals with the reflecting microscope. See, Reno H. Sales 'Ore Deposits of Butte, Montana,' *Trans. Amer. Inst. Min. Eng.*, Aug., 1913, pp. 1523-1631.



B, bornite.

Cc, chalcocite.

Cov, covellite.

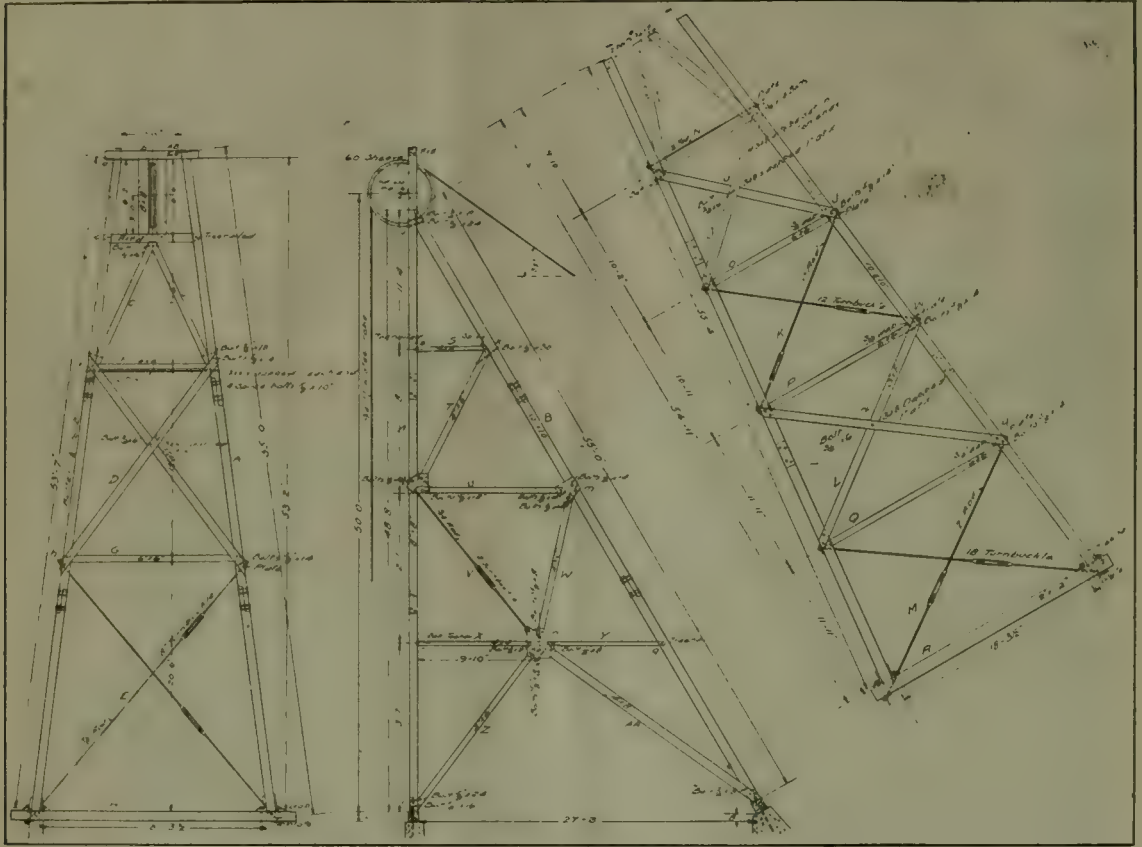
Eng, enargite.

Py, pyrite.

A Small Head-Frame

We present below a detailed drawing of a 50-ft. head-frame built for the Nevada Central Copper Co.,

of 94,609 tons. A large part of the coal used in by-product ovens in states that do not produce coking coal was obtained from West Virginia mines. Mr. Parker estimates that the quantity of West Virginia



FRONT, SIDE, AND BACK ELEVATIONS OF HEAD-FRAME.

by H. A. Linke. As complete dimensions are given, no description is necessary.

Coke Production in 1913

All records in coke production were broken in 1913, according to Edward W. Parker, of the U. S. Geological Survey, the output being 46,311,369 short tons, valued at \$128,951,430. This is an increase over the 1912 output of 2,327,770 tons in quantity and \$17,146,317 in value. Of the 1913 production, 33,596,669 tons was made in beehive ovens and 12,714,700 tons, or 27.4%, in retort or distillation ovens where all the by-products tar, gas, ammonia, etc., are saved. The increase in production of by-product coke was over twice as large as the increase in beehive coke. The principal increase in by-product coke production in 1913 was in Alabama, where the gain was nearly 50%, from 1,349,797 tons in 1912 to 2,022,959 in 1913. The increase in Pennsylvania was nearly one-third, from 1,974,619 tons in 1912 to 2,628,680 tons in 1913. Indiana showed an increase of 110,686 tons, and Illinois

coal made into coke outside of the state was 7,800,000 tons. The quantity of coal made into coke in West Virginia was 4,034,251 tons, and the quantity of coke produced therefrom was 2,472,752 tons. If all the coke made from West Virginia coal were credited to that state, the total production would amount to about 7,750,000 tons.

Coal production in Georgia in 1913 was 255,626 short tons, valued at \$361,319, according to the U. S. Geological Survey, in cooperation with the Georgia Geological Survey. This was the largest production in five years, or since 1908. Compared with 1912, it shows an increase of 28,123 short tons in quantity and of \$22,893 in value. The maximum production of coal in Georgia was 416,951 short tons, obtained in 1903. Each of the 500 free miners (convicts were employed up to 1904) produced 1.95 tons per day.

Copper concentrate produced by the Elmore vacuum plant at the Sulitjelma mine, Norway, amounted to 770 tons in April.

Determination of Flue-Dust Losses

By T. NELSON and L. LARSON

The determination of flue-dust losses in metallurgical works is one of prime importance to all smelting companies and the method employed in arriving at a correct solution of the problem is valuable to the chemist and metallurgist.

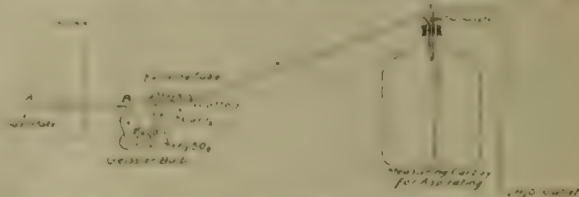
Steptoe Valley Smelter

As a contribution to this subject we present the following description of the method adopted at the Steptoe Valley Smelting & Mining Co. smelter, embodied in the form of a report. For obvious reasons the actual results of flue-dust losses are not given. This, of course, does not detract from the value of the paper. Except in some minor details, originality is not claimed for the process, nor for the calculations involved.

The actual weight of flue-dust can be arrived at by determining the percentage of Cu in the flue-dust and

ground to fit, and after inserting the filter papers, the edges are sealed with a thin coating of paraffine.

DETERMINATION OF MOISTURE IN REVERBERATORY STACK GASES



SKETCH OF APPARATUS USED FOR EXTRACTING MOISTURE FROM GAS.

Note.—The gas samples were obtained by drawing the gas from the stack as shown in sketch above. The gas was drawn out very slowly, the moisture being extracted by the Geissler bulb, with attached CaCl_2 tube and the quantity of gas measured in carboy as shown. The moisture which has condensed in the tube AB was then driven into the Geissler bulb and CaCl_2 tube by drawing dry air through the tube. The bulb

TABULATED DATA

Date of test.	Duration of test.	Litres of gas.	Gas temperatures.		Moisture collected.	Moisture per litre.
			Carboy, deg. F.	Stack, deg. F.		
June 17, 1913	1:00 p.m. to 3:00 p.m.	9.0	85	550	0.171	0.019
" 18, "	10:25 a.m. to 3:12 p.m.	11.0	78	...	0.241	0.0219
" 19, "	9:20 a.m. to 2:57 p.m.	10.0	80	...	0.230	0.023

Average moisture = 0.0214 gm. per litre of reverberatory stack gas.

1 litre of H_2O vapor weighs 0.804 gm. at N. T. P.

Then $0.0214 \text{ gm.} \div 0.804 \text{ gm.} = 0.0266$ litres of H_2O vapor extracted from each litre of gas.

Each litre of gas measured + moisture extracted = volume of original gas = $1 + 0.0266 = 1.0266$ litres.

Therefore, percentage of moisture = $0.0266 \div 1.0266 = 2.59\%$.

DETERMINATION OF CO_2 , CO , AND O_2 , AND CALCULATIONS OF THE WEIGHT PER VOLUME OF REVERBERATORY STACK GAS

TABULATED DATA

Date of test.	Time.	Analyses			Stack Temp. gas		Remarks.
		CO_2 , %	O_2 , %	CO , %	temp., °F.	sample, °F.	
June 20, 1913	9:00 a.m.	5.9	15.7	0.0	550	80	Reverberatories No. 2, 3, and 4 in operation
" "	10:10 a.m.	4.5	16.5	"	"	"	"
" "	10:20 a.m.	5.0	15.0	"	"	"	"
" "	10:40 a.m.	3.8	16.8	"	"	"	"
" "	10:50 a.m.	3.8	16.6	"	"	85	"
" "	11:10 a.m.	4.5	15.7	"	"	"	"
" "	11:18 a.m.	4.2	15.3	"	"	"	"
Averages		4.53	15.94	0.0	550	82.5	"

using that ratio to the weight of Cu which is found in the test.

The investigation is divided into several parts:

1. Determination of moisture in gases.
2. Determination of CO_2 , CO , and O and calculations.
3. Velocity determinations by Pitot tubes and calculations.
4. Determination of flue-dust and Cu in gases.

The average percentage of SO_2 and SO_3 was so slight that it was left out of calculations.

In order to make an air-tight joint in the apparatus used in Part 4, the faces of the two glass funnels are

and tube were weighed before and after the test, the difference being the weight of H_2O extracted.

Note.—The gas samples were drawn from stack and analyses made with an Orsat and an Allen-Moyer gas apparatus. The samples taken for analysis were 100 c.c., but the moisture in each sample was 2.66 c.c., as determined by the moisture test. During the process of measuring the samples, this moisture condensed so the volume of the original sample was 102.66 c.c. Therefore, the correct percentages must then be calculated from 102.66 c.c.

Thus, calculating back: $4.53\% \text{ CO}_2 = 4.41\%$

$15.94\% \text{ O}_2 = 15.55\%$

$2.66 \text{ c.c. H}_2\text{O} = 2.59\%$

N by difference = 77.45%

Total = 100.00%

CALCULATIONS OF THE WEIGHT PER VOLUME OF REVERBERATORY STACK GAS

At N. T. P. 1 litre	CO ₂ = 1.965 gm.	From average analysis	CO ₂ = 0.0441 litre × 1.965 gm. = 0.08665 gm.
" "	O ₂ = 1.429 "	" "	O ₂ = 0.1555 " × 1.429 " = 0.2222 "
" " H ₂ O vapor = 0.804 "	" "	" "	H ₂ O = 0.0259 " × 0.804 " = 0.02082 "
" " N = 1.250 "	" "	" "	N = 0.7745 " × 1.250 " = 0.96812 "

At N. T. P., total weight of 1 litre reverberatory stack gas = 1.29779 "

1 cu. ft. = 28.3 litres. Then 28.3 × 1.29779 = 36.7249 gm. per cubic foot.

36.7249 : 453.6 = 0.08096 lb. = weight per cu. ft. of reverberatory stack gas at N. T. P.

VELOCITY TESTS AND CALCULATIONS OF VOLUME OF GAS PASSING UP REVERBERATORY STACK PER DAY

Pitot tube readings were taken across the stack at a point 16.5 ft. above the top of the gas inlet to the stack. The average of several sets of these readings was used in the velocity calculations. Several sets of Pitot readings were also taken in the inlet to the stack and the average of these was used in a separate velocity calculation as a check.

STACK VELOCITY CALCULATIONS

Average Pitot tube velocity reading in stack = 0.136 in. H₂O. 0.08096 lb. = weight of 1 cu. ft. reverberatory stack gas at 32° F. and 760 mm.

$$\frac{P_1}{P_0} = \frac{W_1}{W_0} \text{ or } P_1 W_0 = P_0 W_1, \text{ where } P_0 = 760 \text{ mm. } P_1 = 610 \text{ mm.}$$

$$W_0 = 0.08096 \text{ lb. } W_1 = \text{wt. cu. ft. gas at 610 mm. and } 32^\circ \text{F.}$$

$$W_1 = \frac{P_1 W_0}{P_0} \text{ or } W_1 = \frac{610 \times 0.08096}{760} = 0.06498 \text{ lb.}$$

$$\frac{W_1}{W} = \frac{460 + T}{492} \text{ or } W = \frac{492 \times W_1}{460 + T} \text{ where } T = \text{stack temp.} = 590^\circ \text{F.}$$

and W = wt. of cu. ft. of gas at 590° F. and 610 mm.

$$W = \frac{492 \times 0.06498}{460 + 590} = 0.03044 \text{ lb.}$$

62.4 lb. = Weight of a cubic foot of water.

$$\frac{62.4}{W} = \frac{62.4}{0.03044} = 2049 \text{ factor to convert column of H}_2\text{O to stack gas at } 590^\circ \text{F.}$$

$$\frac{2049}{12} \times 0.136 \text{ in.} = 23.21 \text{ ft. of gas} = h.$$

$$V = \sqrt{29h} = \sqrt{29 \times 23.21} = \sqrt{673.09} = 25.93 \text{ ft. sec.} = \text{velocity of gases in stack.}$$

$$\text{Diameter of stack} = 20 \text{ ft. Area} = \pi r^2 = 3.1416 \times 10^2 = 314.16 \text{ sq. ft.}$$

$$314.16 \times 38.5 \times 60 \times 60 \times 24 = 1,045,021,824 \text{ cu. ft.} = \text{volume of gas passing up stack per 24 hours.}$$

STACK INLET VELOCITY CALCULATIONS

Average Pitot tube velocity ready in stack inlet = 0.2446 in. H₂O.

Stack temperature = 560° F.

Other figures and calculations same as above.

From calculations, velocity of gases in inlet = 51.0 ft. per second.

Area of inlet 28.11 ft. × 8.5 ft. = 238.9 sq. ft.

$$238.9 \times 51.0 \times 60 \times 60 \times 24 = 1,052,688,960 \text{ cu. ft.} = \text{volume of gas passing through stack inlet per 24 hours.}$$

Note.—Three reverberatory furnaces, No. 2, 3, and 4, were in operation during these tests.

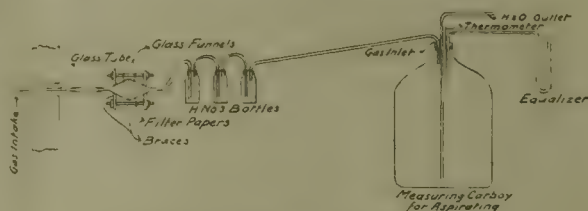
METHOD OF DETERMINING THE AMOUNT OF FLUE-DUST AND COPPER IN GASES AND METHOD OF CALCULATING VALUES ESCAPING

METHOD OF TEST

Gas was drawn from the stack at a point 16.5 ft. above the top of gas inlet to stack, as shown in sketch. The filter was composed of three filter papers held between two glass funnels placed face to face. The gas was passed through three bottles containing dilute HNO₃ in order to catch any copper

which might escape the filter papers. From 25 to 35 cu. ft. of gas was taken for each test.

After each test the amount of flue-dust collected was de-



APPARATUS FOR DETERMINING FLUE-DUST.

termined. The copper content in the acid bottles, if any, was added to the copper in the flue-dust for total copper in sample.

METHOD OF CALCULATING

Sample of gas = 33.67 cu. ft. at 70° F. and 610 mm. Average stack temperature = 555° F.

V = volume at 70° F. and 610 mm. pressure = 33.67 cu. ft.

V₁ = volume at stack temp., 550° F. and 610 mm. pressure.

$$\frac{V}{V_1} = \frac{T}{T_1} \text{ where}$$

T = absolute temperature of gas = 460 + 76 = 536° F.

T₁ = absolute temperature of stack = 460 + 555 = 1015° F.

$$\frac{33.67}{V_1} = \frac{460 + 76}{460 + 555} \text{ then } V_1 = \frac{33.67 \times 1015}{536} = 63.75 \text{ cu. ft. gas at stack temp. and 610 mm.}$$

Moisture in gas (as found) = 2.59%, which correction must be added.

Then 63.75 ÷ 0.9741 = 65.44 cu. ft. volume of gas sample, including moisture at stack temperature.

Flue-dust collected from gas sample = x grams, containing y% copper.

Flue-dust per cubic feet = x ÷ 65.44 grams.

From previous calculations, 1,045,021,824 cu. ft. gas passes up stack per 24 hours.

Then 1,045,021,824 × (x ÷ 65.4) ÷ 453.6 = pounds flue-dust per 24 hours.

Ore and tailing treated by the Zinc Corporation, Broken Hill, New South Wales, in April amounted to 13,751 and 29,000 tons, respectively, producing 3820 tons of lead concentrate by water concentration, and 6805 tons of zinc concentrate by flotation. The gross value of these products was \$220,000, and profit \$53,000.

A dry season in Colombia has resulted in the Pato dredge being shut down for about two months. Rain has commenced, and from June the dredge should yield \$50,000 per month for some time. W. A. Pritchard reports that drilling has added 100 acres to the proved area at Pato.

Work at the new platinum deposits in Westphalia, Germany, is well under way, and 60 miners are developing the area.

The Murex Process in a German Works

By JAMES M. HYDE

At the Bergwerks Wohlfahrt near Clausthal, in the Harz mountains of Germany, the Murex process of concentration, controlled by the Murex Company, Ltd., of London, is being used for the separation of very fine galena from a slime tailing containing much heavy spar, barite. The installation is of particular interest because it is very profitably treating material which no other type of concentration process has been able to handle satisfactorily.

The ore treated is from the Wohlfahrt mine, a gov-

3. Spathic iron ore, containing galena in spathic iron with quartz and barite.

These three classes of ore are stored in separate bins as they come from the mine, and are milled separately as they are of such widely different character as to require different adjustments of the jigs and tables.

The coarser part of the ore, after crushing and screening, is fed to revolving picking tables and divided into three products. Rich lead ore is picked out and sent to the smelter. The lumps of high-grade barite are picked out and sold to paint manufacturers. The remainder of the ore is further crushed and jigged and tabled for the production of a lead concentrate.

Treatment of Slime

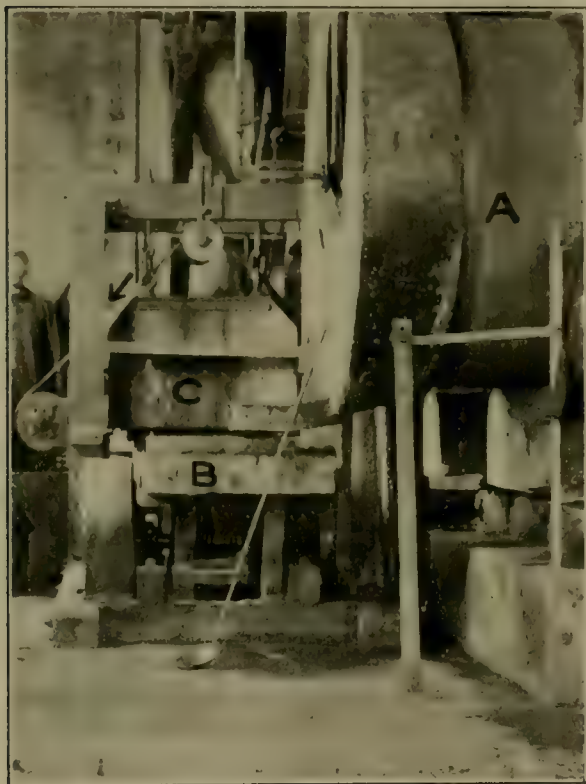
The slime produced in the various crushing operations contains so much of the heavy spar that it has been found impossible to satisfactorily recover the lead content by any of the forms of table, vanner, or buddle concentration used in the plant. As local conditions make it necessary to discharge no slime into the streams, the slime tailing has been diverted to tailing ponds, in which it has been settled by the addition of a small quantity of magnesium chloride. This salt is a cheap by-product of the potassium salt works, which are not far away. The accumulated slime contains from 10 to 11% of lead and is high in silver.

The mill also produces a fine sand middling which contains from 4 to 7% of lead which is not recoverable by water concentration because of the large amount of heavy spar present.

The slime is dug from the pond and hauled to the mill. The feed for the Murex plant is made up of about 33 to 40% of slime to 60 to 67% of middling. The dry feed is fed into a trough mixer of the concrete mixer type, wherein water is added to make a pulp containing about one part of water by weight to one part of ore. From the mixer it flows to a little tube-mill consisting of a barrel containing small pebbles to completely break up the rough balls of dried slime and produce a homogeneous pulp.

To the pulp is then added a small quantity of a mixture of oil, pitch, resin, and finely ground magnetite as it flows to a cylindrical oiling device in which the galena is oiled and made ready for electro-magnetic separation.

The barrel in which the pulp is agitated and oiled is a tube-mill-like sheet iron vessel, 1.2 metres in diameter and 3.5 metres long. This is lined with beechwood blocks, 14 cm. high, placed on end so that the wear comes on the end of the grain. The mixer revolves at about 20 r.p.m. and contains a mixture of pulp, the oiling mixture, small flint gravel, and steel



A, OILING BARREL; B, LAUNDER; AND C, ELECTRO-MAGNET.

ernment property, and is divided by the management into three classes:

1. *Schwarze erz*, which is a mixture of a dark schist and galena, which, by hand picking, jigging, and tabling, yields a lead concentrate containing approximately 70% of lead.

2. *Weisse erz*, which is a mixture of barite, schist, quartz, and galena. The most carefully hand-picked galena from this will not carry more than 40% of lead, the jig and table concentrates average about 58% of lead. In this type of ore the galena is filled with minute veinlets of quartz, necessitating such fine grinding as to yield a high percentage of slime.

screen punchings. The steel punchings become coated with the oily mixture and assist in oiling the fine galena. The gravel seems to be chiefly useful in keeping the thick charge open and flowing.

The oiling barrel works continuously, discharging the oiled pulp through a slotted discharge and thence to a screen on the head of a shaking launder feeder. This screen catches any chips, gravel, or punchings which may escape from the oiling barrel. The shaking launder feeds the pulp in a thin agitated stream beneath a specially designed electro-magnet which is enabled to separate the oiled galena from the uncoiled gangue because of the finely ground magnetite contained in the oil.

Referring to the cut, which is reproduced from a photograph taken by me at the works on January 20, 1914: *A* is the oiling barrel, *B* the shaking launder which feeds the oiled pulp under *C*, the electro-magnet. The take-off belt of the electro-magnet travels in the direction indicated by the arrow, the concentrate being discharged into a hopper which does not show in the photograph. A jet of water is sprayed on to the belt to facilitate the discharge of the concentrate. The long handled spoon leaning against the housing of the mixer is used to reach into the mixer and take samples of the pulp for inspection. When the screen punchings are properly coated with the oiling mixture the work is proceeding satisfactorily. When they become bare, the recovery drops and it is necessary to increase the rate of oil feed, or regulate the percentage of resin in the oil mixture. It is found that on this ore the process works best at a temperature of 17°C. to 20°C. The pulp is heated to this temperature by exhaust steam.

Concentration Results

The feed to this plant contains from 6 to 8% of lead. The concentrate produced assays from 56 to 62% lead and about 1.13% silver. The tailing averages about 1.1% lead. A tube-mill is being installed to pulverize the middling, as it is found that the portion which passes through a one-half millimetre screen, assays 0.8% lead, while the coarser stuff goes as high as 5%. The plant is now making a recovery of about 80% and it is confidently expected that the recovery will be 85% or better after the tube-mill has been put into operation.

The mixing barrel contains about 150 kg. of iron shot or screen punchings from 4 mm. to 6 mm. diameter, and 150 kg. of 10 mm. to 20 mm. flint or quartz pebbles. The monthly consumption of these materials amounts to about 5 kg. of iron and 5 to 10 kg. of pebbles.

In treating 9000 kg. of ore per day 20 kg. of paraffine oil and 40 kg. of pitch, or bitumen (both from the distillation of brown coal) are used with 0.2 kg. of resin and 72 kg. of finely ground magnetite. The cost at the works of these materials per metric ton is reported to be: paraffine oil, 140 marks (\$33.60); pitch, 115 marks (\$27.60); resin, 320 marks (\$76.80); magnetite, 25 marks (\$6) in large lumps as delivered:

41 marks (\$9.84) ground ready to use. The cost of labor for running and repairs is reported to be 0.98 mark per metric ton treated, and the cost of power, 0.4 mark. Reducing these costs to terms of American currency and short tons the principal items figure out as follows:

Oil 4.4 lb. @ \$0.0153	\$0.0673
Pitch 8.8 lb. @ \$0.0125	0.1100
Resin 0.44 lb. @ \$0.0349	0.0153
Magnetite 15.84 lb. @ \$0.00447	0.0708
Labor	0.2064
Power	0.0877
Total	\$0.5575

Although the plant is running for only one shift and treating but nine to ten tons per day, the total cost of treatment in this department is reported by the management to be but 2.45 marks, or, approximately \$0.59 per metric ton. The same amount of labor would handle a number of units of greater capacity than the one in use. The power costs would also be proportionately lower. The profits of the operation have been so satisfactory that the capacity of the plant is to be doubled and the ores of other government-owned mines are to be carefully tested to determine how widely the process may be used on the Crown properties.

Comparison with Other Processes

The Murex process differs from the other oil concentration processes in that it is not necessary in using it to produce those conditions under which the oiled mineral will float. This permits great latitude in the application of the process. Practically all of the separations made by other oil concentration processes can be equally well made by this process. In addition, it is possible to make certain separations which have previously been considered to be practically impossible. Thus copper carbonates and oxides can be satisfactorily concentrated from either quartzose or calcareous gangues. Blende and galena can be separated from heavy spar, also from each other, and from pyrite. In certain cases chalcopyrite can be separated from pyrite, and lead carbonate can be concentrated from the gangues with which it usually occurs. Material of two or three millimetres diameter may be successfully treated by the Murex process if the mineral is all free.

The methods of agitation and of removing the concentrate result in the entanglement of practically no clean particles of gangue. Hence it is possible to make very high grade products. Entirely volatile cheap oils may be used, permitting the concentrate to be freed of its oil and magnetite at little cost where blende is being recovered. The bulk of the oily mixtures generally used consists of very cheap oils such as crude petrolums, residuums, and creosotes. The American equivalents of the oily materials used in Germany cost much less than the German products. Roasted pyrite may be converted into magnetic oxide of iron by being heated in the presence of a reducing agent. This material may be used in place of natural magnetite. It has the

advantage of being more cheaply ground than the natural magnetite. Fairly magnetic pyrrhotite, which occurs in many mining regions can probably also be used instead of magnetite.

Much skill may be exercised in blending oil mixtures, in governing the type of agitation used, and modifying conditions of pulp thickness, acidity, alkalinity, and temperature, in such manner as to make commercially successful differential separations which have hitherto

been considered practically impossible. The apparatus used, while simple, is the result of careful study over a period of years during which the conditions necessary in the various operations of the process have been mastered. The process is not expected to be a panacea for all the troubles of the anxious millman but it should fill an important place in the rapidly developing art of ore dressing, and is a step forward in the treatment of certain ores.

Rock-Drill Repair Costs

By C. K. HITCHCOCK, JR.

*In an endeavor to compile accurate and definite information on the life of rock-drills, and the cost of keeping them in repair, I have collected certain data, of which the condensed results are here given. These data are unfortunately incomplete, as the work was cut short by labor troubles. However, the results obtained are so significant as to lead me to believe that they may be of interest to others.

One great obstacle to obtaining data on the life of a rock-drill is the manner in which repairs are made. I refer to the common method of taking worn parts from a machine, and, after truing them up, putting them into some other machine, which is in condition to use them. It is often possible to true up a part several times before having to throw it away, and each time this is done it may be put back into a different machine, so that in a comparatively short time the original parts of a drill may be widely scattered. It is probably true that each one of a group of machines which are at work on the same job for two years will, at the end of that time, consist principally of new parts and parts taken from other machines.

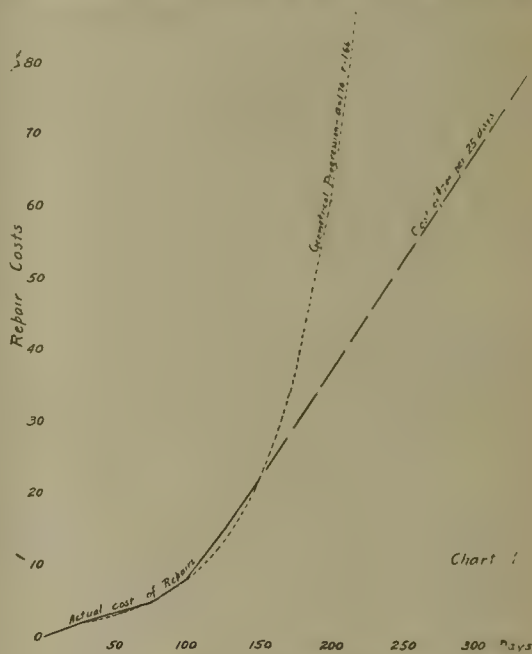
Fortunately, the keeping of the costs to be discussed

TABLE I. REPAIR COSTS OF 2 $\frac{3}{4}$ -IN. DRILLS.

Drill	Days in use.								
	25	50	75	100	125	150	175	200	225
A	\$ 0.60	\$ 1.25	\$ 1.50	\$ 2.40	\$ 3.00	\$ 7.05	\$10.80	\$11.40	\$21.80
B	3.75	7.50	7.90	8.75	12.00	16.25	21.80		
C	3.30	10.00	11.10	13.50	20.30	40.75	40.01	40.95	
D	.90	1.25	4.55	5.30	28.30	28.39	28.39		
E	.15	.40	1.50	4.50	5.80	6.40	9.20	9.85	13.20
F	3.80	7.40	8.00	8.08	8.08	12.15			
G	.20	.50	1.10	4.75	8.00	14.95	16.20	20.08	27.20
H	.55	1.05	5.60	5.91	7.80	10.57	10.70		
I	4.00	6.20	8.70	12.30	41.20	54.59			
J	.70	.70	3.50	4.70	8.29	8.45			
K	.60	1.00	1.50	21.00	41.00	42.10	43.36	52.40	
L	.55	1.00	2.20	0.10	12.00	12.30	21.30		
M	.85	1.20	4.40	7.70	8.70	10.25	18.14	22.70	
N	3.05	4.10	4.85	5.05	8.50	50.50	52.01		
O	2.55	4.35	4.65	5.20	11.20	14.60	14.75		
Average	\$26.15	\$47.90	\$71.05	\$118.24	\$224.26	\$329.30			
	\$ 1.74	\$ 3.19	\$ 4.74	\$ 7.88	\$14.95	\$21.95			

in this article was started with a group of 20 new drills. Of this number, 5 did not see enough service to make their record of value, whence the data here given relate to 15 machines. They were of a well known make, having 2 $\frac{3}{4}$ -in. pistons, and were put to

work during the spring and summer of 1912. The records were kept by the month, and the total repair cost of each drill, including both labor and material, but not including mountings or connections, was plotted at the end of each month on a chart against the total number of days, of two shifts each, during which the drill had worked from the time it was put into commission. From this chart was scaled the cost for each drill for each period of 25 days, as recorded in Table I. The average of these amounts is shown at the bottom of Table I, and is plotted in Chart 1 by a



solid line. The service varied a good deal, as will be seen, ranging from 150 days to 325 days each. This variation does not indicate poor service, but is explained by the fact that the drills were not all put to work at the same time, and also that the number of drills on hand was somewhat in excess of the actual number in use, so that some were always idle, whether in the repair shop or not. Good average results, therefore, were obtained for only 150 days, beyond which

*School of Mines Quarterly.

time the averages are incomplete and inconsistent, and lose all significance. It should be added that most of the smaller repair parts for the drills were made in the mine shops, but that the larger parts were bought from the makers of the drills. Also, when a machine was sent to surface, it was replaced at once by another, no serious attempt being made to keep the same machine in the same working place.

It is a curious fact, though probably only a coincidence, that the average repair cost for the first 150 days approximates closely the following geometrical progression, having 1.66 as a ratio: 1.74, 2.89, 4.80, 7.96, 13.22, 21.95. This progression is plotted as a dotted line on Chart 1, the solid line representing the actual repair cost. Obviously, if the repairs should follow the dotted line to, say, 200 days or farther, the expense of keeping up these drills would be so great as to indicate that they had practically gone all to pieces, which, of course, is contrary to general experience. I believe, therefore, that beyond 150 or 175 days the repair cost graph, if it could have been continued, would have become in time approximately a straight line, having such inclination as to represent a cost of \$10 or over for each 25 days, provided all the machines were kept in commission. This approximation is based partly on the fact that the actual repairs between 100 and 150 days were about \$7 for every 25 days, and partly upon the performance of another size and type of drill, which I shall now discuss.

The drills of the second group were larger, having a 3 $\frac{1}{4}$ -in. piston. Eight new ones were put to work in 1911, and the records were kept in the same way as

TABLE II. REPAIR COSTS OF 3 $\frac{1}{4}$ -IN. DRILLS.

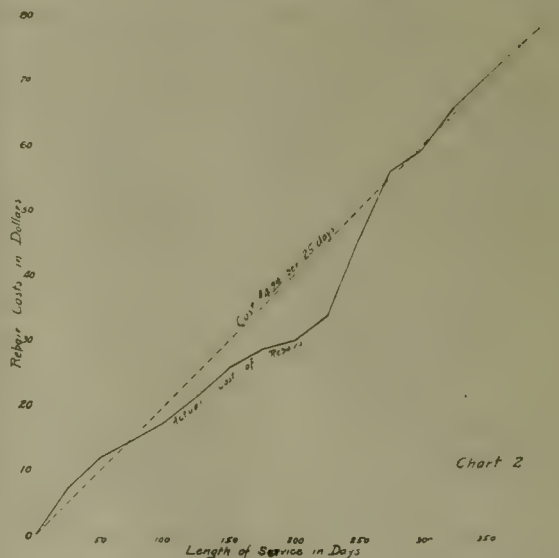
Drill.	Days in use							
	25	50	75	100	125	150	175	200
P	\$ 2.00	\$ 2.50	\$ 4.00	\$ 5.40	\$ 8.00	\$ 19.00	\$ 22.00	\$ 22.00
Q	3.00	11.30	19.10	22.30	27.00	34.00	40.20	41.30
R	6.10	14.20	18.20	19.60	24.50	28.60	28.00	28.90
S	4.20	5.20	6.20	9.20	18.10	18.20	18.30	21.50
T	28.00	33.30	36.10	37.00	38.10	41.50	44.70	45.90
U	.50	4.30	4.90	11.00	12.80	14.00	17.80	18.20
Average	\$ 43.80	\$ 70.80	\$ 88.50	\$ 104.50	\$ 128.50	\$ 155.30	\$ 171.00	\$ 178.40
	\$ 7.30	\$ 11.80	\$ 14.75	\$ 17.42	\$ 21.42	\$ 25.88	\$ 28.95	\$ 29.73
Drill.								
	225	250	275	300	325	350	375	400
P	\$ 40.00	\$ 64.20	\$ 84.80	\$ 88.10	\$ 97.00	\$ 99.50	\$ 101.50	\$ 102.00
Q	42.20	46.70	53.20	50.60	66.00	66.80	67.00	78.80
R	32.60	33.40	40.30	49.20	50.30	48.80	54.50	61.00
S	22.10	46.00	46.00	47.60	48.20	53.70	54.60	57.10
T	46.50	46.00	48.20	49.30	72.00	90.50	111.20	112.00
U	18.20	35.00	55.20	59.30	60.20	60.70	63.00	63.70
Average	\$ 201.60	\$ 272.20	\$ 333.70	\$ 353.30	\$ 393.60	\$ 420.00	\$ 451.80	\$ 474.60
	\$ 33.60	\$ 45.37	\$ 55.92	\$ 58.88	\$ 65.60	\$ 70.00	\$ 75.30	\$ 79.10
Drill.								
	425	450	475	500	525	550	575	600
P	\$115.50	.....	.....	.....	.....	.....	.....	.....
Q	79.30	.....	.....	.....	.....	.....	.....	.....
R	75.00	\$ 76.70	\$ 77.10	.....	.....	.....	.....	.....
S	60.20	62.70	62.70	\$ 63.00	\$ 64.00	\$ 67.70	\$ 78.10	\$ 78.30
T	113.80	113.80	114.00	114.50	.....	.....	.....	.....
U	64.00	70.00	73.70	74.40	98.80	.....	.....	.....
Average	\$468.00	.....	.....	.....	.....	.....	.....	.....
	\$ 84.67	.....	.....	.....	.....	.....	.....	.....

for the 2 $\frac{3}{4}$ -in. machines. But after two of the drills had worked about 160 days, their cylinders cracked and they were put out of commission. The repair costs and service of the remaining six drills for two years is given in Table II, and is plotted in Chart 2. The graph

thus produced is more irregular than that for the smaller drills, but a straight line joining the two ends averages the irregularities fairly well and represents a cost of practically \$5 per 25 days. Of course this is hardly a fair comparison, and for the purposes of this discussion, it would have been desirable to have had the drills repaired and kept in commission. The immediate cost would have been between \$60 and \$80, with a resulting average increase of \$8 or \$10 at the 175-day period. How much of this increase would have shown as an increase throughout the remainder of the graph, is, of course, uncertain, but probably enough to have brought the average beyond 175 days up to \$10 for every 25 days.

Again, from other data too incomplete to give here, obtained from such of another group of drills of the same size and type as had been in commission for from three to five years, the repairs amounted to \$7.50 every 25 days. This rate, of course, is based on the best machines of the lot, the poor ones having been discarded. If all had been kept at work, there is evidence that the cost would have been nearly double.

The practical application of such data as here given should be obvious. For instance, having obtained or assumed the average repairs for a certain lot of machines at work on a given job, and having plotted it on a chart, it would then be an easy matter, even for the



repair man, to see how things were going, simply by plotting the record of each individual machine, month by month, alongside the average. Some machines, at times, will show up badly beside the average, for some good cause, while others will compare poorly from some inherent defect, and will be a constant source of expense. By a study of the chart, in connection with the care of the drills, economy and efficiency could both be served, either by culling out the worst offenders, or by giving them such a thorough rejuvenation as would tend to cut down their maintenance expense.

Gases Found in Coal Mines

In discussing gases found in coal mines, which also bears on metal mining to some extent, George A. Burrell and Frank M. Seibert, in U. S. Bureau of Mines Miners' Circular No. 14, summarize their more important statements as follows:

Pure, dry, outside air contains about 21% oxygen and 79% nitrogen all over the globe.

All mine air contains water vapor, the proportion depending chiefly upon the temperature of the air and the amount of water present along the passageways.

A mixture of methane and air is explosive when it contains 5.5 to 13% of methane, but some burning will occur in a mixture that contains considerably less or more methane than these proportions.

Methane, or any other gas, once thoroughly mixed with air, will not separate from the mixture.

Ordinary fire-damp has no odor.

Black damp is not carbon dioxide alone, but a mixture of carbon dioxide and nitrogen.

Lights grow dim or go out in atmospheres containing black damp because of the low proportion of oxygen in the atmospheres, and not because of the presence of carbon dioxide (CO_2).

The effects on man of the black damp in atmospheres in which lamps do not burn are sometimes due to the carbon dioxide present, sometimes to the lack of oxygen, and sometimes to both of these causes.

An ordinary wick-fed flame goes out when the proportion of oxygen in mine air is reduced to about 17 per cent.

An acetylene flame goes out when the proportion of oxygen is reduced to about 12 or 13 per cent.

All flames become dimmer when the proportion of oxygen becomes less than that in outside air.

Air may be what is termed chemically pure and yet cause distress if its temperature is high and much moisture is present. This distress is heightened if the air is motionless.

The most dangerous gas in after-damp is carbon monoxide (CO).

An atmosphere must not be assumed to be non-explosive because it does not contain enough oxygen to support the combustion of an oil-fed flame.

A lamp flame may burn fairly well in an atmosphere that contains a fatal proportion of carbon monoxide. The presence of fatal proportions of this gas is not indicated by the appearance of the flame.

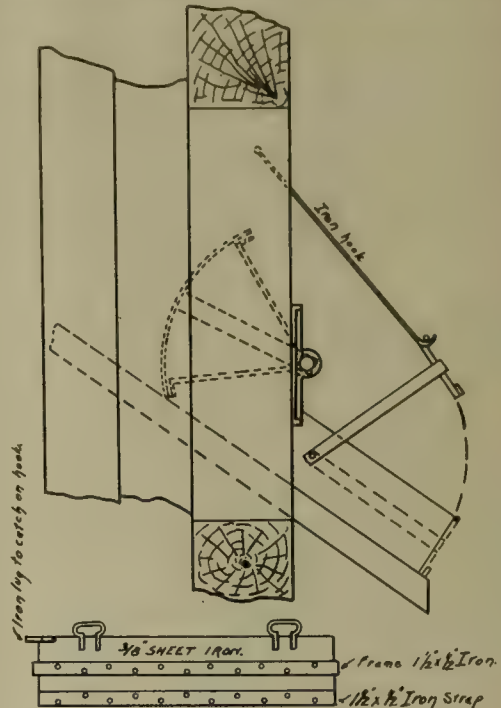
Mice or birds, preferably canaries, should be used by men not wearing breathing apparatus when exploring mines after explosions or fires, to ascertain the presence of gas in appreciable quantities.

Ore reserves of 53 mines on the Rand, controlled by 10 mining concerns, amount to 92,569,045 tons of fully developed ore. Adding the partly opened ore, *The South African Mining Journal* makes a total of 115,000,000 tons, worth approximately \$744,000,000.

Emergency Gate

By P. B. McDONALD

This emergency gate for ore-chutes, underground, is a simple $\frac{3}{8}$ -in. iron plate which is supported in such a manner that it may be dropped over the end of the chute, and thus stop the ore in case an obstruction prevents the quarter-pan from closing down. The mouth



—DETAILS OF—
EMERGENCY GATE

of an ore-chute is a precarious place when the ore gets stuck, and barring or blasting is sometimes necessary to loosen the mass inside. The trammers are often careless and reckless, and many accidents occur. The chute here shown is designed for soft, fine ore.

Capital outlay on electricity supply in greater London, with a population of 7,252,963 persons, totaled \$126,516,340 to the end of 1912; and the outlay on generating machinery amounted to \$39,220,050. It is proposed to unify all the systems. Comparison of the electric systems of the largest cities of Europe and the United States is as follows:

Cities.	Population.	Area square miles.	Kilowatts connected.	Units used per capita.	Av. per unit, cents.
London	7,252,963	693	523,865	130	4.65
Paris	2,800,000	31	226,890	27	10.35
Berlin	2,200,000	24	225,721	111	3.45
Hamburg	1,000,000	30	99,031	43	6.25
New York	4,754,000	131	782,682	360	5.28
*Chicago	2,185,283	191	545,235	425	2.21
Boston	1,051,907	597	175,146	400	5.48

*Including traction.

Discussion

Readers of the MINING AND SCIENTIFIC PRESS are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment. Insertion of any contribution is determined by its probable interest to the readers of this journal.

The Rand Banket

The Editor:

Sir—Mr. Horwood has so thoroughly studied the Rand banket and has discussed the character of the deposits and the introduction of the gold from so complete a survey as to leave scarcely any points uncovered. Rarely has a writer on an ore deposit brought to bear upon its study so much in the way of observation and reading. No line of attack seems to have been left untried. As I run over in my mind other recent contributions from those actually engaged in mining, only one paper readily occurs in which, in the same thorough-going way, a great district has been so completely investigated in its various geological features. This is the study of the Butte vein system by Reno H. Sales, as published in the *Bulletin* of the American Institute of Mining Engineers last August. The two papers cannot but make those teachers of geology, who expound the lore of ore deposits to their students, wish that their hearers, when actively engaged in mining in their later years and when confronted from day to day with the wonderfully interesting phenomena of vein formation, would oftener plot and describe the facts and ponder the causes.

Mr. Horwood speaks convincingly regarding the introduction of the gold. Indeed, it has seemed to many observers who have reflected carefully upon the suggested placer explanation and who have studied thin sections of the ore, that pyrite could hardly be expected to survive the oxidizing conditions surrounding 'pebbles on the beach.' By so clearly demonstrating the origin of the rounded masses of the pyrite from the replacement of quartz pebbles, and the irregular bits of the sulphide of iron by replacement of the conglomeratic matrix, the evidence of the pyrite is made a strong argument for the introduction of the gold in solution. The black edged pebbles, the wholly black ones, and the milky white ones are all excellent corroborative phenomena, which have been interpreted with care and skill.

The presence of the carbon is a peculiar and interesting feature and makes of importance those comments on other cases in which similar observations have been recorded. One is ordinarily over-inclined to think of hydrocarbons in connection with the products of igneous action. Reference may be made to the careful experiments of Arthur W. Wright, of Yale, upon the extraordinary quartz of the famous pegmatite at Branchville, Connecticut, which is so rich in carbonic acid inclusions. Thin sections of the quartz fairly teem with cavities containing this compound in both liquid

and solid state. Professor Wright crushed the quartz in a vacuum under a bell-jar by an ingenious pestle and mortar arrangement, working like a piston in an air-tight cylinder. He thus set free the gas under such conditions that he could confine and analyze it. Each time that he passed his samples of gas through his apparatus he secured an appreciable tarry residue of some form of bitumen or heavy hydrocarbon. Now there can be little doubt that the pegmatite is a product of the granite intrusives which are abundant in southwestern Connecticut, and that gas and bitumen came off with them. The general process is closely akin to the one favored by Mr. Horwood, but the pegmatites, of course, involve a great richness in the components of feldspar, quartz, and, in the Branchville instance, of minerals containing lithia.¹

Wm. Libbey, of Princeton, has reported spectroscopic evidence of burning hydrocarbons in the gases freed from the lake of molten lava in the famous Hawaiian crater.² Graphite in pegmatite veins is quite common in the southeastern Adirondacks, and was for many years in the last century mined near Ticonderoga. The old workings are said to go down six or seven hundred feet.

Carbon or hydrocarbons are thus reported, or are actually known, today in several cases of igneous or aqueo-igneous products in addition to the instances cited by Mr. Horwood. Carbon in any condition short of the extremely resistant forms of the diamond or graphite, could hardly fail to be a sufficiently strong reducing agent to precipitate so sensitive a metal as gold. Apparently the two would be antagonistic if in solutions or vapors at the same time and place.

I would again remark, in closing, that the hope is to be entertained that Mr. Horwood's paper will encourage similar close observations on the part of others.

J. F. KEMP.

New York, May 12.

Prospecting and Government Aid

The Editor:

Sir—In the issue of May 2, under the caption of 'Prospecting and Government Aid,' F. L. Ransome gives some reasons why the members of the U. S. Geological Survey are unable to meet all the demands that are made upon them for examinations, reports, consultations, etc., by the owners of all kinds of prospects, mines, and near-mines from all over the country. The chief reason advanced, strange as it may seem, for not doing all this beneficent work is not because it is not a part of the Government's function to render such service to individuals, but simply because, from lack of funds, they are unable to get around to all solicitors. Mr. Ransome informs us that "The new district of Rochester, Nevada, was visited by a geologist a few weeks after its discovery, and a brief account of its geology and the character of its deposits was fur-

¹American Journal of Science, March 1881, p. 209.

²Ibid., May 1894, p. 371.

nished the press before the geologist returned from the field." This was lightning work, and I suppose I will soon hear of efforts being made to secure appropriations for the Survey so that every prospector, or certainly every prospecting party, may have attached a geologist of the Survey, so that it will not even be necessary to send to town and have such a member rushed to the ground.

But why should the prospector or the rich mine-owner ask and receive gratis from the Government a service that costs a handsome sum, and if done by private practitioners or the miners themselves would have to be paid for? Why isn't it just as logical and justifiable for the Government to furnish me the necessary legal talent to defend a civil suit at law; or supply me with the capital necessary to develop a mine or ranch; or, in fact, supply me with any requisite or service my fancy may crave or my necessities may require? How many instances are there where geologists of the Geological Survey have been set at work in mines, and in particular districts where the Government didn't own a single acre of land and had not the vestige of title to any mine, to solve if possible the complex and often baffling problems that have confronted such individual miners or districts, and to the profit of the individual only? Well, it wouldn't be wise, or perhaps safe, to say just how many times this thing has been done. But the reasons are given for all this activity in that ancient and hoary-headed plea that "The sound practical application of geology to mining must rest upon a solid substratum of scientific research, and demands such training as rigorous scientific investigation can alone supply." I remember, years ago, in my student days, this same ancient and overworked plea was doing overtime then, I have noted no diminution in its activities since, and it is altogether likely that on down, in the long roll of the centuries, it will still be invoked for a similar service.

After an existence verging on half a century, perhaps it might be well to inquire just how many positive definite principles the Survey, at an expenditure of many millions of dollars, covering many different fields, and with the best brains and talent obtainable, has been able to add to the 'Science of Ore Deposits.'

As I glance hastily over the numerous and ponderous tomes that stand as evidence of the patient and painstaking labors of their talented authors, I am deeply impressed with the magnitude of the tasks attempted. But when I casually brush the dust off the backs of any one of eighty or ninety elaborate monographs and professional papers which have been issued by the Survey, chiefly on the questions concerned with the nature and genesis of ore deposits and examine the contents of the works, I soon discover the following facts, which are common to nearly all:

1. An accurate detailed account of the history of a particular district or locality, together with its exact geographical location: also everything about the streams, the roads, the forests, the deserts, the land-

scape, the scenery, the sunshine, the atmosphere, the people, and what they do and think, and nearly everything else that might prove interesting, entertaining, or possibly instructive and which occupies space.

2. A labored and elaborate description of the general geology of the district; and fortunate indeed is the geologist who has, or thinks he has, anything that is suggestive of an eruptive rock; because a fragment of eruptive rock, no matter how small its dimensions, is always large enough for the best geologist to lavish his utmost abilities upon when it comes to a description of the precious thing, at the same time straining the unabridged for names and terms sufficient and ponderous enough to do it with. What a fruitful field of speculation and mental exercise it is, to carefully inquire into the reasons why each little crystal contained in a particular rock came to be there, and what it is doing, and what would happen if some other mineral was present that is not.

3. Economic geology follows as a matter of course with an elaborate table of statistics showing the value and production of the district from the dawn of history to date. For this, of course, we are thankful. Then particular classes of ore deposits, or mines, are taken up and described by rule and line: every rock, every crevice, every seam, and every twist, bend, turn, regularity, and irregularity of the deposit, and every rock even remotely connected with it are described with marvelous detail. Having arrived thus far in our study we probably feel convinced that there has been some kind of ore deposit once in existence, and we are free to guess how much there is left of it. But no description of any ore deposit is complete without an inquiry into its genesis. And it must be admitted that when our true geologist sets himself the task of answering this question, he may always be expected to let himself out to the last link, and 'get up and hump himself.' The mineral *was* there—so much he has ascertained from his inquiries (and no competent and wise geologist will positively affirm more than this). Now how did it get there? Of course, so far as directions are concerned, there are only three possibilities: it came from below, from above, or from the sides. So far all are agreed. After an exhaustive discussion of all the possibilities, a guess is finally hazarded that it probably came from one of the three; but if not, then there can be no doubt whatever that it came from either one or both the other directions. However, on the basis of whatever hypothesis may have been selected, a diligent inquiry is next made as to the ultimate source of the minerals, what agent or agents it was that carried them from their primal resting place to the place where they were found, and why not somewhere else. Of course, this at once opens up a vast field of speculation, of possibilities or probabilities, but does not move us to firm and solid ground.

4. Well, I have turned over the last page of the discussion embodied under No. 3, expecting to find a scientific statement and summary of all that has gone before, but instead I find that I have reached the

index, and so I must close the volume. If I am a poor innocent, and new at the game, I probably entertain high hopes that, in view of all the minute and elaborate descriptions and arguments, I will finally be rewarded at the end with a body of positive, definite, and scientific statements that this ore deposit or class of ore deposits have certain well defined characteristics; that it occurs in certain other parts of the country or the world; that it will continue to a certain depth, will be of a certain width, and its metal content will be so much; and that exactly similar deposits will be found elsewhere when certain ascertainable surface conditions are found to exist; and not with the proviso that they may possibly be there, but with the short, convincing, clarifying little word that they *are*. Until the so-called 'Science of Ore Deposits' is able to deal in something a little stronger than mere guesses, or surmises, or might-have-beens, or may-have-beens, or could-have-beens; or so long as it is compelled to confine itself simply to statements of a multitude of mere observations which show nothing, which demonstrate nothing beyond them, it would be better to apply some other term than 'science' to the matter. Geology is the only 'science' which has been persistently and abundantly subsidized by the Government, and the only one which has continually been seeking it, and the only one which is still deficient in a groundwork of a positive and definite body of principles. If nearly a half-century of government, state, and even private subvention has failed to lay down a single solitary principle that can be called a guide to the every-day worker, what hope is there that the 'scientific research' and 'rigorous scientific investigations', that the Survey officials consider so essential, are going to add to the stock of useful knowledge? The hope, certainly seems to be a forlorn and distant one.

ROYAL P. JARVIS.

Knoxville, Tennessee, May 14.

The Compensation Act and Prospecting

The Editor:

Sir—I have been much interested in reading the different extracts from your letters on 'Prospecting,' as well as your editorial criticism on the 'Compensation Act.'

There is such a thing as 'strangling the goose that lays the golden egg.' The general principle and the object of the Act, no one will gainsay, but in its present condition it is a very serious matter, judging from your citation 'from an actual case.' Let us suppose a man was developing a prospect with two or three miners, thinking he might determine its merit in a month or two, he would hardly think of going to the trouble and expense of insurance, of temporary work of that class, and yet an accident might occur where one or all three of the miners would be killed. Suppose further, that the prospect had no merit, proved valueless, then where would the man 'get off,' for giving these few miners employment. It was not entirely a selfish

motive, he was favoring the miners to some extent, by giving them work, and a chance to draw wages. Why not fix a basal rate as is the case in other states? I am afraid if this is not adjusted, and that soon, you will not be able to boast long of California as the banner gold producing state. I do not believe that a \$3.69 ore (the average for the Mother Lode counties, as shown in late statistics) will stand this tax.

Now regarding the prospector. It is a well known fact that the old time prospector has nearly, if not quite, passed, but I believe in government aid to those remaining, and the new, to the extent of unrestricted access to the mineral territory of the United States, and I think that this condition exists, or is supposed to. However, I have met miners or prospectors who are averse to prospecting in forest reserves. This seems to be the stickler, especially when it is heavily timbered. The prospector says, "if I find anything I may lose it through the ignorance of some forest agent, who knows absolutely nothing of veins or ores." This in a measure is true and should be corrected. Even if it is not true, the idea prevails to some extent, and should be corrected, made plain and clear. I know that this is not the intent, but I also know of a case in point where a miner was subjected to no little trouble, expense, and delay in securing patent to his claim.

While on this forest reserve subject, I wish to cite a case where a man asked for a permit to cut his winter's wood, for domestic purposes. He waited for his particular trees to be marked until winter set in, when he was compelled to buy his wood from the owner of a patented claim, as his trees now were marked. This happened right in the midst of a big pine forest where, in my opinion, it would be better, and possibly good business, to pay for removing the dead and fallen timber, as a fire protection. It at least could be encouraged by removing the permit restrictions, if nothing more, on domestic wood.

Going back to the original subject, 'prospecting,' I am of the opinion that there is plenty of available capital for meritorious prospects, but capital must be given the consideration due and the prospector willing to assume his share of the chances. I believe these conditions are growing more and more favorable, and consequently the prospector and capital are getting closely together.

CLARENCE K. COLVIN.

Denver, Colorado, January 20.

Ore production of New Caledonia, a French island in the Pacific Ocean, in 1913 was as follows: nickel, 93,190 tons; chrome, 63,370 tons; and nickel mattes, 5893 tons, valued at \$1,500,000. The nickel ore exported to France averaged 6.27 per cent.

Feldspar output of the United States in 1913 was 118,932 tons worth \$771,501.

Aluminum consumption of the United States in 1913 was 72,379,090 pounds.

Concentrates

Most of these are in reply to questions received by mail. Our readers are invited to ask questions and give information dealing with the practice of mining, milling, and smelting.

Of the timber cut in Colorado in 1911, approximately 25% was used by the mining industry of that state.

A mining exhibition is being held at Christiania, Norway, which shows the complete operation of a mine. All the important mining and reduction companies have contributed to the show, which remains open all the summer.

Products from the refining of 1000 gal. of petroleum at the Zorritos plant, in the province of Tumbes, northern Peru, are as follows: gasoline at 65°B., 130 gal.; kerosene at 46°B., 400 gal.; residue at 27°B., 400 gal.; and incondensable gas, 70 gallons.

Electric power is generally reliable, yet it sometimes fails. To insure a constant supply of power for vacuum pumps, used for the Belmont, Tonopah, slime-plant, in the event of the electric power failing, a 15-hp. steam turbine has been installed with good results.

The standard of silver, in the reign of Edward the Sixth of England, according to Roberts-Austin, reached the exceptionally low fineness of 250 parts per 1000. The restoration of the standard was completed in the reign of Queen Elizabeth and has not since been lowered.

Steel belts are being used in rolling mills in Germany, and cotton mills in Lancashire. They are a success and save a considerable amount of power. In one instance an 8-in. belt replaced ten 2-in. ropes; and in another, four 6-in. belts replaced twenty-two 2-in. ropes, transmitting 900 hp. in the latter case.

There are seven chemical abstract journals in Germany; three in France, two in England, and one in the United States (*Chemical Abstracts*), according to John J. Miller, in *The Journal of Industrial and Engineering Chemistry*. Six of these are abstracting from 110 to 633 journals each and publishing from 5200 to 25,971 abstracts per year, the larger figures being for the American journal, followed by *Chemiker-Zeitung* in Germany.

Cost of sand-filling stopes at the Witwatersrand Deep mine amounts to 15c. per ton of sand-filling. The surface cost, 7.6c., includes discharging the sand from the treatment vats, running and maintenance of conveyor belts, pumps, cones, and water lost at 15c. per 1000 gal. The underground costs include all timber, matting, launders, and labor required for putting in the stulls to retain the sand and for supervising the filling, according to E. E. Hardach.

Trypanosomiasis, generally known as sleeping sickness, is a dread disease found in the Congo, Uganda, and other parts of Africa. The malady originates in a spore, or *trypanosome* as it is technically termed, which is picked up by a species of fly, the tsetse fly, which is indigenous to Africa. In appearance, the insect who thus acts as a host, might be mistaken for the ordinary house-fly, although it is generally of slightly larger proportions. It frequents river areas or swamps, and emerges from its retreat in the early morning in search of food. The tsetse fly lives entirely on blood and attacks whatever animals are at hand, but exhibits a decided preference for the blood of human beings. It has a remarkable capacity for gorging itself with food and is capable of absorbing up to 200 times its own original weight. Investigations have shown that it feeds only every other day, and then only during daylight. In this respect it differs from the *anopheles*, or malarial mosquito, whose activities are confined to the night season. The sleeping sickness infection is thus carried by the fly to either animal or man, and some of the smaller wild animals are not immune from the fatal effects of the disease. In human beings the infection shows itself in glandular swellings in the neck. These are followed by a terrible and increasing lethargy, which eventually ends in death. No preventive or curative methods are known, but an immense amount of research work is being carried on in infected areas and in those schools of tropical medicine where cases of sleeping sickness are being watched. The only method of combating the disease is to quarantine entirely certain fly-infested districts against immigration. If this is not done, an appalling death rate is inevitable. According to Treves, the disease has been responsible for over 20,000 deaths within five years in one part of Uganda. Sleeping sickness has spread to northern and even southern Rhodesia, and travelers are now warned against the danger of entering certain districts. In an effort to stop the spread of the disease, large tracts of land have recently been thrown open, without restriction, for game shooting. The result has been that 'royal' game, and particularly the elephant, is being shot wholesale. In this way parts of Rhodesia are being rapidly denuded of valuable game which are not likely to spread the disease, whereas the smaller animals, such as deer and monkeys, which have been known to die of sleeping sickness, are left and possibly scattered by the hunters. On the Portuguese island of Principe, in the bight of Biafra, preventive measures against the spread of the disease are now being taken. Laborers are being sent to work with a strip of paper affixed to their backs. The paper is much the same as ordinary fly-paper, and is coated with an adhesive substance which imprisons the fly when it settles upon it. The number of tsetse flies thus caught are counted daily and then destroyed. It is hoped that a solution of this dread disease will eventually be reached.

Special Correspondence

NEW YORK

COLUMBIA UNIVERSITY ANNIVERSARY.—UTAH COPPER OUTPUT, LEACHING AND FLOTATION PROCESSES TO BE USED.—THE FLOTATION SITUATION.—CAMP BIRD PROFITS.—MESSINA MINE.—DEVELOPMENT AT SHEEP CREEK.—ORONOGO CIRCLE.

The event of the week has been the celebration of the fiftieth anniversary of the School of Mines at Columbia University, and as a result an unusual number of distinguished mining engineers have been in town, all of those who make New York their headquarters making it a point to be here for the exercises, while a considerable number have come from outside. Dr. F. Kolbeck, the rector of Freiberg, and T. A. Rickard, the delegate of the Royal School of Mines, were in attendance as representing their respective schools. Mr. Rickard made one of the addresses at the celebration. Hennen Jennings was also present, and among other distinguished engineers who were in New York during the week were Alfred James and C. W. Merrill.

The output of the Utah Copper mine has reached such a high level that the stock market prophets are looking forward to an increase in the dividend rate, which is 75c. per share per quarter. It is not likely to make very much change in the quotation if it comes, however, because movements of this sort are detected by the stock market operators a long while in advance, and are usually discounted in the quotations before the change is actually made. The Utah Copper is going ahead with its plans for the leaching plant, and hopes to have the first unit in operation within a year. So far as possible, the Company wishes to get enough of the plant in operation at an early date so that it may take all the oxidized material which is now being removed in stripping operations and thus save dumping it and afterward reclaiming it. The difficulty is, of course, that the technique of leaching operations is not yet thoroughly worked out, and consequently a small unit will be built at first in order to determine what is the best method of operating before the whole plant is constructed. Plans are well under way for the construction of a flotation plant to take care of the concentrate from the present Arthur and Magna mills. The fine concentrate from these mills is fairly high in silica, and consequently takes a smelting rate which is less profitable to the mining company. By putting this low-grade concentrate through a re-concentration, it has been the practice for several years past to raise its grade and thus command a better smelting rate for it. It is now the intention to use flotation instead of wet concentration for this second concentration. Just what effect the decision against the Minerals Separation company will have on the Utah Copper has not been announced, but it is quite possible that they will go ahead without making any arrangement with the Minerals Separation.

Another flotation enterprise which is making a good success is that of the National Copper Co., at Millan, where J. M. Cullow, of Salt Lake City, has developed a process which is giving excellent results. It is believed here that the process used at the First National cannot be regarded in any way as an infringement of the Minerals Separation patents, since the only agitation to which it is subjected is in Pachuca tanks, and the froth which is formed is quite different from the Minerals Separation froth, breaking up almost immediately after it has floated off the top of the tanks. Altogether, the flotation situation is a very interesting one, and it looks as though the Minerals Separation will not reap as large profits in America as it had at first hoped. Strong efforts are being made to appeal the Butte & Superior case to the Supreme Court of the United States, and it is possible that

this may be done, although the court has long made a practice of not hearing patent cases unless there is a very urgent need of doing so.

The Camp Bird mine continues to produce a good deal of ore, in spite of the fact that it was expected to be exhausted some little time ago. In the first quarter of this year 6700 tons of ore was mined at a profit of about \$100,000. Exploration work continues to disclose small quantities of ore. During the quarter the profits of the Camp Bird company from its holdings in the Santa Gertrudis amounted to approximately \$250,000. The mention of these companies draws attention to the fact that Arthur M. Grenfell, who is chairman of both companies, as well as of the Messina Development Co., has recently come to grief as a result of too extended operations in the railroad share market, and has lost his position as the dominant interest in these companies. It is generally reported that H. C. Hoover will acquire the controlling interests in the Messina company, and that being the case, it is to be expected that the Messina will be developed along more progressive lines than has been the case so far. Herbert Lang, in a recent issue of the *Mining and Scientific Press*, referred to the way in which metallurgical operations at the Messina have been conducted.

Now that the Sheep Creek adit of the Alaska Gold Mines has been completed, good progress is being made in the various levels in getting the mine ready to furnish a large tonnage of ore upon the completion of the mill. No. 8 and 9 levels west are both connected with the surface and finished. No. 7 will be opened to the surface in about six weeks. Developments incidental to the preparation of the Sheep Creek adit for the handling of the ore are particularly interesting. It will be recalled that the connection from the bottom of the shaft, which at this level is several hundred feet in the foot-wall, to the adit, had passed through a formation containing gold, the last 20 ft. yielding high assays. At several points in the adit, stations are being cut for the ore-chutes and the adit is being widened to permit the laying of loops. At both No. 1 and No. 2 ore-ways the cutting of the station for the chutes is practically finished, and a drift west, wide enough for passing track is being continued. All the rock taken out in this development is ore, and this foot-wall orebody as opened is looking well. This, of course, is of importance as confirming the indications given in the driving of the connection mentioned above. Development is progressing at the rate of 700 ft. per week. At the dam, pouring of concrete was resumed on April 24. This work is progressing smoothly: two shifts are working on this and averaging 600 to 700 yd. per 24 hours. Pouring of the concrete should be completed not later than the middle of July. The railroad is now connected clear through to the Sheep Creek portal camp, and it is possible to send materials and supplies directly up to the mine through this. Progress at the mill is particularly satisfactory. At the coarse-crushing plant the steel workers are now at work riveting, and by the time they are through with that, which will be in about two weeks, all the necessary steel will have arrived for the main fine-crushing plant, so that they can begin at once on the erection of the roll and concentrating unit. The steel itself has been arriving on schedule time in good shape. Pouring of the concrete for the roll plant is going ahead night and day at the rate of about 300 yd. per day. This should be completed by the time the workers are ready to start erection of this plant.

The Oronogo Circle mine, the largest zinc and lead producer in the Missouri-Kansas-Oklahoma district, has been sold to Turner & Co., of New York City, by Henry Russell Platt and J. B. Moos, of Chicago, the former owners. The Oronogo Circle company was capitalized at \$300,000, and it is understood the purchase price was slightly in excess of this figure. A. J. Burnham, manager of the mine for several years, will be retained in this capacity. The mine consists of 126 acres

of the Granby Mining & Smelting Co. land at Oronogo, Missouri. The Company holds a first lease which will expire in 1926, and a royalty of 10% of the gross sales of ore is paid to the land owners. Ore has been mined down to a depth of 240 ft., at which level mining is conducted on a large scale. Core-drilling shows the orebody almost continuous down to 300 ft.; below this level there is some thin ground,

varying from 1 ft. to almost 6 ft. wide. This vertical has been followed for a distance of nearly 300 ft., and of the ore extracted 50 tons was shipped to the Golden Reward cyanide plant, at Deadwood, which assayed from \$16 to \$20 per ton, and on which the net results amounted to \$370. Other ore, classed as milling grade, to the amount of several hundred tons, remains on the dump, and 50 tons of shipping ore will



SURFACE EQUIPMENT, ORONOGO CIRCLE MINE, WEBB CITY, MISSOURI.

and then, at greater depth, other orebodies are found. A large quantity of ore is ready for stoping. A gasoline locomotive hauls the ore from the outlying shafts to the mill, which has a capacity of 1000 tons per 10-hour shift.

DEADWOOD, SOUTH DAKOTA

DEADWOOD STANDARD, HEIDELBERG GROUP, ORO HONDO, AND DAKOTA CONTINENTAL MINES DEVELOPMENT.—IMPROVEMENTS TO GOLDEN REWARD MILL.—WASP No. 2.

The Deadwood Standard property, in the Ragged Top district, has been leased by Hodges, Burkett & Nicholls, of Terry, who intend to thoroughly prospect the ground during the coming summer. It is equipped with a dry crushing, direct leaching cyanide mill of 150-ton daily capacity, which is being operated at part capacity at the present time. Except for a few months' work a couple of years ago, the property has been idle for twelve years, and the mill is not in as good repair as it might be; however, if the summer's run is successful it is proposed to put on a new roof and make other necessary repairs before winter comes. The lessees have opened some new orebodies, and claim to be getting satisfactory results.

Since last August, when development started on the Heidelberg group, on Two Bit creek, \$5000 has been expended by the local people who became interested through the promotion of the enterprise by the Deadwood Business Club. The final installment on the subscriptions to the fund was payable May 23. Since developments have been highly satisfactory, plans for raising further funds are being considered; and at a recent meeting of the owners it was decided to incorporate a company, and from the proceeds of the sale of stock carry on mining work. It will be remembered that in return for the \$5000 which was pledged last summer the subscribers were given a half interest in the property; the money was to be expended in developing the ground under the supervision of a board of trustees consisting of the two original owners, two men selected by the subscribers and a fifth man to be selected by these four. Work at the mine has demonstrated a 'vertical' of ore in the Cambrian shales

be forwarded immediately. It is believed that the basal quartzite is several hundred feet below the present workings, and it is proposed to sink a working shaft to this quartzite and open the 'vertical' on that horizon. Preliminary to shaft sinking, a diamond-drill hole was put down to determine the position of the quartzite, the character of intervening formation, etc.; the facts thus gathered to serve as a guide in sinking, purchase of machinery, and equipment. The proposition is particularly interesting. The mine is in an entirely new district, and several miles from any producing mine. It is a pioneer in a new territory, directly tributary to Deadwood. The formation is almost identical with that of the Bald mountain and Ruby Basin districts, which have been large producers. The ore is amenable to cyanidation. Tub tests at the Golden Reward mill show extraction, on 20-mesh, unclassified material, of 91 to 93%. The property includes 180 acres, part of which is heavily timbered and supplied with water for large cyaniding operations; at least two excellent sites are available for milling plant. It is three miles directly east of Deadwood, but five miles by a good wagon-road.

Operations at the Oro Hondo came to a standstill when it was discovered, after removing the water, that the boiler capacity was not sufficient to operate the hoisting engine, air-compressor, and the necessary pumps which would be used in sinking below the 1050-ft. point, the present bottom. To remedy this, two new boilers are being installed, and when in shape for use, sinking will be started with a full crew of three shifts. It is proposed to continue the shaft to the 2500-ft. level, and do it in the quickest practicable manner. John T. Milliken, president of the Golden Cycle company, of Cripple Creek, is personally furnishing the funds for this work. The property adjoins the Homestake holdings on the south and east, the shaft being situated 2640 ft. from the Ellison shaft of the Homestake. It is believed that the Homestake orebodies traverse the property, and will be found by sinking.

The Golden Reward company will spend \$15,000 in improvements and repairs to its mill at Deadwood. The most important piece of work contemplated is the installation of a tube-mill, work on which is well in hand. Several minor changes in the interior arrangement are to be made, and the mill brought up to date.

At the Dakota Continental copper property, near Hill City, sinking has been suspended and cross-cutting is now in progress on the 850-ft. or lowest level.

Since resuming work at the first of the year, the Wasp No. 2 has been operating successfully and a good surplus is accumulating, so that the shareholders anticipate a dividend at an early date. The property is now in charge of Edward Manion, who is pushing its capacity to the limit.

JOHANNESBURG, TRANSVAAL

EAST RAND PROPRIETARY MINES RESULTS FOR 1913, AND THE FUTURE.—MARCH OUTPUT AND PROFITS.—PROPOSAL TO AMALGAMATE ALL THE RAND PROPERTIES.

The annual meeting of the East Rand Proprietary Mines was this year but little different from other Company meetings on the Rand, notwithstanding the fact that this huge mining undertaking is just on the point of entering a serious crisis in its career. The year's profit, after allowing for debenture interest and special expenditure, was £831,565, but there are signs that the current year's profit will be lower. Owing to various drawbacks, development has fallen behind somewhat, and advantage is to be taken of this fact by closing down the Driefontein mill, in the expectation of reducing costs of ore reduction by milling the same tonnage with the three as was formerly milled by the four plants, and at the same time making room for further additions, providing that future developments justify such a step. It is just this question that adds interest to the present position of the Company. During the last year the profitable ore reserves have been depleted to the extent of 400,000 tons, leaving at the end of the year 5,600,000 tons of profitable ore against 6,000,000 tons at the close of the previous year. This means that there is only about three years' supply of such ore blocked out. It must not be overlooked that it will not prove an easy task to increase the ore reserves, as where good ore is likely to be found, large quantities of water are likely to be encountered, and to pump water from depths varying from 2000 to 4000 ft. is not an easy task. On the other hand, where development is easy the ore is poorer, and, as far as can be seen at present, the East Rand Proprietary Mines is not by any means clear of its troubles. It is the uncertain value of the large area to the dip of the Hercules and Angelo Deep shafts that somewhat obscures the future prospects of this extensive property. More confidence is felt that the areas to the west, and beyond the water dike, will contain better ore than the ultra-deep areas east of the dike, to the south of the Angelo Deep and Hercules shafts. It is intended, however, to attack these areas in an energetic manner during the current year, and results will be awaited with more than ordinary interest. As far as development has gone during the year, results are considered satisfactory, but it must not be forgotten that all work in these doubtful areas has been avoided as much as possible. It is interesting to notice that the compensation and insurance against miner's phthisis has cost this Company during the year about 10c. per ton milled, with an even heavier additional cost likely to be added in the immediate future. The working results for the year may be briefly described as 1,769,000 tons milled, yielding 646,185 oz. of fine gold valued at £2,718,484, or an average recovery of \$7.38 per ton; while the working cost has averaged \$4.76 per ton, leaving a working profit of £965,277 or \$2.62 per ton milled. How long the Company will be able to maintain these results will, of course, depend upon the success of future developments. Asked to state the estimated life of the property, the chairman of directors replied that it was impossible to give exact figures, but the directors were of the opinion that profitable mining in the property will not cease during the next twenty years.

The gold output for March shows a more assuring tend-

ency than for several months past, the total value, according to the Chamber of Mines, being, for the whole of the Transvaal, £2,917,346. As for the total output for the present year, it seems doubtful whether it will reach that of 1913, which, it must be remembered, showed a marked decrease when compared with that of 1912. One important feature of the March output declaration was the reappearance of the Randfontein Mines at the head of the list of producers with a yield valued at £246,589, as against £241,700 for the Crown Mines, the East Rand Proprietary Mines making rather a bad third with £210,131. The Ferreira Deep, which produced £111,609, seems to have taken indefinitely the position so long occupied by the Robinson mine, at one time the richest mine on the Rand. The total profits earned by the different groups in March was declared at £929,299. The only feature of encouragement to be found in the Rand gold-mining industry today is the increase in the native labor supply, March showing an improvement of 5142 as compared with February, but even then it is 44,918 below that of a year ago.

The all-absorbing mining topic on the Rand recently has been the evidence placed before the Dominion's Commission with regard to the benefits, or otherwise, of merging all the gold mines on the Rand under one control. It may be a day-dream, but there can be no doubt as to the opposition such a proposal would, if seriously entertained, receive at the hands of public opinion on the Rand. It has been pointed out in some quarters the ease with which the Rand Mines, Limited, as its name implies, could become the parent company of the whole of the gold mines of the Rand. Raymond Schumacher, a director of this concern, did not hesitate to express the opinion that while in some respects such an amalgamation might be of benefit, the objections likely to be raised against it would render its adoption inexpedient and impracticable at the present time; in fact, the Eckstein group, of which he was the representative, must not be regarded as in favor of the proposal. Apart from anything Mr. Schumacher said, it must not be forgotten that under existing conditions the Rand Mines and Central Mines already possess and control most of the properties worth anything on the Witwatersrand, including the pick of the mines. That may or may not be one of the principal reasons why this fortunate group may not regard the proposal with favor. Undoubtedly, the scheme would enable the best use to be made of the somewhat precarious and unskilled native labor supply, but at the same time it would bring mining on the Rand to an earlier end, unless, as prophesied, working costs would as a result of the scheme be materially reduced. It cannot be said that the different mine amalgamations carried out on the Rand have brought about the anticipated reduction in working costs, or increase in working profits, and it is on this account difficult to see that the widest extension of the scheme would be attended, on the whole, with any better results. The Kimberley instance of amalgamating the whole of the area over a diamond 'pipe' is not one analogous with the scheme of amalgamation of the Rand, where the first result would be the adoption of selective mining on an extensive scale, leaving the less profitable areas to be worked later, when it is problematical whether they would be worked to greater advantage.

No doubt the Consolidated Gold Fields of South Africa might be pleased to get rid of the troublesome Germiston low-grade and unprofitable area, as might also the Goerz group of its Western Rand areas; but it is doubtful whether these areas would be worked at all under this wholesale amalgamation scheme, and, even if they were worked, it is hard to see that they would be handled any better than they are today. With the calling into existence of such a general amalgamation scheme, a general reduction of unskilled and skilled wages would eventually follow, and possibly earlier than under existing conditions; but after all, the Rand con-

tains only a fixed amount of gold, and it will only be mined so long as conditions enable it to be extracted at a profit, to which all other matters become subordinate.

MELBOURNE, AUSTRALIA

GREAT COBAR'S TROUBLES.—GREAT FITZROY.—BROKEN HILL JUNCTION.—TASMANIA COPPER AND REFRACTORY ORES OF THE WEST COAST OF THE ISLAND.

The mining industry in the eastern states cannot be said to be in a very flourishing condition. The announcement regarding the shutting down of the Tasmania gold mine, the closing of the Chillagoe smelters, and the troubles in connection with Mt. Elliott, the Great Fitzroy, and Broken Hill Junction have been followed by the temporary total cessation of work in the Great Cobar. Bewick, Moreing & Co. have recommended this step, and the firm's general manager in Australia, G. C. Klug, has announced that in his opinion profits will in the future be much less than had been anticipated. The recommendation includes the expenditure of \$175,000 and has put an end to a reconstruction scheme which had been adopted by the debenture-holders' committee. The face value of the shares is \$25, and the market price has fallen to 75 cents.

As for the other concerns mentioned above, the Great Fitzroy has given the Mount Morgan company a three months' option of purchase on the Laloki mine, Papua, island of New Guinea, the purchase price being fixed at \$375,000. Part of this sum, if it ever changes hands, will be used for the redemption of the existing debenture debt of \$180,000, and the balance will go to development work. The arrangement provides for the Great Fitzroy having a call on 25% of the Laloki output for use in its smelters at a price 10% above cost. If the deal comes off it will greatly improve the Great Fitzroy's position; but still it constitutes a serious admission of financial impotence.

The Broken Hill Junction mine and plant were recently offered for sale at auction, but no satisfactory offer was forthcoming. It was then proposed to reconstruct the Company on a basis which would give the Company about \$75,000 with which to put things straight. To the general surprise, the invitation to underwrite the new shares to be issued was so well responded to in Sydney, Melbourne, and Adelaide, that applications exceeded the supply of shares by 20,000. This was probably the outcome of recent satisfactory developments at Broken Hill, especially in regard to treatment methods, for there is nothing in the mine concerned to justify the confidence shown in its future.

As a result of an inspection of the Tasmanian Copper Co.'s property at Rosbery by G. C. Klug, of Bewick, Moreing & Co., and A. Rutter Clark, a circular has been issued by the directors stating that notice has been given to the Metals Extraction Co. on the cancellation of the contract existing between them, and that a six months' option has been accorded to a syndicate which is not named. The secretary of the Metals Extraction Co. questions the power of the directors of the Tasmanian Copper Co. to give the option while the present contract is in existence, so there is a possibility of trouble.

The west coast of Tasmania is a mining district that is being brought into considerable prominence at the present time because of the attention which has been drawn to its huge deposits of refractory zinc-lead sulphide ores, ranking among the largest in Australia, according to a writer in the *Australian Mining Standard*. The composition of these ores is fairly persistent, and would average about as follows: gold, 0.16 oz.; silver, 8 to 12 oz.; lead, 8 to 10%; zinc, 26 to 30%; copper, 8 to 10%; iron, 12 to 15%; manganese, 1.5%; alumina, 2%; sulphur, 28 to 32 per cent.

The chief minerals are pyrite, zincblende, and galena, and these are generally so finely and intimately intermixed that a

clean mechanical separation becomes a matter of absolute impossibility, except when very fine sliming is resorted to. Apart from a company working a wet process, the only company which has seriously grappled with the problem has been the Tasmania Smelting Co., Ltd., an English concern, which owns large and fairly well equipped works at Zeehan, about 20 miles distant by rail from the mines of the Mount Read-Rosebery district, reached by and connected with two lines of railway. From a metallurgical point of view, its operations have been successful, and but for the somewhat limited and variable output of the mines, the business, it is said, would have been successful commercially. Over 250,000 tons of this refractory ore was treated here, and a clean silver-lead bullion and a ferruginous and highly zinciferous slag produced. Foreign metallurgists have praised the work of this plant on such ore. Altogether the Zeehan smelters have treated 441,911 tons of crude ore, exclusive of almost an equal quantity of iron gossan from the Dundas field, since the erection of the works in 1898. During the years 1898 to 1913, the total output of crude ores of the Zeehan field, including the Mount Read district, was 513,096 tons.

In 1899, the smelting company treated only 15,346 tons of crude ore against 11,460 tons exported to Europe; while in 1912, the last full year of the Company's operations, it treated nearly 50,000, against an export of 1900 tons, this showing the practical value of the smelter to the district. Government records show that of recent years the ore bought by the smelter averaged 10% lead and 13 oz. silver per ton.

CALGARY, ALBERTA

OIL BOOM CONTINUES TO GROW.—HIGH-GRADE OIL FLOWING.—SPECULATION IN OIL SHARES.

Calgary has at last had a genuine oil discovery, which has resulted in great excitement among westerners, followed by tremendous speculation and wild-catting. The find occurred on May 14 at the Dingman oil well near Okotoks, and 36 miles south of Calgary, belonging to the Calgary Petroleum Products Co. Shares of this concern jumped at once from \$12.50 to \$200 and over. All the recently organized companies were kept busy taking subscriptions, and new companies were formed whose shares found ready purchasers. The Calgary Industrial Bureau made a statement that the well produced 150 to 200 bbl. per 24 hours. The oil is high grade. In addition to the oil, the natural gas output is estimated at 2,000,000 cu. ft., the gas being wet and containing 1 to 1.5 gal. of gasoline per 1000 ft., said to be capable of being extracted at a profit. The genuine character of the find is further confirmed by a statement from J. S. Dennis, assistant to Sir T. G. Shaughnessy president of the Canadian Pacific railway, which is greatly interested in the discovery, as it owns large areas of western lands. Mr. Dennis states that there is no doubt that a find has been made, there being 2000 ft. of oil in the 10-in. hole at the Dingman well at the last measurement made by the department officials. The sudden impetus given to reckless speculation, and the sale of wild-cat stocks is likely to result in widespread loss to the public if it is permitted to go on unchecked. The province of Manitoba, however, has taken prompt action for the protection of its citizens. Recent laws have given wide powers to Judge Robson, public utilities commissioner, to regulate the sale of stock. A number of Calgary brokers who came to Winnipeg to sell shares in oil companies, were refused permission to do so until they had satisfied the commission of the genuine character of their propositions. He requires to be assured that the company has a bona fide well, and that the stock is not speculative, and a financial statement must be furnished showing that the company is on a sound basis. When satisfactory proofs to this effect are forthcoming the promoters can obtain a certificate authorizing the sale of stock, which is otherwise illegal.

General Mining News

ALASKA

The report of the mine inspector, Sumner S. Smith, for the territory of Alaska to the Secretary of the Interior, for the fiscal year ended June 30, 1913, has just been published at Washington, D. C. The inspector's headquarters is at Juneau, but the office is short of funds for clerks, furniture, instruments, and laboratory work. Trips of inspection were made through the Fairbanks and Nome placer-mining districts, the coalfield of Controller bay, and the lode mines of southeastern Alaska, Kenai peninsula, and the Willow Creek part of the Susitna district. The Bering River coalfield was discussed with members of the U. S. Bureau of Mines and mine inspectors of Colorado and Idaho. Over 40 dredges have been placed on the Seward Peninsula to date, one being for stream tin. Boats were worked in the Circle, Fairbanks, and Iditarod districts. Lode mining at Fairbanks received a good impetus. New copper mines on Prince William sound started shipping ore. At Juneau two companies are developing the low-grade orebodies of Silver Bow basin. A small though steady output of gypsum and marble was made from southeastern Alaska. There was an ample supply of labor for all districts, and about 1500 new employees started in the Juneau district. Wages in the interior of the territory are relatively low considering the cost of living, board at \$2.25 per day, and the high transport charges. The 8-hour law for metalliferous mining went into effect on July 24, 1913. Recommendations are given for the betterment of mining conditions.

CHISANA

United States mail has been sent in limited quantities to Chisana during the winter, and a new contract has been let



THAWING GRAVEL. MANLEY AND PRICE BOILER ON THEIR LAY ON JAMES' GROUND 4 ABOVE, CHISANA.

to J. A. Fagenberg to carry 200 lb. each two weeks from McCarthy. The postmaster at Chisana, T. Kettleison, has written to H. T. Ray at Fairbanks stating that there is little activity in the new district, and men are leaving for other

fields. It was hoped that the Manley-Price-Ives outfit would prove considerable ground, but they have given an option to H. Hamshaw, of the Shushanna Gold Fields Trading & Mining Co., which concern is not regarded seriously at Chisana.

ARIZONA

COCHISE COUNTY

(Special Correspondence.)—Prospecting at the Great Western copper claims has been stopped, and the owners, Young Bros., are to start work at the old Mammoth gold mine, on the San Pedro river, in Pinal county. The mine has been opened to 700 ft. Tailing from the old mill has been concentrated for its vanadium content, and also cyanided twice. The vein is said to be of considerable extent and has produced some fine specimens of crystalline vanadium.

Courtland, May 28.

GILA COUNTY

(Special Correspondence.)—Concreting the Inspiration main shafts is being done at the rate of 5 ft. each per day. No forms will be moved until the two shafts are completed. The timber used for concreting can then be used for underground work. The test mill is treating 1000 tons of ore per day. A 66-in. Bradley crusher is installed. Improvements are being tried in the 8 and 12-compartment flotation machines.

Forty men are employed at the Warrior mine, and 50 tons of ore per day is sent to El Paso. During May the Iron Cap produced 16 cars of ore, the last six assaying 8.77, 11.57, 15.09, 8.72, 6.69, and 8.69% copper. The 800-ft. level is opening well. From the Superior & Boston 100 tons of ore per day is shipped to El Paso. Lessees are also producing ore. Development in the Arizona Commercial continues satisfactory.

Miami, May 30.

GREENLEE COUNTY

The Detroit Copper Co. is reopening old ground which was abandoned about 30 years ago. The shaft being overhauled is the Old South of the Blue mine, which is under the town of Morenci.

MOHAVE COUNTY

A first payment, \$10,000, has been made for the purchase of the Copper Giant mine by the United Verde interests. The balance of \$20,000 will be paid in four months. A large orebody has been opened at 450 ft. The ore will be sorted at the mine and shipped to the smelter at Clarkdale.

YAVAPAI COUNTY

(Special Correspondence.)—Tests on tailing at the old Congress mine show that a high recovery is possible. A large-scale plant is being arranged, using old tanks below the dump, and if this plant checks laboratory experiments, a big one will be erected. The tailing is from the 40-stamp mill which worked about 30 years ago.

Congress, May 28.

CALIFORNIA

ELDORADO COUNTY

The new mill at the Ingraham mine started work on May 1. J. G. Harrell, of Sacramento, is in charge. Four old mines in this county are being reopened, namely, the Hairlah and Montezuma near Nashville, Crusader, Church, and Union near Eldorado.

NEVADA COUNTY

The North Star Mines Co. has paid its first quarterly dividend for 1914, amounting to \$50,000. Preliminary work has started at the Murchie mine.

INYO COUNTY

The Wilshire Bishop Creek mine equipment has been examined by Luke Severy, who will be followed by Harry Johnson, of Los Angeles, in inspecting the mine, when it is unwatered. Snow has disappeared from the camp, and it is hoped that the mill will be producing gold in three months.

HUMBOLDT COUNTY

Oscar H. Hershey, of the firm of Birch, Cretford & Hershey, of San Francisco, arrived at Eureka on May 22 to make an examination of a copper property on Horse mountain owned by Messrs. Looftbontow and Perrott, H. W. Jackson, L. Everding, and others, who form a close corporation of 15 members. This ore deposit is a peculiar one, and a good deal of money has been spent in this and Del Norte county in development without any return up to the present. On Horse mountain, after considerable work, there is nothing in sight but the 'float' ore and a few disconnected pockets of copper ore underground in serpentine rock. This deposit has been referred to by the *Mining and Scientific Press*. For several months ore from the Horse Mountain mine has been on view on Bush street, San Francisco.

MARIPOSA COUNTY

(Special Correspondence.)—Some good ore has been opened on a claim near the Pine Tree mine by Howert and Medrano. Machinery on the Santa Rosa mine has been sold for installation on Shroder brothers' claim, near Mariposa. The Number Five mine is said to be under option to Eastern people. L. C. Worthington, of Bakersfield, and associates are reopening some quartz claims in Devil's gulch. The Number One mine, near Hornitos, is said to be a good property but is closed down for no important reason. A 5-stamp mill has recently been started at the Malone mine, on Bear creek, with W. H. Johnson in charge. David B. Scott, of the Miami Copper Co., Arizona, is visiting a mine six miles northwest of Mariposa. After an absence of 60 years, W. H. Westfall, who came to this county in 1850, has returned to permanently live in Mariposa.

Mariposa, May 29.

RIVERSIDE COUNTY

Development of the iron-ore deposits of the Eagle mountains now only awaits clear titles to the claims of the Iron Chief Mining Co. Eighty claims have been declared valid, and this decision is to go to the General Land Office and the Secretary of the Interior for review.

SAN DIEGO COUNTY

(Special Correspondence.)—The North Hubbard gold mine, in the Julian district, is to be reopened by San Diego people. It was worked for free gold only some years ago. A mill will be erected.

San Diego, May 20.

SHASTA COUNTY

After lying dormant for about 200 years, Lassen peak, 10,437 ft. high, in the southeast corner of this county, started throwing out some mud, steam, and rocks on May 30. There has been a good deal of thermal activity in the district for many years. The new volcanic action is causing considerable interest among geologists. It is probably geyser action.

SISKIYOU COUNTY

From the Quartz Hill mine, at Scott Bar, nuggets and fine gold worth \$7000 was recovered one day last week. Nunan Bros. own the property, and they have produced from \$10,000 to \$12,000 per year with a few men. At the St. Albans copper-gold mine in the Blue Ledge district, the Company proposes to erect a concentrating plant to cost \$25,000. A large tonnage of ore has been opened. The Trail Creek Mining Co. has started its stamp-mill.

SOLANO COUNTY

The St. John quicksilver mine, northeast of Vallejo, which has been idle for a considerable time, is to be reopened under the management of Clifford G. Dennis. New plant to treat 1000 tons of ore per month is to be installed.

TRINITY COUNTY

Work has been resumed at the Nash gravel mine, on Coffee creek. This property has produced a good deal of gold.

COLORADO

The geology of the pitchblende ores of Colorado is described by Edson S. Hustin in professional paper 30A of the U. S. Geological Survey. The field studies of the mode of occurrence at Quartz Hill, Gilpin county, were made late in 1912. Of the output of uranium ores of the United States, nearly all came from sandstones of the high plateau regions of southwestern Colorado and southeastern Utah in which the ores occur as the canary yellow mineral carnotite ($2\text{UO} \cdot \text{V}_2\text{O}_5 \cdot \text{K}_2\text{O} \cdot \text{H}_2\text{O}$). This mineral occurs in granite pegmatites in North Carolina; and in intimate association with metallic sulphides in certain mineral veins in Gilpin county, Colorado. Pitchblende has been obtained from the Calhoun, Wood, Kirk, German, Belcher, and Alps mines at Quartz Hill. (The occurrences in Europe and England are described.) The veins of these mines are of two types, pyritic and lead-zinc, and have been worked principally for their precious-metal content as well as some copper and lead. The principal primary minerals of the first type are pyrite and quartz, with some chalcoppyrite, tetrahedrite, enargite, fluorite, and rhodochrosite in smaller amounts. In the other type the primary minerals are galena, sphalerite, pyrite, chalcoppyrite, quartz, and calcite. The pitchblende ores of Quartz Hill are believed to represent merely a local and unusual variation in the main sulphide mineralization of this region. No evidence was found to support Forbes Rickard's theories as published in the *Mining and Scientific Press* of June 7, 1913. Nickel and cobalt have not been found at Quartz Hill. The Quartz Hill uranium ore belt was examined during May by R. D. George, state geologist. This was done at the instance of Du Pont interests. The Zimmerman group of claims, including the White, Effie, Ezra, Blagdon, Telephone, Telegraph, and Bouvier, surround the Du Pont claims. Mr. George stated that greater orebodies with higher mineral content should be found at lower points, instead of near the surface. The Bezanet mine, in Leavenworth gulch, is a promising one for uranium ores.

CLEAR CREEK COUNTY

(Special Correspondence.)—The failure of Gay & Sturgis, of Boston, has brought to an end their connection with the reopening of the Terrible-Dunderberg, under the management of A. J. Eveland. A. L. Wells, who first took up this old property, which had been closed and full of water for several years, will continue development work, which is now under the direction of Arthur Canahan. The Terrible and Dunderberg properties, which adjoin the Seventy-third and Dives-Pelican, were once producers of lead ore rich in silver, and it was hoped that new ore reserves might be developed by exploration along the Terrible vein on the bottom levels, and also that modern milling methods would render profitable some of the low-grade ore which had been used as filling or left in the stopes in the earlier work. The rejuvenation of this old property would do much for the Georgetown district, and it is to be hoped that the work will be successful.

Georgetown, May 25.

CUSTER COUNTY

Some cerussite (carbonate of lead) deposits of this county are described by J. Fred Hunter in *Bulletin* 580-C of the U. S. Geological Survey. The deposits near Ilse were examined in June 1913. The Terrible mine is the most important in the zone. S. F. Emmons visited the area in 1887. Oak creek, along which the ore occurs, is 8100 to 8400 ft. above sea-level. The country in the vicinity of the cerussite belt is chiefly granite, intruded by dikes of syenite, diorite, and pyroxenite. The ore mined from the Terrible is said to have averaged 5 to 8% lead, and could be concentrated to 60 or 70 per cent.

PITKIN COUNTY

The Smuggler Mining & Leasing Co., of Aspen, is pumping 2000 gal. of water per minute and mining 400 tons of ore per day from the Free Silver shaft. This ore is concentrated

at the Company's mill, and the product sent to Colorado smelters. Of great interest to Aspen people is the Hope adit, being driven in the Little Annie claims. It is in 3800 ft., and has from 500 to 700 ft. to go to cut the vein.

TELLER COUNTY (CRUMPLE CREEK)

About 1200 ft. of track has to be laid to reach the face of the Roosevelt tunnel, which should be finished in 30 days. The size of the extension is to be 7 by 8 ft. in the clear, with a ditch 30 by 42 in. on 0.33% grade. The ventilating plant is in operation clearing out foul air. Allen L. Burris, of the El Paso Consolidated company, states that the 1170-ft. drifts have not been driven far enough to cut the rich ore mined on levels above. At 1350 ft. depth, ore worth from \$12 to \$35 per ton has been proved for 120 ft. over two to six feet.

IDAHO

CUSTER COUNTY

As soon as the smelter at Mackay has been overhauled, it will be started again by the Hill Copper Co., in charge of J. H. Greene. A good tonnage of ore is said to be blocked out.

SHOSHONE COUNTY

At the Ray-Jefferson mine, No. 2 adit is being driven 450 ft. below No. 1, and should cut the vein at 800 ft. This property is in the Sunset district, where are also the Amazon-Manhattan, Tuscumbia, Idora Hill, and others. On June 4 the Bunker Hill & Sullivan company paid dividend No. 201, amounting to \$81,750. The total to date is \$15,219,750. Additions to the Hecla mill are expected to increase the capacity by 40%, or a total of 350 tons per day. In No. 5 adit of the Hunter mine, 18 in. of gray copper ore, containing from 253 to 900 oz. silver, has been opened. The National mill is to be shut down, as the copper mine is not able to supply it with ore to full capacity.

MICHIGAN

HOUGHTON COUNTY

During the first four months of 1914, the Mohawk mine has produced 127,348 tons of 'rock' yielding 2,454,300 lb. of 70% copper 'mineral.' The present daily output of 'rock' is 2250 tons, which is to be increased to 2600 tons in June. The Isle Royale has produced 106,230 tons of 'rock' during the four months, yielding 1,611,513 lb. of refined copper. Daily shipments are now about 1750 tons. Costs at both mines are decreasing each month.

NEVADA

ESMERALDA COUNTY

During April the Goldfield Consolidated mill treated 28,221 tons of ore, yielding a net realization of \$150,764. Development in the mine totaled 2409 ft., costing \$7.39 per foot. Costs for the month were \$6.05 per ton, including 18c. for examining the Aurora mine in Mineral county. Six lessees were working in the Goldfield mine, two producing ore worth \$4214.

The Goldfield Consolidated Mines Co.'s output in May was \$327,000 from 30,200 tons of ore. Operating expenses were \$175,000, and profit \$152,000.

HUMBOLDT COUNTY

(Special Correspondence.)—The Nevada Packard Mines Co. has received settlement for a 25-ton car of ore from the Kromer-Hampton-Loufek lease at Rochester. The car contained 50,451 dry tons and was settled for on the basis of 0.03 oz. gold and 129.40 oz. silver, a total value of \$74.68 per ton. After deducting 3% for loss in smelting, the value of the shipment was \$1790. The lease is employing four men, who are said to be taking out about 30 tons per month of this grade of ore.

Rochester, May 28.

LYON COUNTY

The usual ore shipments are being made from the Nevada-Douglas property. A large tonnage of 3% copper ore is being opened in the Casting Copper mine. Between 600 and 700 ft. in the Ludwig, 8 to 9% ore has been cut.

NYE COUNTY

Machinery is arriving for the White Caps company at Manhattan. The 75-hp. hoist, from the Denver Engineering Co., is the largest in the district. A new Leyner compressor has been purchased. Ore worth \$25 per ton has been opened at 200 ft. in the Big Pine. Development at the Wall-Blaker claims has been stopped by the bondholders. Victor Barnt, of the Railroad Valley Co., is to reopen the old silver mine at Barcelona, 10 miles north of Manhattan.

NEW MEXICO

SOCORRO COUNTY

(Special Correspondence.)—Rich bornite has been opened in an upper stope of the Deadwood mine. Denver people have secured a bond and lease on the Gold Eagle claims, north from the central portion of this district. Shipments of ore will be made from a 30-in. vein. Work on the Eberle mine, by the Oaks Co., is proving satisfactory. Good ore has been sent to a local mill. A large vein of \$25 ore has been opened at 400 ft. in the Pacific. The best ore mined in the district comes from stopes above this level. The output to date is \$150,000. On May 18 the Socorro Mining & Milling Co. took over the Pacific, on which an option is held.



MAP OF NEW MEXICO.

An aerial tramway is to be erected between the mine and the Socorro mill by September or October, also a water and power line.

Mogollon, May 25.

OREGON

The mineral resources of southwestern Oregon are described by J. S. Diller in *Bulletin* 546 of the U. S. Geological Survey. This publication of 147 pages is accompanied by illustrations and interesting maps of the various districts, and covers the geology, mineral production (\$6,218,741 since 1900), gold-quartz lode mines, copper mines, and prospects (blister copper output in 1912, 260,429 lb.), placer mines, and coal.

BAKER COUNTY

The Gold Center placer ground, west of Sumpter, has been

leased by J. B. Wetherell to the Hudson Placer Mining & Dredging Co. of Portland, on a royalty basis. The Company will install a steam-shovel and 'land' dredge of a capacity of 100 yards per hour.

UTAH

The mine production of gold, silver, copper, lead, and zinc in Utah, in 1913, by counties, was as follows, according to Victor C. Helges, of the U. S. Geological Survey:

County.	Number of producers.	Ore treated, short tons.	*Gold, fine oz.	*Silver, fine oz.	Copper, pounds.	Lead, pounds.	Zinc, pounds.	Total value.
Beaver	24	168,158	1,118	344,437	3,137,234	10,454,583	5,522,324	\$ 1,486,671
Box Elder	3	6,718	254	1,205	622,206	15,832	.....	103,113
Garfield	3	.....	41	7	.....	.....	.....	854
Grand	2	18	25	4	.....	.....	.....	526
Iron	2	2	1	1,037	22	.....	.....	646
Juab	56	383,977	67,002	5,600,617	9,293,661	22,508,439	761,212	7,241,360
Millard	1	12	.....	12	36	6,193	.....	286
Morgan	1	52	.....	97	.....	23,994	.....	1,121
Plute	7	11,809	2,505	9,739	3,904	46,458	.....	60,312
Salt Lake	51	9,195,624	85,973	2,504,021	145,065,188	72,111,025	3,421,724	29,139,248
San Juan	1	.....	25	2	.....	.....	.....	518
Summit	15	216,293	3,591	3,090,282	1,343,846	32,617,400	2,459,783	3,721,982
Tooele	29	147,483	9,804	640,249	1,522,596	14,619,866	1,202,568	1,535,994
Uinta	2	.....	20	2	.....	.....	.....	416
Utah	18	18,186	1,479	265,850	6,945	4,531,687	2,969,793	557,913
Wasatch	2	54,234	629	627,274	450,324	9,191,313	2,520,423	1,007,250
Total 1913....	217	10,202,566	172,467	13,084,835	161,445,962	166,126,790	18,857,827	\$44,858,210
Total 1912....	207	7,770,270	206,360	13,835,903	137,307,485	140,311,135	17,067,177	\$42,922,302

*Includes placer production.

The production of coal in Utah in 1913 was 3,254,828 short tons, with a value at the mines of \$5,384,127, compared with 3,016,149 tons worth \$5,046,451 in 1912, according to E. W. Parker of the U. S. Geological Survey. The increased production in 1913 appears to have been due principally to activity among metalliferous mines and smelters, as nearly all of the increased production was in the quantity of coal made into coke, this item alone indicating a gain of 225,561 short tons out of a total increase of 238,679 tons. Nearly 90% of the total coal production of Utah is mined in Carbon county, which contains a large part of the great Uinta basin. This county produced in 1913 2,830,102 short tons out of a total for the state of 3,254,828 tons. The industry was practically free from labor troubles in 1913, only one company reporting idleness from this cause, and only five men being disaffected. No strikes of any kind were reported in 1912, and only one of three days in 1911. Practically all the mines of the state work eight hours per day. According to statistics collected by the U. S. Bureau of Mines, there were 17 fatal accidents in the coal mines of Utah in 1913, a decrease of one from 1912.

JUAB COUNTY

All leases on the May Day property expired on June 1, and the owners will now develop the mine. Lessees have opened some new orebodies. James C. Dick is manager.

WASHINGTON

SPOKANE COUNTY

Over 4 ft. of good lead ore has been opened in the Galena Hill mine, near Reardon, south of Spokane. W. S. Bliss is manager.

STEVENS COUNTY

(Special Correspondence.)—At a depth of 500 ft. in the Copper King at Chewelah, 4 ft. of gray copper ore has been cut 100 ft. from the United Copper boundary. Construction of a smelter at the Copper King mine is under way, and machinery is arriving. The Jay Gould mine is to be unwat-

ered, and developed under a bond. It has produced some high-grade silver-lead ore. A 1000-ft. adit is to be driven by the Big Bend Mining Co., which has bonded the Mayflower claims for two years.

The Big Bear mine, four miles from Marcus, is developing in a promising way, and a compressor plant has been installed. The Deer Trail district promises to be active during the coming summer. The Queen and Seal mines will prob-

ably be steady producers, the latter being an old silver producer, one of the oldest in the southern part of the county. The Cleveland mine is shipping ore to Tacoma. Springdale is the shipping point for the Deer Trail district.

Chewelah, May 24.

The annual meeting of the Copper King Mining Co., was held at Spokane on May 21. According to the president, S. P. Domer, there is 6000 to 7000 tons of 5% ore ready for the 100-ton per day smelter being installed. The mine is in good condition. A new air-compressor is to be added to the equipment. Nearly 4000 ft. of underground work has been done in the Liberty Mining & Milling Co.'s claims at Chewelah.

CANADA

BRITISH COLUMBIA

Free-milling gold ore has been opened at 1200 ft. in the War Eagle mine at Rossland. Mines in this district shipped 190 cars of ore to the Trail smelter during the two weeks ended May 21. 6572 tons from the Centre Star, 2650 from Le Roi, 848 from the Josie, and 548 from the Ben Hur at Republic, Washington. Charles W. Drysdale, of the Geological Survey of Canada, will examine the ore deposits of Ymir, and do some preliminary work in the silver-lead area of Windermere.

ONTARIO

During the last four-weekly period, the Hollinger mine produced 15,191 tons of ore, including 1013 tons from the Acme, averaging \$13.69 per ton. The mill recovery was 95.1%. All costs totaled \$4,349 per ton, and the profit was \$123,523. The mine continues to develop satisfactorily. The Buffalo mill at Cobalt treated 6767 tons of ore in April averaging 17 oz. silver per ton. Ore reserves in the Seneca-Superior lease of the Peterson Lake Silver Mining Co. are estimated by R. B. Lamb to contain 3,850,000 oz. The output in 1913 was 1,406,772 oz. worth \$828,578, of which the Company received a royalty of \$207,144, or 25%. The Coniagas company has started work on an old shaft in the town of Cobalt.

Personal

S. H. BALL is in Greenland.
 STEPHEN J. LETT is in Russia.
 MARK L. REQUA was in London recently.
 C. W. MERRILL was in New York last week.
 CHESTER W. WASHBURN has gone to the Congo.
 BAILEY WILLIS is coming up from the Argentine.
 ALTON L. DICKERMAN was in New York recently.
 COURTENAY DE KALB has left for Tucson, Arizona.
 B. C. GULLICHSEN has left the Rand and is in London.
 A. K. MACFARLANE, of Chihuahua, Mexico, is in London.
 D'ARCY WEATHERBE has returned to London from Ontario.
 ROWLAND C. FEILDING has returned to London from Spain.
 DONALD F. POSTER has left West Africa and is in London.
 C. W. HAYES and family have returned to the United States.
 W. J. LORING expects to visit California during the summer.
 THOMAS H. LEGGETT has returned to New York from the West.

OTTO SUSSMANN has moved his office to 61 Broadway, New York.

MASON T. ADAMS is engaged on professional work in Kentucky.

NORMAN STINES, manager of the Sissert Estate, has been in London.

R. M. RAYMOND and W. W. RAYMOND have been at Rochester, Nevada.

JOHN H. CALLINAN, of Toronto, was recently at Rochester, Nevada.

WALTER G. PERKINS has gone to the Messina copper mine in the Transvaal.

T. A. RICKARD sailed for England on the *Kaiser Wilhelm der Zweite*, June 1.

E. A. WALLERS has been elected president of the Transvaal Chamber of Mines.

POPE YEATMAN has returned to New York from Chile and has gone to Nevada.

NELSON DICKERMAN, manager for the Pato company, Colombia, is in London.

J. H. CURLE returned to London from Abyssinia and has gone to Nicaragua.

PERCY A. ROBBINS has returned from Europe to the Hollinger mine, Ontario.

ALFRED JAMES was in New York on his return from Canada, and has gone to England.

E. E. HARDACH, manager of the Witwatersrand Deep, is on his way to Nevada, by way of London.

ARTHUR W. JENKS is in the United States and will not return to the Argentine for some months.

E. G. SPILSBURY was in Belgium last week and expects to return to New York about the middle of June.

R. GILMAN BROWN is making a tour of inspection to the Kyshtim, Tanalyk, and Ridder mines, in Siberia.

J. E. VAUGHAN, Government Inspector of Mines for the Union of South Africa, is on a visit in England.

PERCY E. BARBOUR has resigned the management of the property of the Uwarra Mining Co., Candor, North Carolina.

PHILIP L. FOSTER, representative of the Exploration Company in America, has moved his office to 62 Broadway, New York.

H. G. PEAKE, of the Union Construction Co., has returned to San Francisco after spending two years in tin dredging in Portugal.

LAWRENCE ADDICKS has resigned as manager of the refinery at Chrono, New Jersey, belonging to the United States Metal Refining Company.

JOHN H. EGGERS has been appointed to the position of general manager for the Rochester Mines, Rochester Weaver Min-

ing, and Nenzel Crown Point Mining companies, to take effect June 1, succeeding N. M. WADE, who has resigned.

R. E. PALMER, consulting engineer for the Rio Tinto Copper Co., has taken up consulting work, with offices at No. 3 Lombard street, London.

ROBERT E. CRANSTON is making an examination of the Humboldt mine, in Ouray county. This property joins the Smugler Union on the north.

T. H. OXNAM, owner of the Gold Mountain mines, San Bernardino county, has returned to Los Angeles, after spending three months at the property.

FREDERICK BRADSHAW, general superintendent of the Tonopah Belmont Development Co., has been in British Columbia and has returned to Tonopah.

GEORGE A. LAIRD, who was for a short time in charge of the concentrator at Great Cobar, now idle, has opened an office as consulting engineer at Sydney.

HENRY TSCHETSCHOTT, professor of ore dressing at the University of St. Petersburg, Russia, is making a tour of California dredging and hydraulic workings, while en route to Alaska.

Operating officials in Korea of the Seoul Mining Co., of which H. COLLBRAN, of London, is president, and H. R. BOSTWICK, of San Francisco, is first vice-president, are as follows: general manager, A. H. COLLBRAN; auditor, J. S. COLLBRAN; resident engineer, W. T. HALL; superintendent of Tul Mi Chung mine, E. W. MILLS; superintendent of machinery, H. G. ENGLISH; superintendent of transportation, L. C. FAULK; Suan mine foreman, R. BLAMEY; Suan mill foreman, F. C. BROWN; and medical officer, E. DEM. STRYKER.

FRANCIS DUPEN, a mining engineer in the employ of the Miami Copper Co., was instantly killed, on May 26, by falling 350 ft. to the bottom of No. 1 shaft. He was a former Lake Superior man, who had worked with the Phelps-Dodge company at Bisbee and later was at Silver City, New Mexico.

Schools and Societies

THE UNIVERSITY OF UTAH, at Salt Lake City, is to erect a Greek theatre, modeled after that at the University of California, to seat 2500 people. Subscriptions are now being received. A fine site has been secured overlooking the valley, the Wasatch mountains to the east, and the city, lake and smelters to the west.

THE new STATE SCHOOL OF MINES will open at El Paso, Texas, in September, in charge of S. H. Worrell, at present chemist of the University of Texas. The last legislature made an appropriation of \$15,000 for equipping the institution, and to pay salaries of instructors for the first year. The city has raised \$50,000 for the buildings and ground.

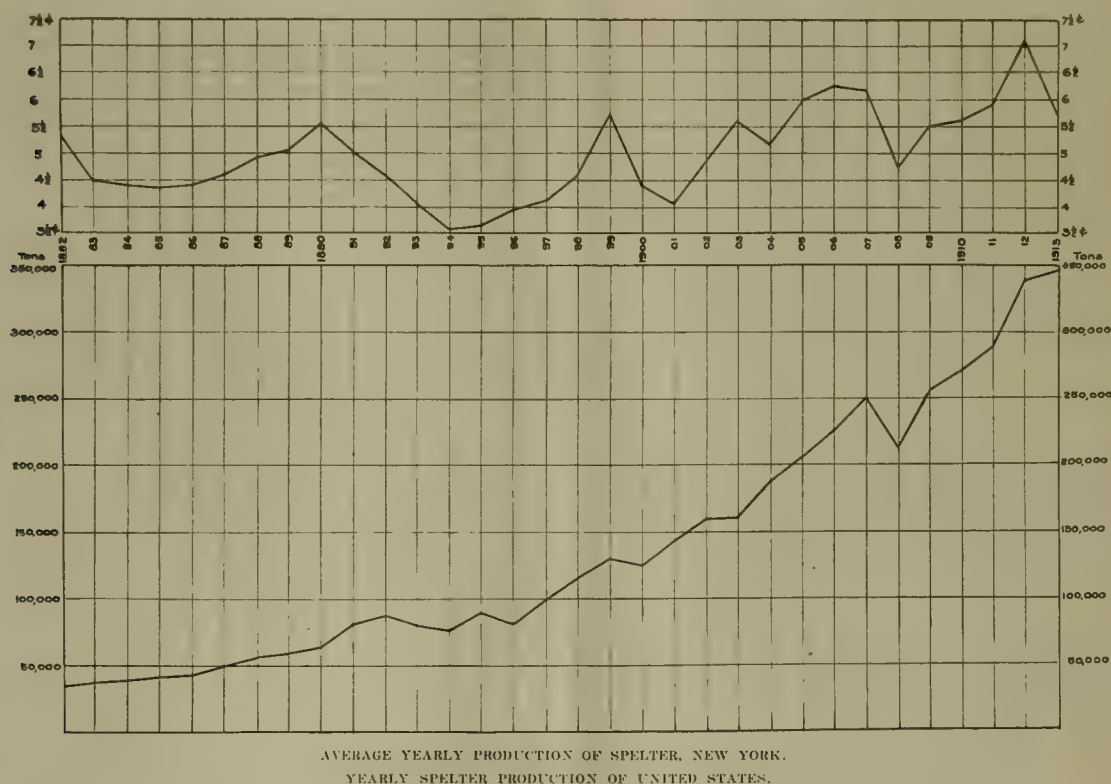
THE report of the Colorado Scientific Society for 1913 states that material progress was made. Nine meetings were held, with an average attendance of 22 members. The present membership is 238, of whom 143 reside in Denver. Additions were made to the library by purchase and gift. Receipts for the year were \$2458, and expenditures \$2314, leaving cash on hand of \$144. The report includes a discussion on 'Systematic Testing in the Evolution of Mill Practice,' by George E. Collins.

PRINCETON UNIVERSITY department of geology first term of the year 1914-15 begins on September 23. There are 18 members of the faculty. The department is housed in Guyot hall, which has a floor space of 85,146 sq. ft., and cost \$425,000 in 1909. The museum occupies 9000 sq. ft. of floor area. Graduate students, unless holders of a fellowship or scholarship, pay an annual tuition fee of \$30. The average residential cost to students ranges from \$8.33 to \$12.50 per week.

New York Metal Market Review

Business in metal products has not been good in May, and raw materials have felt the slackened demand. The best feature at the moment is a better sentiment, but this will not hold long unless buying improves. Much depends upon the railroad freight rate decision, which is hoped to be near at hand. Railroad supplies are notoriously low, and the most unusual makeshifts are being resorted to in the avoidance of buying. Whether the decision is favorable or not, much improvement in buying by the railroads must result from even partly raising the embargo on the activities of the purchasing agents. On the whole, the prices of all metals weakened in May. In copper, a tendency to raise quotations before consumers really take hold is noticeable, which second-hands have used to their advantage. The base price of hot rolled sheet copper was twice reduced during the month. As a result of the prolonged strike in the Lake Superior district, some consumers are now using electrolytic where they formerly considered Lake in-

on May 8 of the Copper Producers' statement, which showed production for April to have been 151,500,531 lb., an increase of 5,848,549 lb., while deliveries decreased 12,541,666 lb. there was moderate selling of electrolytic by agencies at 14.12 $\frac{1}{2}$ c. cash New York. Dealers' prices eased off still more, the reported quotations going as low as 14c. cash f.o.b. New York, but metal at this price was not easy to find. During the remainder of the month, or at least until May 26, electrolytic did not vary much from 14.12 $\frac{1}{2}$ c. cash New York, and business was not heavy at any time. There was a flurry toward the middle of the month, and sellers again tried to advance their prices $\frac{1}{8}$ c. per pound, but there was too much metal to be had at a lower figure to make the advance effective, and, as a matter of fact, lower rather than higher prices could be obtained. It developed that about the only real busy consumers were the manufacturers of ammunition, many of whom use Lake copper exclusively. This was one of the few good results of the trouble in Mexico. The demand for rolled copper was poor, and in the last half of May the price of hot rolled sheets was reduced twice $\frac{1}{4}$ c., making the base



dispensable. Tin dropped heavily abroad on adverse reports from the Straits Settlements, and again following the Banca sale. Lead started the month strong, but finished rather weak. The net change in spelter was a small decline, the slack business of the galvanized sheet mills having been felt. Antimony presented little of interest. Aluminum was without any interesting feature and May finished with prices a little lower for both prompt and future metal.

COPPER

Around 14.12 $\frac{1}{2}$ c. cash, New York which was quoted at the end of April, a fair business developed, but it was checked by an advance to 14.37 $\frac{1}{2}$ c. delivered 30 days, or 14.25c. cash New York, at which price May was ushered in. Consumers did not take kindly to the advance, and concessions were offered by first as well as second hands. After the appearance

19 $\frac{1}{4}$ c. per pound. Since the beginning of 1913, the following base prices have been announced: January 1, 20 $\frac{1}{2}$ c.; February 2, 20c.; March 13, 19 $\frac{3}{4}$ c.; May 13, 19 $\frac{1}{2}$ c.; and May 22, 19 $\frac{1}{4}$ c. Lake copper lost about $\frac{1}{4}$ c. in the month, the quotation May 1 being about 14.50c., whereas on April 26 the minimum was about 14.25c. Lake, which was abnormal both as regards supply and price, during the Lake Superior strike, has suffered in a way unlooked for, since certain consumers who formerly used it exclusively, and thought they must have it, found as a result of the stringency that electrolytic answered their purposes in a satisfactory way. It is probable that some will stick to electrolytic. In the latter part of the month the attitude of most consumers of copper was to buy as little as possible, some of those approached saying they had sufficient for three weeks or a month, and that they saw

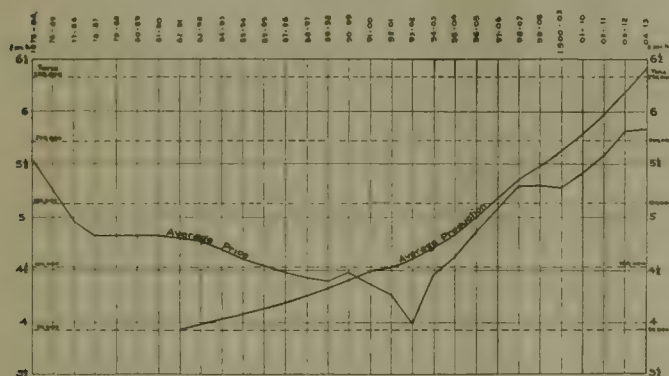
no reason for buying further ahead. In April 34,787 tons was exported, and in May 31,948 tons. The Waterbury average for April was 14.87½ cents.

LEAD

From May 1 to 29, quotations for lead were stationary at 3.90c. New York, and 3.80c. St. Louis. In the early part of the month the tone was good and an advance was looked for, but it did not materialize. The outlook at that time was so good that some sellers were disinclined to sell far ahead. About the middle of the month there were some transactions in futures and premiums were paid. At this time it was noted that the London price had been advancing steadily, and exports were again becoming a probability. Subsequently, however, London declined, and with it went some of the strength of the New York market. Toward the end of May the situation was one of waiting on the part of consumers.

SPELTER

This metal has felt the decline in demand for galvanized sheets, but otherwise there is little to say in comment upon



SPELTER PRICES, NEW YORK AVERAGED FOR 10-YEAR PERIODS.

it. In the first 10 days of May, producers stiffened their prices, the advance being from 5c. New York to 5.15c., but little additional business was forthcoming, and about May 15 quotations dropped 5 points, and the market was easy at 5.10c. New York and 4.95c. St. Louis.

TIN

To sellers, at least, tin was a rather unsatisfactory metal in May, prices both at home and abroad showing recurrent weakness. Average prices on the days specified were as follows: May 1, 34.10c.; May 5, 33.10c.; May 11, 33.40c.; May 15, 34.45c.; May 20, 33c.; May 26, 33.25c.; and May 28, 31.87½c. In the first week of May, the low quotations caused interest in futures and resultant buying of August and September, some for July and less for June; but, all told, it did not amount to a great deal. On May 11, there was notable buying of futures. About this time the big London houses were worried over the almost steady decline in prices and took steps to get together to prevent further weakness. Conditions were getting to a pass where some of the operators would be unable to fulfill their contracts, which would be to the detriment of the entire trade. The reported getting together had a good effect on the New York market, but on May 18 London came down with a rush, £6 5s. being lost on that day, a decline which domestic prices followed, 20 points being lost in New York. The lower level caused a good run of orders in New York on the day of the decline, at least 250 tons being dealt in. The collapse in London was caused by reports that the May shipments from the Straits would be between 6700 and 6900 tons, the estimated figures being record breaking. Up to the time of these reports, the trade was confident of good business and higher prices were in sight.

Near the close of the month there was good buying on one or two days at the lower prices, the turnover on May 25 being about 300 tons for June and July delivery. Despite the realization of a fair price at the Banca sale in Holland, May 28, 2300 tons being sold at an average price of 91 florins, (equivalent to 33.35c. c.i.f. New York, London again broke on that day with a decline of £4. The New York price dropped in turn and some small business was done at 31.87½c. Deliveries into consumption in April were good, amounting to 4200 tons, although deliveries for the first four months of this year show a decrease of 900 tons as compared with the same time last year. The total visible supply on April 30, 1914, was 15,447 tons, or 5625 tons above the total visible supply of April 30, 1913. The arrivals in May, up to May 29, were 3035 tons, and there was afloat 2235 tons. May deliveries were 3800 tons, and in stock and landing May 31 was 1773 tons. The tin plate business has been good.

ANTIMONY

This metal varied but little in price in May, and generally was without interest. Quotations, when the month opened, were about 7.25 to 7.35c. for Cookson's, 6.75 to 6.95c. for Hallett's, and 5.75 to 6.50c. for other grades. At the end of the month Cookson's and Hallett's could be had five to ten points lower. Prices gained a little at one time in the month because of speculative influences, but the gain was lost because of pressure to sell from the same sources. At last reports, accumulating stocks had weakened the situation.

ALUMINUM

Features were lacking in this metal. About the middle of the month the quotation for prompt, 98 to 99% pure, was 17.87½ to 18.12½c., with futures at 17.75 to 18c. The tone at this time was somewhat better, but not much business was transacted. At the end of May quotations were 17.75 to 18c. for both prompt and futures. London price is from £81 to £83 per ton.

Production of Secondary Metals in the United States in 1913

The production of secondary metals in 1913, according to the United States Geological Survey, was as follows:

Metal.	Short tons.	Value.
Secondary copper, including that in alloys other than brass	66,980	\$20,536,068
Remelted brass	99,315	24,651,969
Secondary lead	33,104	
Recovered lead in alloys	39,730	6,409,392
Secondary spelter	50,005	
Recovered zinc in alloys other than brass	3,743	6,019,776
Secondary tin	6,415	
Recovered tin in alloys	7,763	12,567,379
Secondary antimony	45	
Recovered antimony in alloys	2,660	460,932
Secondary aluminum	2,198	
Recovered aluminum in alloys	2,456	2,199,480

Total value\$72,844,996

The tonnage of metals treated in 1912 was practically the same as 1913, but the value of the last year was \$4,550,847 greater.

MACHINERY manufactured in Switzerland in 1913 was valued at \$27,770,000, about 75% of which was exported. It consists of electric generators, water-power apparatus, steam engines, gas, petroleum, and benzine motors, and other industrial machinery.

The Metal Markets

LOCAL METAL PRICES

San Francisco is not a primary market for the common metals except quicksilver. The prices quoted below therefore represent sales of small lots and are not such as an ore producer could expect to realize. Ore contracts usually call for settlement on the basis of Eastern prices, less freight and treatment charges. The prices quoted are in cents per pound, except in the case of quicksilver, which is quoted in dollars per flask of 75 pounds.

San Francisco, June 4

Antimony	9 - 95c
Electrolytic copper	15 - 15 1/4c
Pig Lead	4.15 - 5.10
Quicksilver (flask)	\$39.00
Tin	30 - 40 1/2c
Spelter	6 1/2 - 6 3/4c
Zinc dust, 100 kg zinc-lined cases, 7 1/2 to 8c per pound	

EASTERN METAL MARKET

(By wire from New York.)

NEW YORK, June 4.—Copper is reported weaker, and the spelter market is lifeless, while lead is firm. Copper shares are a little firmer, but the Stock Exchange is having a quiet time. The Anaconda output for May was 23,500,000 lb. Both Mohawk and Wolverine yields were a large increase over April. At St. Louis lead is quiet at 3.80 to 3.82 1/2c, and spelter is dull at 4.97 1/2c. Bar silver in London is dull at 25 1/2d (51.5 cents).

SILVER

Below are given the average New York quotations in cents per ounce, of fine silver.

Date	Average week ending
May 28	57.00
" 29	56.87
" 30 Holiday	
" 31 Sunday	
June 1	56.50
" 2	56.12
" 3	56.12
Monthly averages:	
1913	1911
Jan.	63.01
Feb.	61.25
Mar.	57.87
Apr.	59.26
May	60.21
June	59.03

Date	Average week ending
Apr. 22	58.35
" 29	58.93
May 6	59.14
" 13	58.73
" 20	58.31
" 27	57.12
June 3	56.52
Monthly averages:	
1913	1911
Jan.	57.58
Feb.	57.53
Mar.	58.01
Apr.	58.52
May	58.21
June	57.73

A clear conception of the relative position occupied by Mexico as a producer of silver can be obtained by supposing a bar, 1000 oz. in weight, to be composed of metal drawn proportionately from the different countries which contribute to the world's supplies. Basing the figures on the returns for 1911, 350 oz. would be of Mexican origin, so that the 1000-oz. bar would shrink automatically to 650 oz. if Mexican supplies entirely ceased, according to Samuel Montagu & Co., of London. Further, 267 oz. would be from the United States, and 145 oz. from Canada. Thus, 762 oz., more than three-quarters of the bar, would be obtained from the North American continent alone. The remaining 238 oz. would be obtained as follows: 75 oz. from Australasia, 75 oz. from Europe, 62 oz. from South and Central America, 22 oz. from Asia, and 1 oz. from Africa. The way in which the bar would be divided in proportion to the consumption of the different continents is more difficult to ascertain, for statistics both of coinage and manufacture include old material reworked, and, though the total amount used for coinage is fairly constant, its distribution as regards different countries varies year by year. One thing is very certain: Asia, which only contributes 22 oz. of the bar, absorbs the lion's share, and is prepared to utilize, in one form or another, over 500 oz. of the weight.

COPPER

Quotations on copper as published in this column represent average wholesale transactions on the New York market and refer to electrolytic copper. Lake copper commands normally 1-5 to 1-4c. per lb. more. Prices are in cents per pound.

Date	Average week ending
May 28	13.95
" 29	13.95
" 30 Holiday	
" 31 Sunday	
June 1	13.85
" 2	13.80
" 3	13.75
Monthly averages:	
1913	1911
Jan.	14.07
Feb.	13.99
Mar.	14.02
Apr.	13.93
May	14.00
June	13.98

Monthly averages

1913	1911	1913	1911
Jan.	14.07	July	14.21
Feb.	14.02	Aug.	14.1
Mar.	14.02	Sept.	14.25
Apr.	14.02	Oct.	14.31
May	14.1	Nov.	14.08
June	14.1	Dec.	14.25

The visible supply of copper in England and France and about on June 1 was 21,562 tons, an increase in the fortnight of 2028 tons. At Rotterdam, Hamburg, and Bremen, the supply was 8049 tons, a decrease of 142 tons.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery

Date	Average week ending
May 28	3.90
" 29	3.90
" 30 Holiday	
" 31 Sunday	
June 1	3.90
" 2	2.90
" 3	3.90
Monthly averages:	
1913	1911
Jan.	4.28
Feb.	4.33
Mar.	4.32
Apr.	4.36
May	4.31
June	4.33

Monthly averages

1913	1911	1913	1911
Jan.	4.28	July	4.25
Feb.	4.33	Aug.	4.60
Mar.	4.32	Sept.	4.70
Apr.	4.36	Oct.	4.37
May	4.31	Nov.	4.16
June	4.33	Dec.	4.02

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date	Average week ending
May 28	4.90
" 29	4.90
" 30 Holiday	
" 31 Sunday	
June 1	4.90
" 2	4.90
" 3	4.90
Monthly averages:	
1913	1911
Jan.	6.88
Feb.	6.13
Mar.	5.94
Apr.	5.52
May	5.23
June	5.00

Monthly averages

1913	1911	1913	1911
Jan.	6.88	July	5.11
Feb.	6.13	Aug.	5.51
Mar.	5.94	Sept.	5.55
Apr.	5.52	Oct.	5.22
May	5.23	Nov.	5.09
June	5.00	Dec.	5.07

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending	May 21	May 28	June 4
May 7	39.00	39.00	39.00
" 14	39.00	39.00	39.00

Monthly averages

1913	1911	1913	1911
Jan.	39.37	July	41.00
Feb.	41.00	Aug.	40.50
Mar.	40.20	Sept.	39.70
Apr.	41.00	Oct.	39.37
May	40.25	Nov.	39.10
June	41.00	Dec.	40.00

TIN

New York prices control in the American market for tin, since the metal is almost entirely imported. San Francisco quotations average about 5c. per lb. higher. Below are given average monthly New York quotations, in cents per pound:

Monthly averages

1913	1911	1913	1911
Jan.	50.15	July	40.70
Feb.	49.07	Aug.	41.75
Mar.	46.95	Sept.	42.45
Apr.	49.00	Oct.	40.61
May	49.10	Nov.	39.77
June	45.10	Dec.	37.57

The Old Dominion company has declared a quarterly dividend of \$1 per share, making \$3.25 for the current year; also, its subsidiary, the United Globe company, will pay \$4 per share, making \$8 for this year. On July 1 the Belmont company will pay 25c. per share, or \$375,000, and the Extension will pay 7 1/2c. per share, or \$70,750. Profits of the latter company for the year ended March 31, 1914, were \$82,126. West End profits in May were \$43,336 from 5760 tons of ore.

The Stock Markets

SAN FRANCISCO STOCKS AND BONDS

(San Francisco Stock and Bond Exchange.)

June 3.

BONDS

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Associated Oil Cos.	3 97½	99	Natomas Consol. 68.	—	20
Natomas Con.	—	35	Pac. Port. Cement 68.	100	—
Unlisted.			Santa Cruz Cement 68.	85	—
General Petroleum 68.	34½	37	Union Oil	86½	87½

STOCKS

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Amalgamated Oil	77½	—	General Petroleum	24	4
Associated Oil	38½	39	Noble Electric Steel	50c	—
Im Port	—	84½	Natomas Consol	1½	—
Grant	—	84½	Pac. Port. Cement	60	94
Pac. Int. Borax, com.	—	57½	Riverside Cement	—	83
Sterling O. & D.	—	14	Santa Cruz Cement	40	45
Union Oil	71½	73	Stand. Port. Cement	24	—
West Coast, pfd.	—	112½			

NEVADA STOCKS

(By courtesy of San Francisco Stock Exchange.)

June 4.

Atlanta	16	Montana-Tonopah	8.80
Belcher	29	Nevada Hills	.31
Belmont	7.20	North Star	.32
Con. Virginia	.05	Ophir	.06
Florence	.50	Pittsburg Silver Peak	.28
Goldfield Con	1.40	Round Mountain	.35
Goldfield Oro	.11	Sierra Nevada	.16
Halifax	.75	Tonopah Extension	2.85
Jim Butler	1.07	Tonopah Merger	.51
Jumbo Extension	.25	Tonopah of Nevada	6.80
MacNamara	.03	Union	.07
Mexican	.38	Victor	.38
Midway	.30	West End	.89
Mizpah Extension	.31	Yellow Jacket	.34

CALIFORNIA STOCKS

(Latest Quotations.)

Bid.	Ask.	Bid.	Ask.
Argonaut	\$2.85	Kennedy	7.50
Brunswick Con.	1.05	Mountain King	0.45
Bunker Hill	1.90	South Eureka	1.25
Central Eureka	0.14		

COPPER SHARES—BOSTON

(By courtesy of J. C. Wilson, Mills Building.)

June 4.

	Bid	Ask		Bid	Ask
Allouez	49½	41	Mohawk	8 44½	45
Ariz. Commercial	4½	4½	Nevada Con.	14½	14½
Butte & Superior	40	40½	North Butte	25½	26
Calumet & Arizona	65½	65½	Old Dominion	47½	48½
Calumet & Hecla	410	415	Osceola	76	77
Copper Range	36½	37	Quincy	56½	58
Daly West	14	14	Shannon	6½	6
East Butte	109	11	Superior & Boston	11	2
Franklin	44	44	Tamarack	36½	37
Granby	81½	82	U. S. Smelting, com.	33½	34½
Greene Cananea	32½	32½	Utah Con.	10½	10½
Ile Royale	20	21	Winona	3	3½
Mass. Copper	5	5 5/8	Wolverine	40½	41½

NEW YORK CURB QUOTATIONS

(By courtesy of E. F. Hutton & Co., Kohl Building.)

June 4.

	Bid.	Ask.		Bid.	Ask.
Braden Copper...	7½	7½	McKinley-Dar. . .	75c.	80c.
B. C. Copper...	1½	1½	Mines Co. Am. . .	2½	3½
Can. Cop. Mines . .	1½	1½	Nipissing	6½	6½
Davis-Daly	5½	7½	Ohio Copper	1½	2½
First National . . .	1½	2½	Stand. Oil of Cal.	326	328
Hollinger	16½	17½	Tri. Bullion	1½	1½
Iron Blossom	1½	1½	Tuolumne	45c.	55c.
Kerr Lake	4	4½	United Cop. com. .	3½	3½
La. Rose	1½	1½	Yukon Gold	2½	2½
Mason Valley	2	3			

NEW YORK STOCK EXCHANGE

(By courtesy of J. C. Wilson, Mills Building.)

June 4.

	Bid	Ask		Bid	Ask
Amalgamated	\$ 71½	71½	Miami	\$ 22	22½
Anaconda	31½	31½	Nevada Con.	14½	14½
A. S. & R., com.	62½	63	Quicksilver, com.	1	1½
Calif. Pet., com.	20½	20½	Ray Con.	21½	21½
Chino	41½	41½	Tenn. Copper	34½	35
Guggenheim Ex.	53	53½	U. S. Steel, pfd.	109½	109½
Inspiration	17	17½	U. S. Steel, com.	81½	81½
Mexican Pet., com.	62½	63½	Utah Copper	56½	57

The *Bulletin* of the Pan-American Union, of Washington, states that radium-bearing ore has been discovered in San Salvador, and thus is the radium bill further complicated. The deposit in Central America was found at Cerro Pelon, and an Englishman is credited with the discovery. As a result, two qualified engineers have been sent to make further and more detailed investigations, and in their research they are said to have drilled already 200 ft. The land where the mine is, belongs to the municipality of Sensuntepeque, and already it is proposed to lease this land for a period of years on a basis of 10% of the profits.

Current Prices for Ores and Minerals

(Corrected monthly by Atkins, Kroll & Co.)

The prices are approximate, subject to fluctuation, and to variation according to quantity, quality, and delivery required. They are quoted, except as noted, f.o.b. San Francisco. Buying prices marked *.

	Min.	Max.
Antimony ore, 50%, $\frac{1}{2}$ ton	*\$18.00	\$20.00
Arsenic, white, refined, $\frac{1}{2}$ lb	0.03	0.04
Arsenic, red, refined, $\frac{1}{2}$ lb	0.08	0.08½
Asbestos, chrysotile	100.00	350.00
Asbestos, amphibole	5.00	10.00
Asphaltum, refined, $\frac{1}{2}$ ton	11.50	20.00
Barium chloride, commercial, $\frac{1}{2}$ ton	40.00	42.50
Barium sulphate (barytes), prepared, $\frac{1}{2}$ ton	20.00	30.00
Bismuth ore, 15% $\frac{1}{2}$ ton	*250.00	upward
Chrome ore, according to quality, $\frac{1}{2}$ ton	10.00	12.50
China clay, English, levigated, $\frac{1}{2}$ ton	15.00	20.00
Cobalt metal, refined, f. o. b. London, $\frac{1}{2}$ lb	2.50	
Coke, foundry, $\frac{1}{2}$ 2240 lb	12.00	15.00
Diamonds:		
Borts, according to size and quality, $\frac{1}{2}$ carat	2.00	15.00
Carbons, according to size and quality, $\frac{1}{2}$ carat	55.00	80.00
Feldspar, $\frac{1}{2}$ ton	5.00	25.00
Firebrick:		
Silica, $\frac{1}{2}$ M.	50.00	55.00
Snowball, $\frac{1}{2}$ M	40.00	45.00
Flint pebbles for tube-mills, Danish, $\frac{1}{2}$ 2240 lb.	21.50	22.50
Fluorspar, $\frac{1}{2}$ ton	10.00	15.00
Fullers earth, according to quality, $\frac{1}{2}$ ton	20.00	30.00
Gilsonite, $\frac{1}{2}$ ton	35.00	40.00
Graphite:		
Amorphous, $\frac{1}{2}$ lb	0.01½	0.02½
Crystalline, $\frac{1}{2}$ lb	0.04	0.13
Gypsum, $\frac{1}{2}$ ton	7.50	10.00
Infusorial earth, $\frac{1}{2}$ ton	10.00	15.00
Iridium	55.00	
Magnesite, crude, $\frac{1}{2}$ ton	5.00	7.50
Magnesite, dead calcined, $\frac{1}{2}$ ton	20.00	25.00
Manganese ore, oxide, crude, $\frac{1}{2}$ ton	10.00	15.00
Manganese, prepared, according to quality, $\frac{1}{2}$ ton	30.00	70.00
Mica, according to size and quality, $\frac{1}{2}$ lb	0.05	1.00
Molybdenite, 95% MoS ₂ , $\frac{1}{2}$ ton	*750.00	1,000.00
Monazite sand (5% thorium), $\frac{1}{2}$ ton	150.00	200.00
Nickel metal, refined, $\frac{1}{2}$ lb	0.45	0.60
Ochre, extra strength, levigated, $\frac{1}{2}$ 100 lb	1.60	2.00
Osmiridium, $\frac{1}{2}$ oz	40.00	
Platinum, native, crude, $\frac{1}{2}$ oz	30.00	45.00
Silic fluxing for tube-mills $\frac{1}{2}$ 2240 lb	35.00	45.00
Sulphur, crude, $\frac{1}{2}$ ton	15.00	25.00
Talc, prepared, according to quality, $\frac{1}{2}$ ton	20.00	50.00
Tin ore, 60%, $\frac{1}{2}$ ton	*400.00	450.00
Tungsten ore, 65%	425.00	450.00
Uranium ore, 10% min.	25.00	per unit
Vanadium ore, 15% V ₂ O ₅ , $\frac{1}{2}$ ton	150.00	180.00
Wolframite (see tungsten ore).		
Zinc ore, 50% up, $\frac{1}{2}$ ton	*15.00	20.00

Current Prices for Chemicals

(Corrected monthly by Braun-Knecht-Helmann Co.)

Prices quoted are for ordinary quantities in packages as specified. For round lots lower prices may be expected, while in smaller quantities advanced prices are ordinarily charged. Prices named are f.o.b. San Francisco and subject to fluctuation. Other conditions govern Mexican and foreign business.

	Min.	Max.
Acid, sulphuric, com'l, 66%, drums, $\frac{1}{2}$ 100 lb.....	\$0.85	\$1.10
Acid, sulphuric, com'l, 66%, carboy, $\frac{1}{2}$ 100 lb.....	1.25	1.75
Acid, sulphuric, C. P., 8-lb. bottle, bbl., $\frac{1}{2}$ lb.....	0.18	0.18
Acid, sulphuric, C. P., bulk, carboy, $\frac{1}{2}$ lb.....	0.094	0.12
Acid, muriatic, com'l, carboy, $\frac{1}{2}$ 100 lb.....	1.85	3.00
Acid, muriatic, C. P., 8-lb. bottle, bbl., $\frac{1}{2}$ lb.....	0.15	0.20
Acid, muriatic, C. P., bulk, carboy, $\frac{1}{2}$ lb.....	0.104	0.15
Acid, nitric, com'l, carboy, $\frac{1}{2}$ 100 lb.....	6.00	6.50
Acid, nitric, C. P., 7-lb. bottle, bbl., $\frac{1}{2}$ lb.....	0.16	0.22
Acid, nitric, C. P., bulk, carboy, $\frac{1}{2}$ lb.....	0.124	0.15
Argols, ground, bbl., $\frac{1}{2}$ lb.....	0.10	0.20
Borax, cryst. and conc., bags, $\frac{1}{2}$ 100 lb.....	3.00	4.35
Borax, powdered, bbl., $\frac{1}{2}$ 100 lb.....	3.38	4.50
Borax glass, gd. 30 mesh, cases, tin lined, $\frac{1}{2}$ 100 lb.....	10.50	13.50
Bone ash, 60 to 80 mesh, bbl., $\frac{1}{2}$ 100 lb.....	6.50	6.50
Bromine, 1-lb. bottle, $\frac{1}{2}$ lb.....	0.55	0.65
Clay, domestic fire, sack, $\frac{1}{2}$ 100 lb.....	1.50	2.00
Cyanide, 98 to 100%, 100-lb. case, $\frac{1}{2}$ lb.....	0.18	0.22
Cyanide, 98 to 100%, 200-lb. case, $\frac{1}{2}$ lb.....	0.18	0.22
Cyanide, 129%, 100-lb. case, $\frac{1}{2}$ lb.....	0.22	0.264
Cyanide, 129%, 200-lb. case, $\frac{1}{2}$ lb.....	0.22	0.25
Lead acetate, brown broken, casks, $\frac{1}{2}$ 100 lb.....	9.00	10.50
Lead acetate, white broken, casks, $\frac{1}{2}$ 100 lb.....	10.50	10.75
Lead acetate, white, crystals, $\frac{1}{2}$ 100 lb.....	12.50	13.25
Lead, C. P., test, gran., $\frac{1}{2}$ 100 lb.....	13.00	15.00
Lead, C. P., sheet, $\frac{1}{2}$ 100 lb.....	15.00	18.00
Litharge, C. P., silver free, $\frac{1}{2}$ 100 lb.....	11.50	13.50
Litharge, com'l, $\frac{1}{2}$ 100 lb.....	8.00	9.50
Manganese ox., blk., dom. in bags, $\frac{1}{2}$ ton.....	20.00	25.00
Manganese ox., blk., Caucasian, in casks, $\frac{1}{2}$ ton.....	31.00	50.00
(5% MnO ₂ —4% Fe)		
Nitre, double ref'd, small cryst., bbl., $\frac{1}{2}$ 100 lb.....	7.00	8.00
Nitre, double ref'd, granular, bbl., $\frac{1}{2}$ 100 lb.....	6.50	7.50
Nitre, double ref'd, powdered, bbl., $\frac{1}{2}$ 100 lb.....	7.25	8.00
Potassium bicarbonate, cryst., $\frac{1}{2}$ 100 lb.....	12.00	15.00
Potassium carbonate, calcined, $\frac{1}{2}$ 100 lb.....	7.50	9.00
Potassium permanganate, drum, $\frac{1}{2}$ lb.....	0.104	0.13
Silica, powdered, bags, $\frac{1}{2}$ lb.....	0.03	0.05
Soda, carbonate (ash), bbl., $\frac{1}{2}$ 100 lb.....	1.50	1.75
Soda, bicarbonate, bbl., $\frac{1}{2}$ 100 lb.....	2.00	2.50
Soda, caustic, ground, 98%, bbl., $\frac{1}{2}$ 100 lb.....	3.00	3.25
Soda, caustic, solid, 98%, drums, $\frac{1}{2}$ 100 lb.....	2.50	2.75
Zinc shavings, 850 fine, bbl., $\frac{1}{2}$ 100 lb.....	12.00	13.00
Zinc sheet, No. 9—18 by 84, drum, $\frac{1}{2}$ 100 lb.....	10.20	11.00

*Extra charge for packing nitric acid for shipment to conform to regulations.

Current Prices for Oils and Candles

(Corrected monthly by Standard Oil Co., California.)

All prices are f.o.b. San Francisco except where otherwise specified, and are subject to change without notice.

Granite Mining Candles.	Per set, cents.	Granite Mining Candles.	Per set, cents.
6s-12 oz.-40s	8 3/4	6s-11 oz.-20s	9 1/2
6s-12 oz.-20s	9	6s-16 oz.-40s	10
6s-14 oz.-40s	9 1/4	6s-16 oz.-20s	10 1/4

Extra hard 1c. per set higher than the above.

The following prices are for oils (Calol) in wood barrels; cases (2-5 gal.) 3c. per gallon higher.

	Per gal., cents.		Per gal., cents.
Compressor oil	40	Light gas engine oil.....	26
Amber gas engine oil.....	40	Red compressor oil.....	26
Castor machine oil.....	20	Red engine oil.....	17
Dynamo and motor oil.....	24	Turbine oil	35
Engine oil	24	Turbine oil, heavy.....	35
Gas engine oil	26	Diesel engine oil	40
Heavy gas engine oil.....	45	Cylinder oil	37
Heavy red engine oil.....	19	High-pressure cylinder oil. 50	
Heavy red journal oil.....	21	Low-pressure cylinder oil. 37	
Ice machine oil	28	Valve oil	50

The following prices are for oils in iron barrels, cases (2-5 gal.) 7c. per gallon higher, except on Eocene, which is 8c. per gallon higher.

	Per gal., cents.		Per gal., cents.
Pearl oil	9	Red Crown gasoline	15
Headlight oil	10	Engine distillate	7
Eocene oil	11	Arcturips	25
Star fuel oil (o.b. Richmond Refinery)		Per bbl.	\$1.00
Petrolastic cement X		Per ton	\$12.00
Petrolastic cement XX			11.00
Asphaltum		\$5.50 to 12.50	

Company Reports

NORTH LAKE MINING COMPANY

This is an R. M. Edwards' company, operating in Michigan, and is still in the exploration stage. The shaft has been sunk to a depth of 345 ft., with a 112-ft. cross-cut at the 300-ft. level. The assets of the Company are given as \$904,649, of which \$22,800 is in cash and supplies.

INTERNATIONAL SMELTING & REFINING COMPANY

This Company operates a smelter in Utah, is building one in Arizona, and has an interest in several mines, and will soon be absorbed by the Anaconda Copper Mining Co. Results in 1913 were as follows:

Net income	\$1,066,238
Dividends	800,000
Balance	266,238
Previous surplus	1,862,988
Total surplus	2,129,226
Ores and materials on hand at end of 1913.....	6,251,184

ST. JOSEPH LEAD COMPANY

This and affiliated companies, after eliminating inter-company interest and dividends, report for the year ended April 30, 1914, as follows:

Net profits from operation.....	\$2,240,132
Other income	87,595
Gross income	2,327,728
Net income	1,583,938
Profit and loss credits.....	27,000
Surplus	1,610,939
Surplus after charges and dividends.....	1,183,483
Previous surplus	7,654,144
Total surplus	8,837,627
Dividends declared from surplus.....	219,294
Final surplus	8,618,333

The condensed balance-sheet shows total assets and liabilities of \$23,169,217, and cash on hand and on deposit of \$413,180.

NORTH BROKEN HILL MINING COMPANY

This is one of the prosperous companies at Broken Hill, and during the last half-year had the following results:

Development to 1400 ft. depth, feet.....	3,319
Ore reserves, above 1250 ft., tons.....	2,000,000
Ore milled, tons	154,829
Lead concentrate, tons	26,852
Metal content of concentrate:	
Lead, per cent	69.1
Zinc, per cent	6.5
Silver, ounces	22.6
Recovery by water concentration:	
Lead, per cent	75.9
Silver, per cent	53.8
Total working cost, per ton.....	\$4.36
Revenue	\$301,322
Dividend	120,000
Carried forward to 1914	42,139
Surplus	208,460

AMALGAMATED COPPER COMPANY

This is simply a holding company, owning the stock of the operating Company, the Anaconda Copper Mining Co. It also holds an interest in several other operating and selling companies. The report covers the calendar year 1913, and may be tabulated as follows:

Net income	\$ 8,871,799
Dividends	9,233,274
Deficit	361,475
Previous surplus	24,000,614
Surplus at end of 1913	23,639,139
Assets:	
Investments	\$182,741,677
Cash and cash assets.....	19,212,885
Total	201,954,562
Liabilities:	
Capital stock	\$153,887,900
5% gold notes	12,500,000
Accounts payable	11,927,523
Profit and loss surplus	23,639,139
Total	201,954,562

CHINO COPPER COMPANY

This Company's mining property in New Mexico amounts to 2645 acres. The area controlled for mill-sites and water rights contains 16,700 acres. During 1913 no drilling was done for the sole purpose of developing additional ore reserves. Nineteen holes, aggregating 10,593 ft., were drilled to make sure that waste was not dumped on ore-bearing areas. These holes proved increases in the extent of certain orebodies. Ore reserves are estimated at approximately 90,000,000 tons averaging 1.8% copper, and are somewhat higher than those for the previous year. There are now 10 steam-shovels, 19 locomotives, and 29.3 miles of track at the mine. Overburden moved was 3,082,174 cu. yd., and ore mined 1,976,572 tons. Waste removed to date totals 8,822,000 cu. yd. The average cost of steam-shovel work was 36.87c. per yard, against 29.14c. in 1912. Mining was hampered by the limited areas in which the shovels could work and avoid interfering with stripping operations. No important additions were made to the mill. All sections, while in commission, worked 93.6% of the possible time, and treated 1,942,700 tons of ore averaging 2.033% copper, with 67.31% recovery. Concentrate produced amounted to 183,116 tons assaying 14.518% copper. The metal production was 53,170,145 lb. Financial results were as follows:

Revenue from copper at 15.0884c. per pound.....	\$7,621,419
Mining, treatment, stripping, selling commission..	4,431,126
Operating profit	\$3,190,293
Miscellaneous income	137,533
Total profit	\$3,327,826
Interest, income tax, etc.	93,793
Net profit	\$3,234,033
Dividends	1,919,070
Depreciation	212,147
Balance to undivided profits.....	\$1,102,816
Previous balance and other profits.....	2,640,351
Balance at December 31, 1913.....	\$3,743,167

GREENE CANANEA COPPER COMPANY AND SUBSIDIARY COMPANIES

This Company owns 954,442 out of 1,000,000 shares in the Greene Consolidated Copper Co., which in turn is largely interested in the Cananea Consolidated Copper Co. Greene Cananea also controls the San Pedro Copper Co. Operations of the Companies are centred at Cananea, Sonora, Mexico, and

the combined reports cover the calendar year 1913. During the term, Greene Cananea received dividends amounting to \$1,050,000 from the Cananea Consolidated, and paid dividends totaling \$950,000.

The general manager of Cananea Consolidated, J. S. Douglas, reports as follows concerning operations last year: The revolution in Sonora affected all work from time to time, necessitating partly closing down the smelter. Ore extracted from the various mines was as follows: Elenita, 4839; Puertecitos, 54,458; Henrietta, 3940; Elisa, 90,826; Pro. of Sierra de Cobre, 72,976; Capote, 164,611; Oversight, 88,857; Veta Grande, 90,257; Kirk 15, 1,526,675; Kirk, 42,234; Cobre Grande, 20,025; and Chivatera, 13,838; also lessees, 1498; a total of 673,034 wet tons. Costs of mining were \$2.89, ranging from 58.5c. to \$13.36 per ton. The Puertecitos mine is opening fairly satisfactorily; lessees have mined a little good ore from the Henrietta; an important 4% orebody has been partly developed in the Elisa; the Eureka does not look well; at 200 ft. in the Sierra de Cobre, adjoining the Eureka, a promising 4% orebody is being opened; the Capote is generally in good condition; prospects in the Oversight are decidedly interesting; in the Veta Grande, the Massey orebody contains 70,000 tons of 4% clayey ore, and between 200 and 300 ft. there is 75,000 tons of 5% silicious ore blocked out; the Kirk shaft is down 900 ft.; while nothing has been done in the Cobre Grande since March 1913. Development totaled 49,505 ft., of which 800 ft. was shaft-sinking. In June, nearly all development was changed to the contract system, resulting in reduced cost.

The concentrating plant treated 343,081 wet tons of ore, of which 42,072 tons was from the Cananea-Duluth. Three Hardinge mills were installed, and, not including them, the cost was 7.16c. per ton. Including custom ore and 46,248 tons of Miami concentrate, the blast-furnaces treated 567,434 dry tons of copper-bearing material at a cost of \$2.54 per ton. Two reverberatory furnaces worked 537 furnace-days, with an average charge of 226 tons per day, at a cost of \$1.67 per ton.

The Great Falls type converters reduced the cost of converting copper by a total of \$9.13 per ton for the year. Arthur C. Cole was in charge of the smelter, and Frank J. Strachan at the concentrator. The total net cost of fine copper sold was 9.547c. per pound. Results may be summarized as follows:

Ore treated from all sources, tons (Company ore, 2.4% copper)	757,460
Copper from Company ore, pounds.....	33,205,160
Copper from custom and Miami ore, pounds.....	42,806,847
Silver in Company bullion, ounces.....	1,069,746
Silver in other bullion, ounces.....	428,192
Gold in Company bullion, ounces.....	5,438
Gold in other bullion, ounces.....	2,582

Greene Consolidated and Cananea Consolidated combined statement:

Revenue	\$7,576,138
Expenditure	5,389,878
Net income	2,186,260
Balance from 1912	3,776,321
Total surplus	5,962,581
Dividends paid	950,000
Balance for 1914	5,012,581

The San Pedro Copper Co. reports that 93,199 tons of ore averaging 2.059% copper, 2,020 oz. silver, and 0.0115 oz. gold per ton was treated, and 42,072 tons was milled, yielding 8647 tons of concentrate. The metal yield was 3,839,030 lb. copper, 188,293 oz. silver, and 1076 oz. gold. The income was \$709,747, and net profit \$158,332. Adding the balance of \$345,889 from 1912, the amount available was \$504,221, of which \$225,000 was paid in dividends, leaving a surplus of \$279,221.

Development in the Cananea-Duluth mine totaled 4885 ft. Mining cost \$2.59 per ton of wet ore. The mine has not been worked since March 8, 1913. All ore is treated at the Cananea Consolidated plant.

Recent Publications

MINERAL INDUSTRY OF TASMANIA. Progress during last quarter of 1913. Compiled by W. H. Wallace, Secretary for Mines. P. 18. Hobart, 1914.

PROCEEDINGS OF THE AMERICAN MINING CONGRESS. Sixteenth annual session at Philadelphia, October 20 to 24, 1913. P. 410. Ill., index. Denver, Colorado, 1914. Contains the discussions given on subjects coming under the influence of this society, which have been noted in this journal at the time of the meeting.

CEMENT MATERIALS AND INDUSTRY IN THE STATE OF WASHINGTON. By Solon Shedd. Bulletin No. 4. P. 268. Ill., maps, index. State Geological Survey, Olympia, 1913. The chapters include the following: General Consideration of the Hydraulic Cements; Raw Materials of the Cement Industry; Composition of Limestones, Clays, and Shales; History of the Cement Industry; Examination of Cement Materials and Location of Plant; Manufacture of Portland Cement; Cement Materials of Eastern Washington; Cement Materials of Western Washington; Possibilities of the Cement Industry of Washington; Table of Analyses of Limestones, Clays, and Shales; and United States Government Specifications for Portland Cement.

Results of spirit levelling, R. B. Marshall, chief geographer: IN ILLINOIS (1911 to 1913, inclusive). Work done in co-operation with the State Geological Survey of Illinois. F. W. De Wolf, director. *Bulletin* 553. P. 110. Ill., index.

IN KENTUCKY (1898 to 1913, inclusive). Work from 1902 to 1913, inclusive, done in co-operation with the Kentucky Geological Survey. *Bulletin* 554. P. 184. Ill., index.

IN WYOMING (1896 to 1912, inclusive). *Bulletin* 558. P. 148. Ill., index.

IN OKLAHOMA (1895 to 1912, inclusive). Part of work done in co-operation with territory of Oklahoma, 1905 to 1907, inclusive, and with state of Oklahoma, 1908, 1911, and 1912. *Bulletin* 564. P. 119. Ill., index.

University of California publications. Berkeley, 1914:

A COMPLETE SET OF POSTULATES FOR THE LOGIC OF CLASSES EXPRESSED IN TERMS OF THE OPERATION 'EXCEPTION,' AND A PROOF OF THE INDEPENDENCE OF A SET OF POSTULATES DUE TO DEL RÉ. By B. A. Bernstein. P. 10.

FAUNA OF THE MARTINEZ EOLENE OF CALIFORNIA. By Roy Ernest Dickerson. P. 94. Map, 18 plates.

SELECTION AND COST OF SMALL PUMPING PLANT. By B. A. Etcheverry. Circular 117. P. 30. Ill. A useful discussion for farmers.

BIRD REMAINS FROM THE PLEISTOCENE OF SAN PEDRO, CALIFORNIA. By Loye Holmes Miller. P. 7.

TERTIARY ECHINOIDS OF THE CARRIZO CREEK REGION IN THE COLORADO DESERT. By William S. W. Kew. P. 12. Ill., 5 plates.

PHYSIOGRAPHICALLY UNFINISHED ENTRANCES TO SAN FRANCISCO BAY. By Ruliff S. Holway. P. 28. 20 plates.

United States Geological Survey publications, Washington, 1914:

Contributions to *Economic Geology*, 1913, part 1-A, 1-B, and 1-C:

THE DARWIN SILVER-LEAD MINING DISTRICT, CALIFORNIA. By Adolph Knopf. *Bulletin* 580-A. P. 18. Map. This was covered in a recent issue of this journal.

NOTES ON THE UNAWEAP COPPER DISTRICT, COLORADO. By B. S. Butler. *Bulletin*. 580-B. P. 5.

RESULTS OF TRIANGULATION AND PRIMARY TRAVERSE, 1911 AND

1912. R. B. Marshall, chief geographer. *Bulletin* 551. P. 206. Map, index.

CONTRIBUTIONS TO ECONOMIC GEOLOGY, 1912. Short papers and preliminary reports. Part I. Metals and non-metals, except fuels. David White, chief geologist. *Bulletin* 540. P. 367. Maps, index. Contributions to this publication are as follows: J. S. Diller, H. G. Ferguson, Adolph Knopf, D. E. Hewett, E. L. Ransome, J. M. Hill, F. C. Calkins, E. J. Jones, Jr., J. B. Umpleby, E. F. Burchard, Eugene Stelinger, L. T. Thwaites, F. C. Schrader, J. F. Hunter, R. W. Peck, C. M. Bauer, G. W. Stose, H. S. Gale, J. H. Hance, R. W. Richards, W. C. Phalen, and H. D. Miser, all of whose papers have received note from time to time in this journal.

GEOLOGY AND GEOGRAPHY OF A PORTION OF LINCOLN COUNTY, WYOMING. By Alfred Reginald Schultz. *Bulletin* 543. P. 141. Ill., maps, index.

MINERAL RESOURCES OF SOUTHWESTERN OREGON. By J. S. Diller. *Bulletin* 546. P. 147. Ill., maps, index.

RECONNAISSANCE OF THE GRANDFIELD DISTRICT, OKLAHOMA. By Malcolm J. Munn. *Bulletin* 547. P. 84. Maps, index.

SOME CERRISITE DEPOSITS IN CUSTER COUNTY, COLORADO. By J. Fred Hunter. *Bulletin* 580-C. P. 13. Maps.

Decisions Relating to Mining

MINING CONTRACT—RESCISSON DENIED

Under a mining contract, the defendant was required to discharge certain liens on the property in question and if it thereafter elected to continue operations, to pay to plaintiff royalties up to a sum which added to the amount of outstanding liens would aggregate \$200,000. After discharging the liens the defendant refused to continue operations claiming that the ore could not be profitably mined, but also refused to surrender possession. Plaintiff brought an action to recover possession in which defendant interposed a cross-complaint seeking a rescission of the contract and repayment of moneys expended. The only grounds claimed for rescission were that the plaintiff lacked title to 1/48 of the property. Held, that defendants could not maintain their position as they had not acted promptly upon discovery of the flaw in the title. Plaintiff's title quieted.

Gordon-Tiger Mining & Reduction Co. v. Brown (Colorado)
138 Pacific, 51. February 2, 1914.

ALASKA PLACER ACT OF 1912 CONSTRUED

A prospector, armed with a power of attorney from his partner, left for the Chisana goldfields in Alaska about September 1, 1912, having been grubstaked by his partner at Dawson. There was no general knowledge in Alaska at that time of the passage of the Act of August 24, 1912, requiring that powers of attorney to locate placers be recorded. The prospector located several placer claims for his partner, but on account of the severe winter and inaccessibility of the Chisana district was unable to get back to the coast and record the power of attorney and location notices until the following August. In the meantime a locator made a location on the same ground subsequent in date to the first prospector and brought suit in ejectment against the prior locator on the grounds that he had failed to record his power of attorney before locating. Held, that the order in which the acts of location are performed is immaterial, that recording the power of attorney is one of the acts of location in Alaska, that having acted in good faith and with due diligence considering climatic and geographical conditions, the first locator should be protected in his location, even though his power of attorney was not recorded until after the location was made.

Likaits v. Tohnson, District Court of Alaska, (not yet reported). March 18, 1914.

Industrial Progress

A Ball Tread Tractor

Yuba ball tread tractors are manufactured by The Yuba Construction Co. in its plant at Marysville, California. For the past ten years this Company has been building gold dredges, suction dredges, and irrigating pumps. The same engineering skill and mechanical accuracy that is reducing delays to a minimum in gold dredges is exercised in building the ball tread tractors. Tractors can well be used in the lumbering industry to perform more work than almost any other mechanical contrivance. Their great power and broadtractive area make them particularly suitable for hilly country. This type of machine can be used not only to haul supplies and machinery into the camp, but in the actual work of lumbering as well. Wherever 12 and 18 horses are used in freight-

so that the wear on the bearings is taken up from below.

On each of the drive shafts is a marine type reversible clutch. Each clutch is controlled by a separate lever from the driver's seat. In this feature lies the secret of the tractor's short-turning ability. The treads are totally independent of each other. One may be going ahead while the other is reversed without putting any undue strain on any part of the transmission. The endless-belt tread was adopted and improved by eliminating the loss of power suffered by the sagging of the upper portion when under load. The ball tread is mounted on a rigid cast steel frame, so designed that it is kept taut at all times. Instead of running the machine over the track on a modified railway truck, the ball-bearing principle has been enlarged and adapted to the tractor. All the weight borne by the treads of the ball tread tractor is carried by large balls, which distribute it evenly over the entire ground-bearing area of each tread. By this means a pressure per square inch on the treads was gained low enough to enable the machine to run over the soft ground without packing it. The balls are made of chilled cast iron, which gives wearing qualities closely equaling



BALL TREAD TRACTOR HAULING 8 TONS OF DREDGE BUCKETS UP A 16 PER CENT GRADE.

ing work the tractor can be used. In one of these machines the power of 12 and 18 horses is compressed until it occupies only as much road space as two horses. This becomes a decided advantage when it is necessary to make short turns on mountain grades. The tractors will operate in soft ground or sand where horses would have extreme difficulty, and streams shallow enough to prevent water reaching the carburetor air intakes can be forded without damaging the mechanism in any way. Their use in connection with mining operations has demonstrated tractors to be invaluable in many instances. The accompanying illustration shows a Yuba tractor in use for freighting buckets to a dredge over a 16% grade. In the manufacture of tractor machines an endeavor is being made to gain greatest strength with least bulk and weight. An ample margin of safety must be put into every portion of the machine. Each part must be made strong enough to withstand much greater strains than it will be called upon to bear in the course of ordinary work.

Model 12 Yuba tractors are equipped with 40-hp. L-head type motors. In the model 18 machines, a 55 to 60-hp. T-head type motor is used. Both motors are built for heavy duty. In order to gain lightness of weight, flexibility, and at the same time produce high power, a long stroke with proportionately small bore is used. In adapting these motors to Yuba ball tread tractors, they have been adjusted to operate normally at about 70% of their maximum speed, to insure longer life to the parts. This method allows a better margin to carry a heavy load through bad spots on the road without stalling the engine. Crank-shafts are supported in such manner as to reduce wear. This is accomplished by the use of unusually long bearings and by designing the crank-case

those of the highest-grade turned steel balls at a small part of the cost. When it becomes necessary to replace either or both, it can be done in the field by the operator. The manganese steel track links of a Yuba tractor will not easily pack with earth or mud. This advantage was gained by making the links with the grouser in the centre. The only place earth can pack is between two links. When the track is picked up from the ground the links turn through a sufficient angle so that any earth packed there breaks and drops off, leaving the tread clean. If earth or sand occasionally gets through the overlapping shoes into the ball bearings of the track, it is claimed no harm will result, as the size of the balls is such that any particles are immediately crushed and thrown out again.

AS CONSIDERABLE publicity was given last fall to a suit brought by George E. Blakeslee against the International Motor Co. *et al.*, the Company has issued a statement from its office to the effect that on May 14, 1914, Mr. Justice Manning handed down a decision which appears effectively to end the litigation. In dismissing the complaint against the International Motor Co., the judge did so because no facts were shown sufficient to constitute a cause of action against the Company.

MECHANICAL oil-burning systems are attracting increased attention of late, due to the ever-increasing use of this type of fuel. The Coen Co., of San Francisco, has recently prepared a series of evaporative tests on steam boilers fired with mechanical oil-burning equipment which present interesting data on this subject.

"Science has no enemy save the ignorant."

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EDITORIAL

CABLE advises report that the borax holdings of Mr. F. M. Smith have recently been transferred to an English syndicate headed by the former minority holders of the shares. This marks the passing of one of the mining industry's unique characters and gives to the syndicate the present control of the world's output of borax. The sale price of the borax properties is reported at \$4,000,000 together with the taking up of \$4,000,000 bonded indebtedness of the company. We discussed the difficulties of the situation in detail May 23, and the outcome of the venture will be watched with much interest. Mr. F. M. Smith, like other of the industry's successful men who have sought new fields for investment, found his judgment poor and foresight blunted, with the result that the fortune amassed in mining has been largely lost in other investments and speculations.

ANOTHER district court has held that there was no sufficient authority in law for the so-called presidential land withdrawals. Mr. Justice M. T. Dooling at San Francisco having followed his Wyoming associate in so ruling. No circuit court has passed upon the matter, which, instead, has been certified to the United States Supreme Court. That body will in time deliver an opinion which will be final. In the meantime it is idle to speculate as to the outcome. There are good lawyers who hold that the authority of the President, acting through the Secretary of Interior as custodian of the public lands, is ample to the purpose. However this may be decided, the practical effect hoped for from the initial withdrawals has been accomplished: that is, monopolization of the public lands by speculators has been checked, and there is now clear and undisputed authority in the hands of the President to withhold lands from entry as it may appear to him necessary or wise.

CHILE, as was true of ancient Athens, draws revenue from mines instead of assessing taxes against its citizens. As Mr. and Mrs. Hoover have reminded us, it was the ores from Larium that paid for the fleet which preserved the independence of Greece. Chile, too, has built a fleet, but fortunately not all the public revenue is needed for that purpose and much of the money derived from nitrate royalties is going into railroads and other profit earning enterprises. Thus

the temporary wealth afforded by the mines is being reinvested in such shape that drying up of the present source of 80 per cent of the public revenue will not result in disaster to the country, as happened when Peruvian guano beds were exhausted. An industry which is so vitally connected with the life of a nation, to say nothing of its world relationships, is well worth study, and we are glad to present this week the first part of an exhaustive review, written by Mr. Lester Strauss, long familiar with the industry and a recent re-visitor to the nitrate regions. In preparing these articles, Mr. Strauss has had the friendly assistance of Mr. S. H. Loram, who wrote for us admirably on the same subject in 1910, and various other engineers and managers in the field. His articles will be found not only timely but most accurate.

DECLINE in the amount of work of the mineral division of the United States surveyor general's office of the state of Utah will probably result in the suspension of this office, according to a recent report from Salt Lake City. The decrease in the number of patented mineral claims is attributed to the fact that of recent years mining men have almost abandoned the idea of securing patents for mineral lands in the state on account of the many technical and adverse rulings of the department. This, coupled with recent stringency of the money market which has curtailed investment in mineral lands, has resulted in the local force being cut from nine men to one.

IN the thoughtful and suggestive address delivered at the Columbia semi-centennial by Mr. Hennen Jennings, two facts, in particular, are brought out that are not often appreciated by the man in the street, and perhaps seldom more than dimly apprehended by the men in the thick of mining work. These are the extreme modernness of big mining, and the fact that almost the whole of our present full flowered material civilization is due to the extra hands set to work by the miner. It is true that mining itself is very old. How old no one rightly knows, though in a fascinating article in *The Mining Magazine* for May, Mr. Courtenay De Kalb shows that in biblical times it was a well established industry. It was not, however, until the last few decades that mining became a big industry. It was only during the war of 1812 that development began in the Pennsylvania coalfields, and it was many years later that the great coal and iron industries of the East made their rapid growth. The ancient world depended upon the capricious winds, on beasts of burden, and on slaves to do its work. The modern world depends upon fuel and metals. Slavery was abolished in the United States years ago, but in the fuel annually mined and set to work, each man, woman, and child in the United States enjoys the equivalent of 27 slaves working continuously without food or sleep. Is it any wonder that we moderns have more things than our forefathers?

The Canal

May marked the beginning of a new era in the maritime commerce of the world, as it saw the passage of the first self-propelled boat through the Panama canal. While the formal opening has not as yet taken place, the tug *Mariner*, towing barges No. 11 and 15, left Cristobal at 6 a.m. on May 19 and arrived at Balboa at 6:40 p.m., thus making the first direct voyage from ocean to ocean by way of the canal. The magnitude of this great engineering work is imperfectly appreciated, we believe, by a great part of the American people, who look upon canal construction as a simple operation and think of the Panama canal as a ditch such as those inland waterways constructed by our forefathers of fifty years ago, most of which, by the way, are now idle or abandoned because of inability to compete with railways. The decade since the transfer of the canal property on the Isthmus from the second French company to the United States, May 4, 1904, has been one of intense activity in the canal zone, and great credit is due to those who have contended successfully with nature's barriers and made the new waterway.

The Panama canal is generally looked upon as a modern development and few realize that an inter-oceanic canal was the subject of serious consideration as much as four centuries ago when Angel Saavedra made the proposal to build a canal across the Isthmus of Darien. Again in 1550 Antonio Galvao made an investigation of possible inter-oceanic canal routes and suggested four different lines, among which was the Panama route which four and a half centuries later was to be actually utilized. The Isthmus of Tehuantepec was looked upon with favor in the early part of the past century and a canal survey was made in 1821 by General Obegoso. Twenty years later, in 1842, a concession was granted to Jose de Garmy for the construction of this canal.

The first detailed study of the Panama route was made under the auspices of Simon Bolivar when president of Colombia. He caused Messrs. Lloyd and Falmare to study the subject and a report was published in the *Philosophical Transactions*, London, in 1830. This early plan included a railway from Panama to the Rio Trinidad, a tributary of the Chagres river, and harbor improvements on the bay of Limon; however, nothing tangible was accomplished. The French government next investigated the subject and in 1843 a French engineer, M. Napoleon Garella, was sent to the Isthmus. He advocated a sluiced canal, but the size of the project was beyond the facilities for canal construction of that time and the French government decided against it. The discovery of gold in California in 1849 gave new impetus to the project and an American company took the matter under consideration. With Messrs. Totten and Trautwine, who had been prominent in connection with the Cartagena-Magdalena canal, in charge, it was decided to build an isthmian railway which, after innumerable difficulties, was completed in 1855.

The first reconnaissance of the present waterway

was the result of a discussion of the subject before the *Congrès des Sciences Géographiques* at Paris in 1875 and a society under General Turr was formed for making the necessary explorations. In 1876 Lieutenant L. N. B. Wyse went to the Isthmus at the head of an expedition for this purpose. In 1878 the Colombian government granted the Civil International Inter-oceanic Canal Society the exclusive privilege of constructing a canal through Colombian territory and at this time the ports and canal were neutralized. In 1879 M. Ferdinand de Lesseps became interested in the project and the first meeting of his company was called in 1881. This may be looked upon as marking the actual beginning of the present canal. The cost was estimated at 600,000,000 francs. The Panama canal was purchased for \$20,000,000 and the canal contractors Couvreur and Hersent began operations in October of the same year. The work of the de Lesseps company was conducted at the cost of millions of francs and thousands of lives. It involved such immense expenditures that it was finally abandoned and the thousands of contributors to the scheme faced a loss. The storm of indignation forced the French Chamber of Deputies to vote for a committee of inquiry and the prosecution of the canal directors. The inquiry began on December 24, 1892, and the loans of 1884 and 1888 were fully investigated. Names prominent in this investigation were Ferdinand de Lesseps and his son Charles, Marius Fontaine, Baron Cottu, and M. Eiffel, builder of the tower bearing his name. After a trial on the charge of giving and receiving bribes, the de Lesseps, Eiffel, Fontaine, and Cottu were sentenced to five years imprisonment, but were released later.

The first American canal commission was appointed by President McKinley in 1899 with Rear Admiral John Grimes Walker as chairman. After an examination of the proposed Nicaragua and Panama routes the commission reported in favor of Nicaragua. After considerable debate in Congress, in March 1902 the House passed a bill in favor of the Nicaragua route, which bill was rejected by the Senate. Soon thereafter a protocol known as the Hay-Herran treaty was signed by the United States and Colombia. The former agreed to pay \$40,000,000 and the latter to grant certain concessions for the right-of-way across the Isthmus for a Panama canal. This was ratified by the Senate of the United States, but rejected by the Senate of Colombia, which demanded more money. This action caused general dissatisfaction in Panama and led to the secession of that state. The United States aided Panama in the establishment of an independent republic and after it had been recognized a treaty was made for the building of the canal, the sum of \$10,000,000 being paid to Panama. The transfer of the holdings of the New Panama Canal Company to the United States from the French was effected on May 4, 1904, the consideration being \$40,000,000.

The second Isthmian Canal Commission assumed charge in March 1904. In 1905 a board of consulting

engineers was created. It consisted of eight American and five European members. This board visited the Isthmus and in January 1906 reported in favor of a sea-level canal, the vote being 8 to 5 in its favor. The minority at the same time presented a report favoring a lock canal. After the receipt of the report by the Isthmian Canal Commission this body recommended the adoption of the minority plan of a lock canal, which plan received the support of the Secretary of War and the President. The latter submitted this plan to Congress and it was adopted.

The work was carried on under civil engineers appointed by the President until February 26, 1907, when Colonel George W. Goethals of the engineering corps of the army was placed in full charge and under his able supervision the canal has been pushed to completion. Much of the credit must, however, be given to Messrs. Wallace, Shonts, and Stevens and the engineers of the old commission, who organized the work and furnished the basis upon which the army engineers built.

The magnitude of the work which has been done will be better understood when it is recalled that the work of the French companies totaled 78,146,900 cubic yards of excavation, of which amount only 29,908,000 was of service to the United States. The total excavation by the United States totals approximately 183,000,000 cubic yards, the concrete work amounted to 4,568,000, and the fill totaled 21,800,000 cubic yards. During the course of active construction work, about 100 steam-shovels and 18 dredges with a total of 45,000 employees were at work. When everything is completed it is estimated the cost will amount to \$325,201,000 which includes \$20,053,000 for sanitation, but does not the \$40,000,000 paid to the French company nor the \$10,000,000 paid to the Republic of Panama.

What the completion of the canal means to the commerce of the world is attested to by the shortening of distances between New York and the Pacific ports north of Panama by a distance of 8415 miles and south of Panama by a distance varying from 8415 miles at Panama to 1000 miles at Punta Arenas, on the Straits of Magellan. From Iquique, the nitrate port of Chile, the distance will be shortened by 5200 miles. The voyage from Liverpool to the Pacific ports will be shortened by 6000 miles and from New York to the ports in the Orient will also be reduced, the voyage to Yokohama by Panama being 3721 miles shorter than by Suez; to Shanghai the distance is reduced 1629 miles, to Sydney 3806 miles and to Melbourne 2656 miles. New Orleans will be 581 miles nearer the Orient than New York.

Engineers are interested in the canal, not only because of the changes in transportation routes that will ensue but because of the many problems involved in the actual work of construction. In one sense it was a great job of mining since the Culebra Cut is not unlike one of the great iron mines of the Lake Superior region and much of the work on the Pacific end was

done with machinery and by methods developed by the hydraulic miners of the Pacific slope. Incidentally many of the steam-shovels used and much of the equipment has been re-sold to the Chile Copper Company and will be used in the open pit work at that great mine where a larger amount of material is to be handled than was excavated in making the canal. In fact the canal, while a large order, is not unique as a piece of excavation and the political and financial problems involved were really larger than those in engineering.

The engineers have done their work. They have made the canal. It will rest with the statesmen and the captains of industry to say what the canal shall mean to the world.

Development of Leaching Practice

The recovery of copper from its ores by wet processes is gradually developing out of the chrysalis stage of experimental work into the mature form of routine practice. Large plants are under construction for the Anaconda, Utah, and Chile Copper companies, and at several other places experimental work is well advanced. The use of sulphuric acid as a solvent is general in the present state of the art. The proposed practice at the Chile Copper mine was fully discussed in our issue of May 2 by Mr. E. A. C. Smith, who has had direct oversight of the experimental work. The Utah Copper Company is about to build the first 2000-ton unit of a 10,000-ton leaching plant to treat the oxidized ore which overlies the sulphide orebody. At both the plants the ore will be coarsely crushed, in order to keep the production of slime at a minimum, and then leached with sulphuric acid. In Chile, the resulting copper sulphate will be electrolyzed; in Utah the intention is to precipitate the copper on iron for the present at least. At the Chile property electric energy can easily be generated by a power-plant on the seacoast, while iron would require to be brought from a considerable distance. In Utah, scrap iron is available, and since its use does not require the solution of any technical problems, the management of the Utah Copper has wisely decided to postpone experiments with electrolytic precipitation until the other details of practice have been completely worked out in the first unit of the plant.

Both the Chile and Utah companies have unusually favorable conditions in that the copper is present in such a form that it can readily be dissolved from coarsely crushed ore and without requiring a preliminary roast. Another somewhat paradoxical advantage is that the ore at both mines does not contain gold or silver in sufficient amounts to make their recovery worth while. Gold and silver can only be extracted along with the copper at the cost of complicating the process, and for an ore of a given value per ton, it is much better to have all metallic content copper, rather than in part precious metals. The work which has been done by the Anaconda Copper Mining Company during the past year in its 80-ton experimental

leaching plant is the more instructive, therefore, since it is necessary both to roast the ore before treatment with acid and to take steps to recover the silver present. The plant and proposed method were fully described in a paper presented by Messrs. Frederick Laist at the Butte meeting of the American Institute of Mining Engineers last summer, and the details of the results attained in the year's work will be presented by Messrs. Laist and Harold W. Aldrich at the meeting in Salt Lake City next August. So much interest attaches to the valuable pioneer work being done at Anaconda by these gentlemen, under the direction of Mr. E. P. Mathewson, that a brief summary of the work which has been done at Anaconda will be of service.

The material which is being subjected to the leaching process is the sand tailing from the concentrating plant. This contains 13 to 14 pounds of copper per ton and 3 per cent sulphur. Of this material about one-half is reclaimed on a 40-mesh screen and only 5 per cent will pass 200-mesh. This is roasted in a 6-hearth, 20-foot McDougall roaster, which handles 80 to 90 tons per day, reducing the sulphur present to 0.6 per cent, about four-tenths of the copper present being soluble in water. It was at first proposed to add salt upon the lower hearths of the roaster in order to chloridize the silver, of which a little more than one-half ounce per ton of material treated is present. Experiment demonstrated, however, that this led to the volatilizing of a good deal of the copper as chloride, and that by simply roasting in the ordinary way a better recovery was made of the copper, while the silver could be recovered by the use of a strong salt solution produced by spreading a layer of salt over the leached calcine just before the addition of the wash water. In this way over 70 per cent of the silver can be recovered at a less working cost, corresponding to a greater operating profit as compared with attempting to secure a higher recovery. It is expected that regular operation will yield a copper recovery of 85 per cent and a silver recovery of 75 per cent, corresponding to 12 pounds of copper and four-tenths of an ounce of silver per ton treated. The copper will be precipitated upon scrap iron, which also brings down the silver.

It must not be forgotten that at the three plants mentioned no attempt is made to treat slime. At Utah and Chile, crushing will be so managed as to guard against the production of slime, while at Anaconda the slime tailing is treated, as in present practice, by briquetting and adding to the blast-furnace charge. Attempts to mix in even a small proportion of slime with the sand tailing lead to great difficulty in leaching. At the Butte-Duluth, only sand is as yet being treated by the process there employed. It is evident that in copper hydrometallurgy, as in cyanide practice, the extraction of metal from slime will require careful and long experiment to develop the technique, as well as the apparatus necessary for its successful performance.

Mining as a Profession, Including First Stages of Metallurgy

By HENNES JENNINGS

*To consider man without the earliest primitive contributions of the miner and metallurgist takes us back to savagery. Man's greatest endowment is his wonderful and crafty brain cells with their latent powers of development, which have shown him the necessity of supplementing his own strength by outside aids, and then gradually and persistently obtaining the materials for his needs and fashioning them into tools of power, and finally incorporating and making them a veritable part of his being.

His first great advances were the commanding of fire, the use of stone implements, then wooden bow and arrow. By these he worked himself into the stone age, but was still brutal, weak, and with little historical recording power. It was not until he delved below the surface of the earth for materials that he was able to fashion the sword, spear, fire arms, protective armor, plow, hoe, pruning-hook, pitchfork, scythe, tires, axe, saw, plane, etc. It was only with metal tools that great agricultural development began and it only reached its present magnitude when further supported by the metals in the form of railroads, steam vessels, harvesting machinery, etc.

Basic Industries

Mining and agriculture are the only basic productive pursuits of man, and they are both fostered each by the other, and both dependent on mother earth. The one skims her surface, the other goes deeper. Agriculture furnishes man with food for existence, but mining gives him the materials for power, art, and civilization. Without metals the scientists' tools for experimentation and determination would not be possible, nor the great diffusion of knowledge and thought by means of the printing press, photographic appliances, telegraph, cable, and the telephone.

Nothing can more forcibly illustrate the might of man as given him by the metals than the modern battleship. What could all the war vessels of history, up to 20 years ago, do against one modern battleship adequately supplied with ammunition, if they were drawn up in open battle array? Could not this one ship, by its superior speed, gun-power, and armor, annihilate at will the whole fleets of history, even if commanded by Vikings, Nelsons, and Farraguts? Is not the control of sea power the cardinal factor in war, and thus has not modern man become a war god indeed by means of his engineering genius?

In contrast to the bewildering might of the battleship's guns, with their 1400 lb. weight, and 2600 ft. per second velocity arguments, the metals have given

man fingers so delicate, untiring, and accurate that they can work and control threads so fine that fleecy muslins and laces grow in abundance under their touch.

Statistics

Let us now deal with mining on a solid and broad statistical basis, attempting afterward to clothe the dry bones of statistics with further meaning.

In this brief sketch it is not possible to incorporate the statistics and results achieved in mining in all countries. What is selected, it is hoped will be considered typical for all countries, and instructive to all interested in mining in a big way.

Great Britain produced more coal than all countries of the world put together until 1871, and more iron until 1885. The British Empire now produces 60% of the world's gold. It was only in 1899 that the United States surpassed Great Britain in coal output, and in 1897 took the decided lead in iron.

Germany's production of iron exceeded that of Great Britain in 1905, and it now mines about the same amount of coal. To Germany must be accorded priority in mining literature and technical training, as evidenced by the publication of 'Agricola De Re Metallica'* in 1556. The Freiberg and Berlin technical schools were founded in the 18th century. The first English-speaking school of mines was that of the Royal School of Mines, London, founded in 1853. Although having but a small output of graduates per year, it has been distinguished for the scientific eminence of its professors and the loyalty and ability of its graduates.

World's Mineral Production

The world's mineral production for 1912 shows that the United States produced 20% of the gold, 39% of the coal, 63% of the petroleum, 41% of the iron, 55% of the copper, and over 30% of the lead and zinc, which gives it an undisputed lead of any one country. The statistics of the United States are thus most representative, and, as the most available to the speaker, they will be extensively used. Difficulty of obtaining reliable, comprehensive mining statistics increases immensely as one goes back into the past, but, on the other hand, there is less and less to record. It will be typical and instructive to examine the last official tabular statement of mineral products of the United States, as given by the Geological Survey for calendar years 1903-1912.

In the 32-year summary of the products, it is found that the production of the metals has increased from

*Published in advance by courtesy of the *School of Mines Quarterly*.

*Translated from the Latin into English by Herbert Clark Hoover and Lou Hoover, 1912.

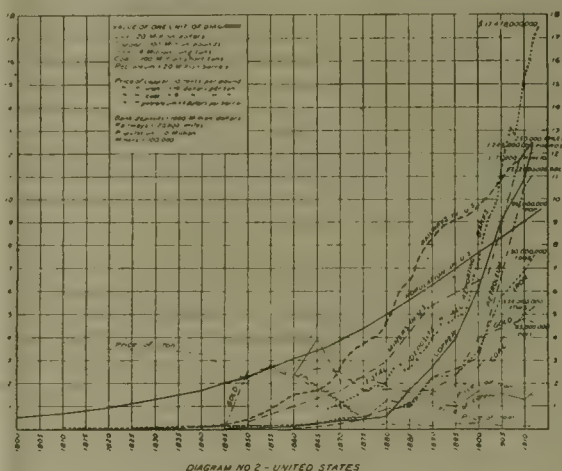
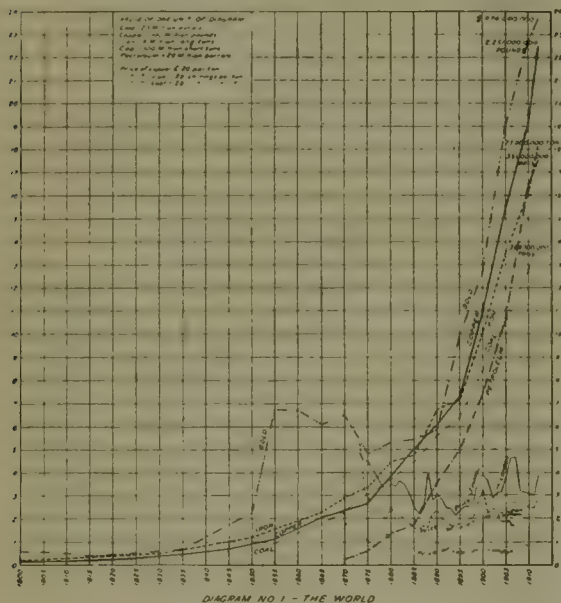
\$186,000,000 to \$867,000,000, or 475%; the non-metals from \$175,000,000 to \$1,376,000,000, or 775 per cent.

Analysing the 10-year statement, it is found that there are 71 mineral products tabulated, all showing material yearly increases in production. Note especially the great and striking increase in the production of aluminum, mirroring, as it does, the successful metallurgical obtainment of a highly useful metal from abundantly distributed clay compounds. The increase in cement records the great growth of modern concrete construction. The output of sulphur in various forms indicates the sulphuric acid consumption, and thus gauges the growth of the chemical and industrial arts. The phosphate rock showing points to the ever increas-

mineral products for the United States. The prices per unit for the products are estimated at pit's mouth and are extended farther into the past. It further shows the growth of the whole population of the country since 1800; the number of men engaged in mining since 1850; the increase in railway mileage since 1840; also the growth of deposits in all reporting banks in the United States since 1867.

From the world's diagram it can be calculated for period under review, that the last 15 years' production of coal has been equivalent to the 97 previous years. That the last 8 years' production of petroleum has been greater than all previous years in history. That the last 12 years' production of iron was equivalent to the 100 previous years. That the last 11 years' production of copper was equivalent to the 101 previous years. That the last 17 years' production of gold was equivalent to the 95 previous years.

In the same way the last years' production for the



ing helping hand mining is extending to agriculture.

Out of the total valuation of \$2,224,000,000 for all the products from the United States, coal, petroleum, iron, copper, and gold were estimated at \$1,579,000,000, or 70%. These metals are so representative and vital that a just and comprehensive idea of the growth of mining, metallurgy, and engineering can be obtained by following their production. This, in a broad way, can be best done by sketch diagrams, large units of products being plotted to small scale.

*Diagram No. 1 shows the yearly production for the world, all countries included, of coal, petroleum, iron, copper, and gold from 1800 to 1912, and also gives the average London price for the units of these products back to 1873.

*Diagram No. 2 gives a similar showing of the same

*Mr. E. W. Parker, of the United States Geological Survey, extended effective and kind aid in the obtainment of the data for the mineral production. The data for the bank deposit curve was taken from the National Monetary Commission Report. The growth of population, miners, and railways are as given by United States census returns. The discovery of gold

United States will be found to balance all the previous years. For coal, the last 11 years; petroleum, the last 8 years; iron, the last 11 years; copper, the last 9 years; and gold, the last 22 years.

Magnitude of Mining

The wonderful modernness of big mining can also be further realized by attempting to obtain any statistics of production previous to 1800, such attempts leading one to the belief that all the coal, iron, and copper mined in all ages, for the whole world, prior to this date would not amount to the probable world's production for the years 1913 and 1914. Petroleum practically came into use only in 1860. It is estimated that the total production of gold from 1493 to 1800 was \$2,371,000,000 whereas from 1800 to 1912 it amounted to \$12,411,000,000.

It is seen that the selling prices of the mineral products at the London market and locality of output in California and Australia caused the great jump of the gold curve 1850-1865.

the United States were higher in the early years than the later ones. Thus the present great increase in cost of living is not to be found in the unit advances of the products of the mineral kingdom. It is interesting to know that the cost per ton for coal at pit's mouth in the United States is less than the cost per ton at pit's mouth in Great Britain.

Fuels—Coal and Petroleum

Fuels are most necessary for the metallurgy of the metals and are storehouses of energy. In 1912 the United States coal production was 534,000,000 tons, and petroleum 222,000,000 barrels. They both have great industrial value besides that of fuel, but our time will not permit of this consideration, or include natural gas in our estimates. To obtain some idea of the meaning of the force locked up in these enormous amounts of fuel, it is only necessary to calculate the work that would be given out if they were all (and which was largely the case) used for the production of steam-power, with at best not more than 15% of the latent power utilized.

Petroleum in the form of gasoline can be more efficiently used for power in the automobile and other forms of the gasoline engine, but reducing the 222,000,000 barrels to the coal equivalent of 51,000,000 tons, we would have the steam force of 585,000,000 tons of coal. Dividing this among 100,000,000 inhabitants would give 5.85 tons per capita. The equivalent of 5.85 tons in horse-power can be taken at 5850 horse-power hours, or as much energy as would be given out at pumping by a man in 9850 days, or 27 years. This coal could thus give out force by the steam-engine equal to a population of 2,700,000,000* strong men.

The life of coal and petroleum deposits has been variously estimated. Should the increment of increase in yearly production continue, the known fields of petroleum would probably be exhausted within a comparatively few years, and coal in one or two centuries, but should the present population and per capita consumption not greatly increase, the coalfields might last one or two thousand years, and the petroleum possibly a hundred.

Should fuel outputs continue progressively to increase, greater and greater numbers of the population must be employed in their mining; also a greater and greater percentage of people would be required to generate, control, distribute, and pay for the power manufactured. There must be, therefore, a point where the population becomes saturated with power and can use or pay for no more per capita. The less the workers, the less the number of hours they work, the less their efficiency, the sooner will this saturation be reached. This may still be a long way off, and may be greatly influenced by future invention, but approach is steadily being made toward it. It will be the determining factor for final outputs.

*Kent estimates man's work pumping 10 hr. per day=1,188,000 ft. lb. 2 lb. coal taken for hp. hour=1,980,000 ft. lb.

Useful Metals—Iron and Copper

Under iron is included steel. The steel is often directly made from iron ores and estimated as pig iron. This group includes tin, lead, zinc, quicksilver, aluminum, platinum, etc., but it is not feasible to deal with them all, and iron and copper in themselves are the mainstays and the most useful of the metals.

Metals in useful form can not be readily obtained from their ores without fuel. On the other hand, the fuels can not be chained to great service without the use of the metals—for example, in the form of steam-power. The metals can be made use of independently of the fuels in manufacturing power from falling water, rising tides, vigorous breezes, and possibly burning sun. They are essential, as has been explained, for all manner of necessary tools and implements. Of late copper, through dynamos and motors, has revolutionized the production and flexible use of power.

In considering the importance of the yearly production of those metals, it must be taken into consideration that they are not destroyed when once used, as is the case in the fuel group. They are put into machinery and tools that may last for many years, and are again given new life by fire and fashioned into other tools and machinery whenever the economic conditions justify such regeneration.

On the other hand, the metals, including the precious, are far less abundantly distributed than the fuels, and their more speedy exhaustion is a matter far more imminent and serious. The utmost parts of the world have been searched for gold, silver, copper, platinum, tin, and nickel. Naturally the deposits of these metals that are in most striking evidence and abundance have already been found. In the future there will be less cream to skim, and a more thorough and costly exploration and prospecting resorted to. The exhaustion, even under the present basis of output, of the metals is not so very far afield, and their discovery, conservation, and right working becomes more and more a matter of importance and difficulty, and should be given serious and broad public consideration.

Precious Metals—Gold

Under this group silver is usually included, but gold alone will be discussed. Gold has a limited use in the arts, also as an ornament, but its chief value is its concentrated and convenient standard of barter. Whether this started on a basis of caprice or custom, it is now firmly established on a labor basis of value. Gold coins can be considered storage cells of human energy that give out a strong and genial current of trade confidence, circulating and binding trade, and bringing together industries of different peoples, in different lands, with different customs. The vitality and value of these cells is the labor elements poured into them—in other words, the human difficulty of their obtaining.

The history of gold mining is almost uncanny in that it has for ages shown success and failure so hand in

hand that it has taken a full labor equivalent to obtain the gold unit.

In the greatest of all gold mines in history, those of the Transvaal, there are employed nearly 200,000 black and 26,000 white men to get out a yearly return of \$180,000,000, and this does not include the labor expended on the supplies and machinery shipped to the mines. It has been found that nearly three-fourths of the output, even of the successfully producing mines, has been required to meet the current working expenses.

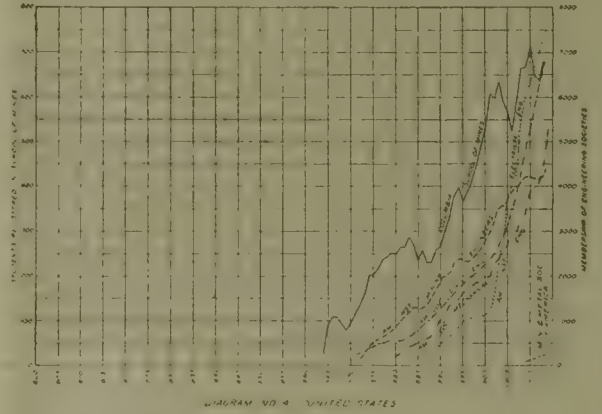
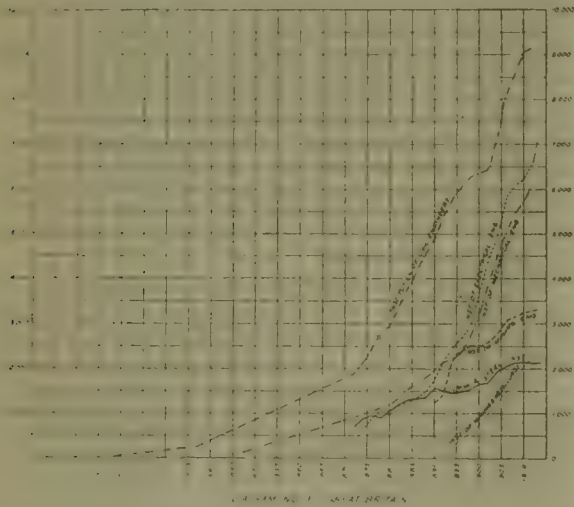
The curves on the diagrams show that the other mineral productions have increased correspondingly with gold. Gold may be cheapened by future phenomenal discovery but until then it rests on a firm foundation and supports vast structures of credit, which have

five of the technical societies of the United States, which, in 1912, totalled about 24,000.

The diagrams show the sudden and sympathetic growth of membership of the societies compared to production of the minerals and is especially noticeable for the mechanical and electrical engineers when compared with the production of iron and copper.

The diversity of the mining and metallurgical societies can be accounted for by the different duties and responsibilities of the coal, iron, and metalliferous mining engineers, the latter being often called upon to do their work in distant lands far from professional aid or corporate guidance. The splitting up of these societies in Great Britain makes the membership and production curves of the minerals less in parallel than is actually the case.

Upon diagram No. 4 the enrollment curve of students in all branches of engineering at Columbia is given and again shows marked accord with the growth of



grown in magnitude even more rapidly than the gold output, as is seen by the bank deposit curve on diagram No. 2. The deposits in 1867 were less than \$1,000,000,000, and are now over \$17,000,000,000.

It may seem a waste of human energy to pay so much in labor for the circulation of financial confidence, but confidence is necessary and vital, and easily disturbed. When nations can have sufficient confidence to do away with their costly war equipments of metal, they will probably also be able to do away with the gold metal standard. There does not, however, seem to be any immediate hope of their doing either, and the limitation of gold mining may be found rather in its increasing scarcity and difficulty of obtainment, as the present goldfields seem to have about attained their zenith.

Engineering Societies and Schools

"Diagram No. 3 shows the birth and growth in membership of the six main technical engineering societies of Great Britain, which, in 1912, totalled about 30,000.

"Diagram No. 4 shows the growth in membership of

*The curves of growth of Great Britain societies have been prepared by Mr. Edgar P. Rathbone. Those for the United States are as given by the American Society of Mechanical

mineral production. The Columbia School of Mines, the oldest and most renowned in the United States, is also a part of one of the largest and most important schools of applied science; although it is only one of the many in the United States. The Bureau of Education (Department of the Interior) in 1911 gave in round figures the total enrollment for the technical students in all schools, colleges, and universities of the United States, as follows:

Civil engineers	9,000
Electrical engineers	6,100
Mechanical engineers	7,000
Mining engineers	2,300

or a total of 24,000. Note how this is in tune with the membership of the engineering societies of the United States.

The number of technically trained men required by the mining industry has been most ably and interestingly dealt with by Professor Christy of the University of California in 1893, and President McNair of the Michigan University in 1905. They both show that al-

Engineers, January 1914. The Columbia School of Mines curve has been prepared by Dean Goetze.

though the number required was not then large in the aggregate, it was in ratio to the production and number of men engaged in mining.

Upon diagram No. 2, it will be noted that the growth of railway mileage is rather in parallelism with the growth of mineral products than that of the population of the United States. The relation of railroad transportation to mining is most marked and important, and was the subject of an able address given by Dr. Douglas to the graduating class of your School of Applied Science in 1906. He then showed that the production of iron and the building of railroads had kept step in the United States since 1840. He also showed by tabular statements that from 45 to 58% of the traffic movement of the United States was in connection with products of mines. Later statistics only confirm this statement, and would indicate an even higher proportion.

Discussion

The object of the diagrams has been to place before you facts in general perspective, rather than accurate detail, and by using tracings so that the diagrams can be placed one above the other, the accord of all the growths shown can be better appreciated than by words. It is certainly interesting to see the great part that is being played by mineral products in the affairs of the world.

In a broad way, let us now try and read some of the meanings and lessons that the foregoing diagrams, statistics, and statements seem to give us. It would appear that mining and metallurgy, after dwelling in a lowland of drowsy accomplishment for centuries, then pioneered and stimulated by great gold discoveries, sprang into gigantic activity, and by leaps and bounds, all within the life of this School of Mines.

This has been brought about by the growth of knowledge through science, invention, and engineering, which first made clear the possibility, and finally the way, of the manufacture of power on a scale never dreamt of before, and thus giving man an almost Aladdin's power of summoning and enchaining a gigantic retinue of obedient impersonal servitors.

All branches of engineering have eagerly and ably contributed to this accomplishment, but they could never even have started without the miner. Do not the force currents that have been generated from mining products, and controlled and set in circulation by engineering skill, supplement or supplant manual work and thus constitute the basic cause of the growth and might of modern wealth? Look at the indicator gauge of bank deposits, and thus bank circulation!

In contemplating this flow of force, are we not impressed with the analogy between the circulation of blood in our bodies, and the wealth currents in trade? Does not a sudden halt and stoppage mean paralysis or death in either case, for circulation is vital to trade as to life?

The arteries of commerce require veins for distribution and return as does the body. All parts of the body,

even the brain, have limited absorbing power and must return the remainder to the moving blood currents, and thus the richest of men have but small individual wealth-absorbing power and must let the rest of the current go through them. They can be a great artery of flow, but not a terminal reservoir.

It is quite natural that bewilderment and unrest should follow the sudden might of this ever-growing flood of power summoned from the mineral kingdom—more time, more patience, and more industry are required to understand and govern it aright. Force uncontrolled or misunderstood is dangerous in proportion to its magnitude, but as it is harnessed and controlled by a serene and equitable understanding, so must it benefit and redound to the service and advancement of man.

To obtain the great production of minerals for the manufacture of force, and then its various useful transformations, has required not only the creation of huge and complex manufacturing tools, but also new great implements of finance, and thus the growth of the Limited Liability Corporation and Stock Exchange has been in sympathy with the mineral production. The precipitous curves in the diagrams all show that there must have been all manner and forms of human stimulus to have made the showings possible.

Over-eagerness to drink of the force fountains produced over-promotion and over-competition, which demanded in turn remorseless skimming of cream resources without any reckoning of the future, as is shown by the wasteful methods of mining and extravagant use of fuels, and the intensive, remorseless use of labor, both of hand and brain.

To obtain the effective dollar, for legitimate enterprise, by means of the stock exchange, many are circulated in demoralizing gambling. The capriciousness of ore deposits is an acknowledged fact and problem in mining, and the wise balancing and weighing of probabilities and possibilities, so as to make good guesses, based on slender foundations, is the great and final accomplishment of the successful mining engineer.

Hazards of Mining

Mining is not an unreasonably hazardous business if its capriciousness is recognized and if initial payments for unproved chances are not made too great, and expenditures for equipment are not undertaken upon insufficient foundations, and risks are averaged by spreading them. Advantage has been taken by company promoters and manipulators of the legitimate uncertainties of mining, to excuse the wildest mining ventures and the exploitation of stock certificates, rather than ore deposits. This has handicapped legitimate mining by making it difficult to obtain promising initial prospects at sane prices for purposes of honest test. It also tends to belittle the good name of a basic industry upon which modern civilization rests.

The fallacy of the belief that mining can only thrive through the stock exchange is known to those who have

been connected with big mining affairs, and have seen that successful enterprises have been initiated and carried through dark days of slow development and depression, by people who have knowledge, courage, and money to back their convictions. The stock exchange shows its greatest activity when least needed, that is, in inflating success and exaggerating failure. The transactions of the mining and other engineering societies, as well as the honest and high-class publications of the leading technical press, are giving such educational light that it is hoped and believed that mining exploitation by the stock exchange is very much on the wane.

To be fair to the stock exchange, it has often caused successful mines to be developed, which otherwise would not be worked, but the profession with which I am dealing, has not the stock exchange as its guiding star. It must nevertheless be acknowledged and understood that mining is not undertaken for making statistical showings, or for philanthropic purposes. Its fundamental idea is to make money for those who undertake it, and the success of the mining administrator or engineer is largely gauged by the return of profits he can show.

After the protection of the lives of his workmen, rightly the engineer's first duty is loyalty to the owners of the enterprise that employs him. The owners, who put up only their own money, have a right to decide to what extent they make their business and engineering information public. But, when a limited liability corporation is formed, the case is entirely different, for this means the partnership becomes unlimited, and, as all partners have right to knowledge, the engineer's loyalty to his owners changes from the few to the many.

In writing reports for private owners, the engineer should protect himself and the public by placing before himself, and then on record, all facts obtainable in any way bearing on the problem, and then, and only then, write his conclusions, submitting the report to his principals upon condition that, if made public, it will be given in its entirety, or as edited by himself. The essence of engineering ethics is to obtain full truth, first for himself, then to give it in full to his employer. If this is done with industry and frankness, all the other ethical rules with which our engineering associations are struggling, will be but corollaries.

The secrets of mining should be more and more confined to those given by nature. Mining titles and laws should be established with more certainty, so the most generous and honest are not handicapped or preyed upon, by the most shady and dishonest.

Educational

The subject of the relationship and preparation of students for the mining industry has been a fruitful theme of papers in transactions, and addresses to colleges and universities, and it is not necessary for me to emphasize its importance.

The interlocking and parallelism of the educational

needs of different branches of the engineering profession were clearly recognized and set forth by Professor Monroe ten years ago, who, at the same time, pointed out the necessity of a greater diversity of knowledge for the mining student than for any other branch of engineering. The decision of this University to demand from all applicants for engineering degrees a sound foundation of general culture before specializing, and equal to that preliminarily required in any other profession, is only in keeping with what I have endeavored to show to be the great responsibilities and powers, which have of late years been demanded of mining and other engineers.

Pioneers in Mining

It is obvious that in the early days of big mining the accomplishment and numbers of technically trained men did not equal or fit the demand, and that many forceful, talented, energetic men must have risen from the ranks to leadership. They were the first in the saddle, and, naturally, did not always see the full necessities of training, without which they themselves had succeeded. But assuming equal individual ability, the wastefulness of acquiring knowledge by only personal experience, and not by making use of the stored experience of others, must tell against the merely practically trained man.

The great self-made mining men of the past must be recognized and revered, both in the technical societies and schools, for they have been the pioneers and makers of history. Though in time a degree from an engineering school may, and should be, regarded as a first necessity, the demand for it should not be made retroactive.

The student of the future should only regard his degree as the trainer's certificate of efficiency and soundness, for a race and struggle, still ahead of him. Practice, as well as theory, is essential. The danger of only theory in formative years, even for the diligent student, is that the slowness of results and drudgery of practice becomes distasteful, and commercial success not so palatable or satisfying as to those who work their way up from the ranks.

Your school of summer practical training, giving students a preliminary contact with actual work, is excellent so far as it goes, and its success has been shown by how greatly it has been copied. It is to be hoped that even greater demand will be made by the schools for early practical experience, and to be rewarded by a post-graduate degree. Students who have worked for wages and have obtained approbation of employers, and have been thrown in intimate contact at the formative time of life with the ordinary wage earner, on equal terms, have obtained an experience most desirable and most necessary for the engineer.

In these days of impersonal corporation ownership, the closest and most intelligent link between capital and labor is that of the engineer. To be of the greatest use he should know the life, ambitions, and viewpoints

of each, and bring wisdom and sympathy to both sides, in the bitter and dangerous struggle that is now going on between those, so intimately bound and tied together, that the paralysis or death of one, means the same for the other. Such experience can only be advantageously obtained for the engineer, before he has assumed responsibility of leadership in dealing with labor.

It is the right labor viewpoint and basic principles of business economy that should be more and more given to mining and other engineering students. Engineering training should not simply be limited to those certain to practice it—it should be used and looked upon as a gateway to leadership in all great business enterprises, for it is fundamental in its training, and teaches the necessity for accuracy, the search of truth, probing error, and the frank acknowledgment of limitations. The gigantic forces set so recently in circulation by the miner and engineer must not only be better understood by the professional man, but also by all leaders of affairs. What is the use of a perfect engineering report, if but hazily and imperfectly understood by those who have to use it?

As to general culture, do the only dumb-bell mental drills of the past, which might be well adapted for a different set of knowledge and economic conditions, hold good when the new economic conditions have revolutionized sciences, wealth, and opportunities of education?

Is the average attitude of the students in our great centres of learning, who so often place athletics and college social success above scholarship, indicative of the satisfying character of knowledge supplied? Never before in the history of the world has there been more necessity for the clearness of vision and honesty of thought than now, when great overwhelming material force is flooding the world. False hopes, false ideals, false education, and revolutionary socialism, which only sees the wrongs and misery of the present, and the cure by annihilation of all good with evil, must be met by sane and strong training of future leaders, and from what schools can we hope to better obtain help than those of engineering?

Conclusion

In conclusion, it will be necessary to consider more closely mining as a profession, in which, of course, is included the early stages of metallurgy. The mining engineer must have some sound general knowledge of all other branches of engineering, inasmuch as in the equipment and running of great mines and metallurgical plants he must make use of the training of engineers in almost all the other branches, and to obtain from them their best and hold their respect, it is necessary for him at least to appreciate the foundations of their specialties, intelligently to confer with them, and decide upon merits, rather than dicta.

In addition, he must have special knowledge and training in all pertaining to the discovery, working, and

valuation of ore deposits. He must have also sound business experience and judgment to gauge the profitability of new ventures, and this in turn requires that he should have had, in some period of his career, a successful experience in management, requiring a knowledge of accounts and faculty of handling men. In distant lands he must have general information of many kinds, and linguistic attainment.

The legitimate uncertainties of mining throw peculiar temptations in his path, as these can be twisted to excuse failures of indolence and unfitness, and also be used as narcotics to conscience when temptation to dishonesty presents itself.

His work, especially in metalliferous mining, is often far afield from the observance and guidance of owners or directors, and his work is not of a character that erects lasting monuments or stimulates either admiration or criticism. Thus character, industry, and tact are even greater requisites for true success than brilliancy of intellect.

Right character building, begun in such an institution as this, is the greatest benefit it can confer. This idea has been most fittingly expressed by one of its most beloved character builders, Professor Kemp, in University quarterly, December 1913.*

It must be a great satisfaction to this University and other kindred training schools for the engineer, to see how the great majority of the students have responded to their character builders, inasmuch as the records of this, and other high-class institutions, show that very few of their graduates have succumbed to gross financial temptation.

Mining brings in touch engineers of different lands with different training, in such a way that general recognition and good fellowship are unstintingly extended (as the speaker must gratefully acknowledge) irrespective of nationality.

Mining as a profession requires varied knowledge and gives scope, ability, and character, and is a profession befitting the true gentleman as well as the adventurous strong man. It affords absorbing and interesting work, and, being basic and productive, extends opportunity for clean money prizes.

Each branch of engineering is based upon metallic foundations: each is dependent upon the other, and none could have reached its present magnitude without the others, but the miner gives to all the other branches the materials that knit them together, in common bond of usefulness making them effective in the art of "Directing the great sources of power in nature for the use and convenience of man."

*"Many, as I have mentioned, follow courses of study in the natural sciences from interest in the subjects, but the student can not do so without reflex influence upon himself. He is, for example, obliged by the very nature of the pursuit to be accurate, precise, and orderly in thinking. False observations, careless records, or confusion of thought bring no results. Clearness and remorseless regard for truth must be all absorbing."



THE SHAFT OF THE RAINBOW LODE DEVELOPMENT COMPANY.

The Rainbow Lode Shaft

By E. C. REEDER

The northeastern part of the Butte, Montana, mining district is of increasing interest to mining men. The advent of the Butte and Superior companies and their phenomenal success in making a bonanza zinc mine out of the old Black Rock claim, which was originally supposed to be valuable only for its silver ores and the pockets of copper ores occurring occasionally, has led to extensive development on adjacent proper-

to prevent the alignment of the shaft becoming impaired through crushing and movement of the wall rocks adjacent to the vein which always follows the mining of the orebodies.

The shaft itself is practically square in section and is divided into three compartments consisting of two skipways and space for a large cage for men, timbers, supplies, etc. (Fig. 1). This type of shaft construction is a decided innovation for the Butte district, where the common type of shaft consists of three compartments arranged side by side, as in Fig. 2, which represents Granite Mountain shaft. On this account the Rainbow shaft is unusual, and this form of construction is being watched with great interest by Butte mining men. This type of shaft has been bor-

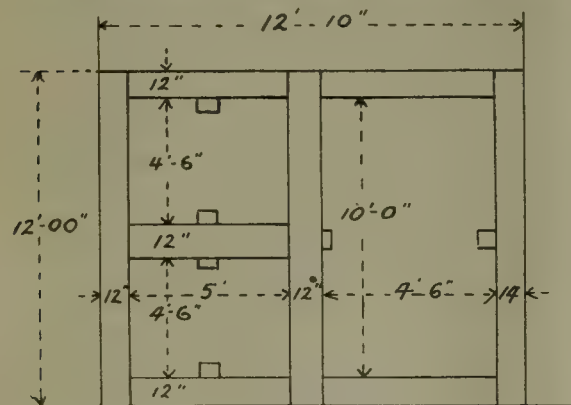


FIG. 1. RAINBOW SHAFT.

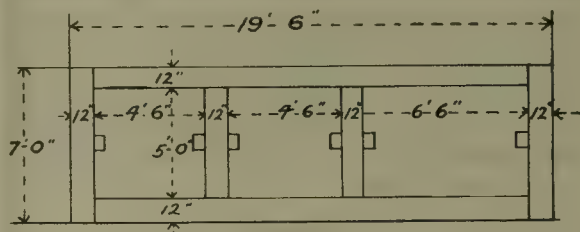


FIG. 2. GRANITE MOUNTAIN SHAFT.

ties in this vicinity. One of these newer properties is the Rainbow Lode Development Co., which is controlled by interests affiliated with the North Butte Mining Co. The property of the Rainbow company comprises an extensive acreage, which is traversed by the outcrop of the Rainbow lode, which is extensively opened farther west in the so-called silver district, and a number of mines are situated on this lode. The name of this lode is taken from the rainbow-like curve its outcrop makes.

The Rainbow lode shaft is situated in the foot-wall side of the lode and at a sufficient distance from it

rowed from the Lake Superior iron country, where it is a common form of construction.

The Rainbow shaft is also the first shaft in Butte to be sunk wholly by electric power. Other shafts in Butte have the benefit of electric power for various purposes such as compressors, haulage, etc., but the entire plant at the Rainbow shaft is operated by motors.

The shaft was sunk from surface to a depth of about 800 ft., using a 75-hp. single-drum electric hoist, and it is the intention to go to the 2000-ft. level before doing a great deal of lateral development. As the

small hoist was too slow and too light to attempt its use for greater depths, a more powerful machine was ordered from the Lidgerwood Manufacturing Co. and was installed last December.

The large hoist is shown in Fig. 3, and consists of two separate drums arranged side by side and driven through friction clutches by gearing to an induction motor. Each drum is 84 in. diameter by 50 in. face, grooved to hold 2000 ft. of 1-in. rope in two layers. Instead of mounting the clutches on the drum-shaft as is the usual construction, they are attached to the driving pinion. With this construction each drum is keyed to its own shaft and has its own separate gear. The advantages of this construction are numerous. The hoist consists of practically two units and can be operated indefinitely as a single-drum machine by merely disconnecting the driving shaft. When hoisting with only one drum and holding the other drum on the brake, there are no drum bushings to wear oval, due to a heavy drum resting on a revolving shaft. The clutches, being attached to the pinion, are small in diameter and proportionately light, and the motor is not required to accelerate such heavy drums as would otherwise be the case. They being small can easily be operated by hand, and complicated auxiliaries are not needed. Repairs and adjustments are easily made. The clutches themselves are of a new type especially developed for this service and consist essentially of two cone-shaped friction surfaces of hard maple with cork inserts, drawn together by a series of toggles and gripping between them a steel friction ring.

The cones are mounted on a steel spider keyed to the driving shaft, and the friction ring is carried by a steel bell or drum-shaped spider, which has a sleeve on one end upon which is mounted the pinion for driving the drum. The bell or drum is fitted with heavy bronze bushings and the entire friction device is enclosed in a case which can easily be opened for inspection and oiling.

Each drum is equipped with a heavy post brake lined with wood blocks. The brake flange on the

drums, instead of being cylindrical is V shaped, and the brake-blocks are shaped to correspond. This gives an especially powerful brake action with very little effort on the part of the operator.

There are two gear reductions, all the gears being of steel with cut herringbone teeth made by the Falk company, and they run smoothly and quietly. They are enclosed in a gear case and run in oil, while the drum gears are covered with channel-shaped guard bands which cover the face and ends of the gear teeth.

This hoist further departs from tradition in that the bedplate or frames are made of structural steel instead of cast iron. The box girders comprising the side frames are sunk into the concrete foundation, so that the base of the pillow-blocks are on the floor line. This securely ties the machinery and foundation together into one compact unit.

The motor is 300 hp., General Electric manufacture, 580 r.p.m., of the wound rotor or slip-ring type, and operates on alternating current, three phase, 60 cycles, 2200 volts. The control is the latest type of magnetically operated contactor with a master controller. The primary circuit is controlled by two contactors, each with three poles, and the switches are air-brake with magnetic blow-outs and slate deflectors. One contactor is provided for each direction of rotation. The secondary of the motor is controlled by contactors which are automatically controlled by current relays and interlocks. The secondary panel is arranged for three points hand control in either direction, with acceleration automatically taken care of at a predetermined rate by the current relays. A small transformer reduces the voltage for the magnets and master controller to 220 volts, so that the high voltage is not passed through the operator's controller.

By the use of high voltage the cost of transformers and the loss through them are saved, and also the effect of drop in voltage is felt much less on the motor than if the usual pressure of 440 volts were used. The secondary resistance is of the usual iron grid type. Dial indicators connected to each drum show the position of the cages in the shaft.

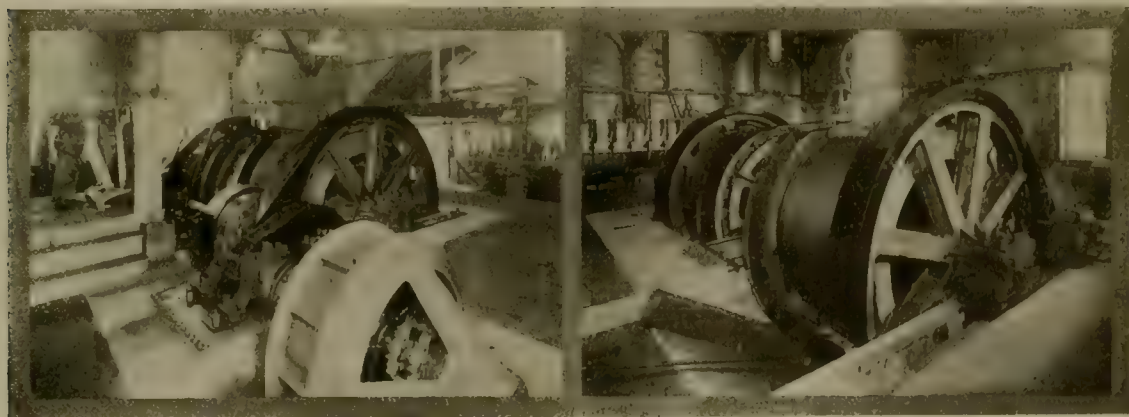


FIG. 3. TWO VIEWS OF RAINBOW HOISTING EQUIPMENT.

Replacement Orebodies at the Gray Eagle Mine

By FRED H. DAKIN, Jr.

The Siskiyou range of mountains extends in a westerly direction, along the boundary line between the states of California and Oregon, to within 45 miles of the coast, and thence in a southerly direction 75 miles, where it joins the Coast range. The Gray Eagle mine is situated, at an elevation of 3000 ft. above sea-level, in the angle thus formed. It lies five miles north of the Klamath river, and ten miles south of the summit of the range and the Oregon boundary, in the northwest corner of Siskiyou county, California. The general elevation of the summit of the range is 5000 ft. above sea-level, with several passes of about 4000 ft. and some higher peaks at an altitude of from 7000 to 9000 ft.

The Siskiyou range consists largely of intrusive rocks, mainly granodiorite, gabbro, and serpentine.

of Happy Camp. The Gray Eagle mine is situated in this area of schists, also several undeveloped prospects. The third series of schists is 10 miles south of the town of Happy Camp and covers an area of 20 square miles. These schists appear to be igneous rocks and are in conformity with dikes of porphyry and serpentine, which are partly schistose.

The Gray Eagle mine was held under option and purchased by John B. Farish, and was developed under my management. It consists of 14 patented claims, and is situated in the Happy Camp area of schists, as stated above, being six miles north of the town of that name. The lode consists of iron and copper sulphides, largely pyrite, marcasite, and chalcopyrite, in the schist formation. The outcrop is known to be at least 1500 ft. long on the strike, and its width is from 30 to 80 ft. The strike is northwest. Part of the lode is in an anticlinal position, but the greater part has a dip of 27° to the northeast. The lode is entirely in the schist formation and conforms with the schistosity in strike and dip. The only rocks other than the schists are a few acid dikes, about one foot in width, which cut across the schist and lodes in various directions. These dikes have no effect on the grade of the ore and do not appreciably alter the deposit. The lode has no walls; the proportion of pyrite in the formation decreasing from the centre across the width in both directions. The solid sulphide ore retains the schistose structure, and shows the deposit to be of the replacement type. The development work has shown several minor faults.

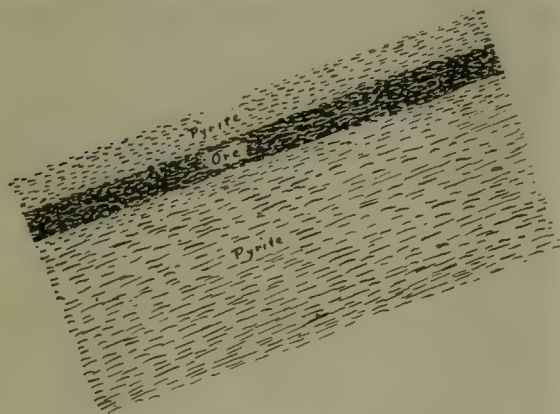


FIG. 1.

Three areas of schists, which appear to be largely of sedimentary origin, cover parts of the south and east slopes of the range. These schist formations contain the copper deposits that have been developed in the Siskiyou range. The schist areas also contain numerous undeveloped gossan outcrops. Copper minerals, largely chalcocite and native copper, have been found in the intrusive rocks, but none discovered up to this time are large enough or regular enough to warrant extensive development work.

One of the schist formations covers an area of 50 square miles, beginning at the Klamath river 30 miles west of the town of Hornbrook and extending in a northerly direction 15 miles across the summit of the Siskiyou range into the state of Oregon. The Blue Ledge copper mine is situated in this schist formation, also a few partly developed prospects and a number of undeveloped prospects. The second series of schists is 35 miles west of the Blue Ledge district. It is 35 square miles in area, extending in a northerly and easterly direction from the old placer mining town

Structure of the Lode

The lode is not uniform in grade across the width, but contains a persistent band of ore, as shown by Fig. 1. This orebody, as indicated by the figure, is not in the centre of the lode, but in most places has 10 ft. of low-grade pyrite lying over it and a greater width of pyrite under it. Its width varies from 6 to 20 ft. It has been exposed in various places on the strike for a distance of 500 ft., and at a depth on the dip of 600 ft., but its entire area outside of these limits has not yet been determined. It is remarkably uniform in grade. Although cross-cuts have been driven through it at a number of places, and several drifts have been driven in higher grade ore, no point has yet been found within the limits of the development where it is below a good ore grade. The percentage of copper varies from 3.5 to 8, but is more uniform than these figures seem to indicate. The orebody also contains from 50c to \$2 per ton in gold. The low-grade pyrite lying immediately over the ore, in a number of places, contains sufficient copper to form a lower-grade ore over a width of several feet.

This also holds true of the pyrite immediately under the ore.

The ore consists of iron and copper sulphides, a large proportion of which appears to be chalcopyrite. It contains practically no zinc or arsenic. A body of oxidized and secondary ore small in comparison with the chalcopyrite orebody lies under the gossan outcrop, the copper being largely in the form of chalcocite. Its average grade is about the same as that of the unaltered ore.

Owing to the fact that the chalcopyrite orebody lies relatively near the overlying limits of the lode, in a section across its width, it has been suggested that it may have been formed by secondary enrichment from the overlying pyrite. A close study of the orebody, however, shows that this cannot be the case. If the ore had originated in this way there would of necessity be stringers of ore cutting across at right angles to the dip of the lode. This condition is nowhere observable, the ore bands all being conformable with the strike and dip of the schists. There are also narrow bands of high-grade chalcopyrite in the low-grade

face under the outcrop until the dip of the lode parallel to the north slope was determined. Cross-cut adits were then driven at greater depth from the north side. In this way it was possible to open the deposit at a depth of 600 ft. on the dip by an adit 460 ft. long. The total development work amounts to between 6000 and 7000 feet.

Comparatively cheap power can be obtained by the development of hydro-electric power. This can be done at a number of places, some of which would develop much more power than the amount required. Owing to a lack of market, no hydro-electric power has yet been developed in the district except for placer mining.

There is an abundance of timber, largely fir, sugar pine, and cedar, in the district, much of which is well suited for mining purposes. Being within the limits of the Klamath national forest, it is almost entirely under government control. Much of this timber has been cruised and estimated by the Forest Service, it being generally understood that it is to be placed on the market and sold as soon as possible. The climate

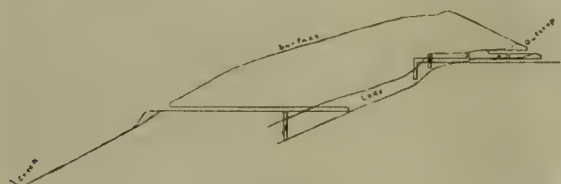


FIG. 2.

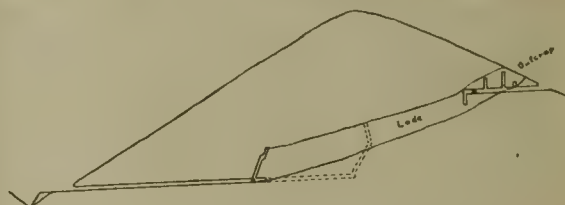


FIG. 3.

pyrite body lying under the ore, many of which are as much as 50 ft. under the orebody. The ore also appears to contain no chalcocite or other secondary minerals, although this has not been definitely determined.

Taking everything into consideration, it seems probable that the low-grade pyrite body was formed first and that the orebody was formed at a subsequent time by a second replacement. The faults have occurred subsequent to the formation of the ore and have no effect upon the grade of the ore except a slight decrease close to the fault planes due to leaching.

The lode, as shown by Fig. 2 and 3, outcrops near the summit of a narrow ridge. It extends under the ridge in an anticlinal position, and then dips roughly parallel with the north slope at an angle of 27°. The strike of the lode is diagonally across the ridge. The northwest end of the outcrop, therefore, extends across the ridge and shows in a number of places on the north side as far as the bed of the creek. This condition determines the western limit of the deposit, at least to the depth of the creek. In the other direction, however, the depth of formation lying over the deposit increases greatly, and the full length in that direction is not known.

The topography above referred to was favorable for prospecting the deposit with comparatively short cross-cuts. Cross-cuts were first driven from the sur-

face under the outcrop until the dip of the lode parallel to the north slope was determined. Cross-cut adits were then driven at greater depth from the north side. In this way it was possible to open the deposit at a depth of 600 ft. on the dip by an adit 460 ft. long. The total development work amounts to between 6000 and 7000 feet.

also is favorable. The rainfall is heavy during the winter months, and in some seasons the snowfall is two or three feet, but the winters are not severe enough to interfere with continuous work. The district as a whole is mountainous, but there are many ranches along the Klamath river and on the tributary streams. The climate and soil are favorable for raising vegetables, fruit, and stock of all kinds. Farm products are, therefore, comparatively cheap. When the timber is removed the area of agricultural land will be largely increased. The Klamath region is at present retarded by the lack of transportation facilities, but as soon as these are supplied it will become one of the active producing districts of the state.

Mica is found in crystals ranging from small ones to those several feet across. Crystals two feet in diameter are not uncommon. The value of the mica produced in the United States in 1913 was \$436,060, North Carolina contributing \$267,913. The total value of the output in 1913 was \$104,164 greater than in 1912 and was the largest ever reported. The production of sheet mica as reported to the U. S. Geological Survey amounted to 1,700,677 lb., valued at \$353,517, compared with 845,483 lb., valued at \$282,823, in 1912. The production of scrap mica in 1913 amounted to 5322 tons valued at \$82,543, compared with 3226 tons, valued at \$49,073, in 1912.



PORT OF IQUIQUE.

The Chilean Nitrate Industry—I

By LESTER W. STRAUSS

Of the metallic and non-metallic minerals peculiar to the West Coast of South America, nitrate of soda is the most important. It forms the basis of an extensive industry in Chile and contributes 80% of that country's revenue by reason of the export duty imposed. Its uses are more far-reaching and beneficial as a re-invalidator of soil, so largely applied abroad, than to other applications in the arts, of which the manufacture of explosives is an important industry.

Beginning of the Industry

The beginning of the nitrate industry is said to date from 1809, in the province of Tarapaca, through the efforts of Tadeo Haenki; the wonderful results obtained in 1830, in the application of nitrate as a fertilizer, marks the realization of its usefulness and the active commencement of its exploitation. (As the outcome of the war of 1879, Chile came into possession of the fields which had previously been Peruvian and Bolivian territory.) From a yearly output of 22,723 quintals (46 kg. each or 101.4 lb.), in 1812, the industry had grown to 56,214,140 quintals in 1912. An appreciation of the 1912 output, although only 54,197,439 quintals was exported, is better obtained from its intrinsic value to the Chilean government as revenue—£6,323,035 (\$31,350,568*); the value of nitrate products was £22,302,956 (\$107,054,090); the export duty is 28d. (\$0.56) per quintal, but at some future date—in view of increased cost of production, mainly due to scarcity of labor and the decline in grade of the material treated—this tax must be lowered and thus make available much ground now too low grade to permit working under the existing duty; which amounts to one-third of the average selling price. According to

figures submitted by the Chilean government, its income from 1891 up to 1913, a period of 22 years, was £84,296,334 (approximately \$405,000,000). The increasing consumption of nitrate has had its corresponding effect upon the yearly revenue from the export duty. These increases make the frequent loans of the Government, for railroads, harbors, and sundry essential improvements, a matter of reasonable security—with in bounds—as no recourse is had to taxation of the citizens individually. The following figures, totals from 1891 to 1912, inclusive, and the individual years 1891 and 1912, give an idea of the importance of the industry:

Output:	1891.	1912.	Total.
Quintals	16,982,931	56,214,140	747,862,160
Metric tons	781,184	2,585,850	34,400,283
Exported:			
Quintals	17,158,971	54,197,439	723,313,593
Metric tons	789,281	2,493,082	33,294,094
World's consumption:			
Quintals	20,960,785	54,990,104	725,862,446
Metric tons	964,158	2,529,545	33,388,335

It is of interest to note that although the output and exportation have more than trebled, consumption has increased less than 2.7 fold during the 22 years; the difference is the necessary stock.

The nitrate industry is confined to the provinces of Tarapaca and Antofagasta in the northern part of Chile (between latitudes 19°30'S. to 26°S.). The latter province is the larger producer. The exporting ports, beginning at the north and proceeding southward, are Pisagua, Junin, Caleta Buena, Iquique, Tocopilla, Mejillones, Antofagasta, Caleta Coloso, and Tal-tal. Iquique is the most important port. The area of Chile is 757,366 square kilometres (292,343 square miles), of which the provinces of Tarapaca and Antofagasta comprise 46,957 (18,125 square miles) and 120,708 (46,593 square miles) square kilometres, re-

*Throughout this article, figures stated in pounds, shillings, and pence refer to English, and those in dollars refer to United States currency.

spectively, up to the present time 4604 square kilometres (1777 square miles) are controlled by the various nitrate companies in both provinces, and 1345 square kilometres (519 square miles) additional have been explored, but not sold by the Government.

The districts are known as follows: pampa Tarapacá, ports Pisagua, Junín, Caleta Buena, and Iquique; pampa Toco, port Tocopilla; pampa Antofagasta, ports Antofagasta and Mejillones; pampa Agua Blanca, port Caleta Coloso; pampa Taltal, port Taltal.

In 1912 there were 170 *oficinas* (the local name for the nitrate treatment plants) including those in construction, of which 38.5% was Chilean controlled, followed by English (37%), and German companies (15%), the remaining 9.5% is represented by six nations. Only one American company exists, the Du Pont Nitrate Co., owned by the E. I. du Pont de Nemours Powder Co., operating in the Taltal district. It operated the Delaware oficina and exported 152,030 qq.* in 1912, equal to 0.28%. Recently interest has been taken by a new company, American Nitrate Co., at Toco in the Tocopilla district, where title to the ground has been in dispute between Bolivia and Chile. W. R. Grace & Co., of New York, through a subsidiary company—the Nitrate Agencies—represents 9 oficinas; the product is sent to the United States and England. The combined output for 1912 was 3,175,400 qq. (about 5.1 per cent).

The Nitrate Fields

The stretch of territory represented by the 6°30' of latitude (about 450 miles) concerned is a dry (rain falls during lapses of 15 to 20 years), arid country rising from 2200 to 7500 ft. above sea-level at distances varying from 14 to 20 miles in from the coast. (The oficina Alianza, in Tarapacá, is at 2300 ft. and the oficina Delaware in Taltal, is 7500 ft. above sea-level.) Between this plateau and the coast, is a range sometimes attaining a height of 5000 ft. above sea-level, which barrier rises rather abruptly from the sea and affords only occasional ports. This remarkable topography begins just at Arica, where the coast line turns from a south-east course to almost due south, as one enters Chilean waters from the north. The nitrate fields appear to occupy a north and south trend, thus paralleling the coast line, the nitrate usually lying on the western side of the *pampa* or plateau. The eastern side of the nitrate fields is flanked by the foothills of the Andes, that serve as a huge wall against the rain-bearing winds from the east thus cutting off the possibility of rainfall which would play ruinous damage with the nitrate ground. The cold Humboldt stream of the Pacific Ocean condenses the moisture of the warm western winds into mists which are rarely permitted to precipitate as rain, due to the strong evaporative powers of the sun. In the winter season these dense mists, or fogs, form nightly but are dispersed by the sun after daylight. The slight moisture thus precipitated affords life to some vegetation, but its effects on the nitrate ground is

not. It has been stated that there is some relation between the fog and the nitrate as the latter is not found where the fog does not form but there is one known exception. The dry climate of this arid region is remarkable but extremely healthy. The days are hot, at noon, with heavy westerly winds in the afternoon and calm at sundown. The nights are cold but invigorating, and the mornings crisp. An amusing feature of the region is the electrical condition. Combining one's hair, dry, brings about a 'sparking' but pleasant sensation. The electrical phenomenon has been noted to affect surveying where compasses are employed.

The rocks of the region are essentially igneous, forming the coastal range and the Andes already referred to; northward from Agua Santa (Tarapacá is con-



NITRATE DISTRICT OF CHILE.

siderable limestone and dolomite. The plateau between is said to consist, in part, of Jurassic rocks, covered over with much marine deposit of sand, gravel, and clay; the recent deposits are not of marine origin and the clays appear to be of volcanic origin. Over this lies stratified mud and angular pieces from the denudation of the hills; bedded in the deposition referred to is the nitrate-bearing mixture.

The origin of the nitrate has not been cleared up despite the theories advanced. It may be stated at the outset that the rocks of the surrounding country have not been considered as a possible source. There are several theories existing, but none are supported by conclusive facts.

It has been already observed that static electricity is present, which, acting on the atmosphere, would liberate oxides of nitrogen and these, in contact with

*Quintals.

the moisture of the air, would form nitric acid. The transition to nitrate of soda in the presence of sodium salts, is readily conceived. Ammonium salts, especially ammonium nitrate, are probable products from the effect of electrical discharges on air and water (that is, mist): reacting with sodium salt ammonium nitrate would be converted into nitrate of soda.

F. W. Clarke, in the 'Data of Geochemistry,' Bull. 530 of the United States Geological Survey, makes the following observations:*

Genesis of Nitrates

"Nitrates are commonly formed in soils by the oxidation of organic matter, a process in which nitrifying micro-organisms play an important part. In moist climates these salts remain in the groundwater, are consumed by growing plants, or are washed away: in arid or protected regions they accumulate to a considerable extent. Some nitrates are also derived from atmospheric sources, the acid being formed by electrical discharges and brought down by rain, but their amount is probably only a small portion of the entire product. Wherever organic matter putrefies in contact with alkaline materials, such as lime or wood ashes, nitrates are produced, a process which has been carried on, artificially, in various countries in order to supply the industrial demand for saltpeter. In sheltered places, such as caverns, calcium nitrate is often produced in large quantities, and its formation has commonly been attributed to the nitrification of bat guano. This supposition, however, may not cover all cases, for W. H. Hess claims that nitrates are uniformly distributed over cave floors in Kentucky and Indiana, even in the remote interiors of caverns where no guano exists. (These views have been disputed by H. W. Nichols who regards guano as the chief source of cave nitrates.) . . . The deposits of potassium nitrates found in Hungary are traced by C. Oehsenius to the mother liquors of sea water, their potassium chloride being first transformed to carbonate, which latter is then nitrified in the presence of organic substances. In this suggestion the hypothetical element is rather large, although it is plausibly defended. . . .

"No satisfactory explanation of the nitrate beds has been found although many theories have been proposed to account for same. C. Noellner, who assumed a marine origin for the deposits, suggested that their nitrogen might be derived from the decomposition of great masses of sea-weeds; but in this view has not been generally accepted. For example, the beds at Marićunga (Chile) are 3800 metres above sea-level, and 180 miles from the coast, and other localities present similar difficulties of distance and elevation. The plain of Tamarugal (Chile), studied by W. Newton, lies between the coast range and the Andes, 3000 ft. above the sea, and the nitrate beds have peculiarities which seem to preclude either an oceanic origin or a derivation from guano. Here, at least, bromides are absent,

and only traces of phosphates can be found. Sea water would yield the former; from guano the latter would remain. Newton regards the nitrates as originally formed by the oxidation of organic matter in alluvial soil. Tropical floods which cover the plain once in every seven or eight years, bring upon it the concentrated fertility of thousand of square miles and sweep the deposits to the landward side of the coast chain where they are mainly found. This is Newton's view, although he admits the possibility that electrically generated atmospheric nitrates may also be present. The same possibility is recognized by Semper and Blanckenhorn, but rejected by A. Muntz, who regards the electrical source as quite inadequate. Muntz accepts an organic origin for the nitrates, and argues that the calcium salt was first formed, as in the ordinary artificial process of nitrification. That compound then reacts with sodium chloride forming calcium chloride and sodium nitrate, a transformation which can be effected experimentally. The same result was also obtained later by A. Gautier, who finds in guano the source of the nitrogen. The reaction is further suggested by the facts that the Chilean nitre is always associated with salt, and that calcium chloride is found in the underground waters of the pampas. Muntz also proved, by direct experiment, that iodides in a nitrifying mixture were oxidized to iodates, and from the absence of phosphates in the nitrate beds he infers that the nitrates have been transported in solution and re-deposited at a distance from the original seat of their formation.

"C. Oehsenius, who has written voluminously on the Chilean nitrates, regards them as derived from the mother liquors of salt deposits in the Andes. These are supposed to flow downward to the plains, their chlorides being partly converted to carbonates by carbonic acid of volcanic origin. The nitrogen is brought as ammoniacal dust from guano beds upon or near the sea coast, the heavier phosphatic particles being left behind. That such dust is carried by the winds is certain: but is it carried in sufficient amounts to account for large nitrate deposits far inland? Another difficulty is suggested by Darapsky, who points out—in his work on Taltal—the comparative scarcity of carbonates in the nitrate regions. Even the waters of the pampas contain little carbonic acid, and among the mineral springs of Chile and Argentine carbonated waters are the exception rather than the rule.

Saline Water Theory

"That the nitrate beds are proximately derived from the evaporation of saline waters is beyond a doubt, but the evidence is strongly against their having a marine origin. The ultimate source of their nitrogen is a more troublesome question and remains, so far, unsolved. The weight of opinion favors a derivation from organic matter, and from this point of view Newton's explanation of the deposits is as satisfactory as any. Explanations of this order, however, are incom-

*Page 205.

plete for they take no account of the remarkable association of boron and nitrogen. Why do borates and ammonia occur together in volcanic waters, or borates and nitrates in the deposits of both Chile and California? This fact, which has already been emphasized, is surely not without significance and it legitimizes the suspicion that the nitrates may be partly derived from volcanic sources. To be sure this is only a suspicion, but it is one which ought not to be left out of account. Hot springs are common in the desert of California and Nevada; they are also found along the volcanic Andean chain; do they contain boron and ammonia as a general rule, or only in sporadic instances? Such waters, collecting in lagoons in the presence of some organic matter and the nitrifying organisms, would yield nitrates, and the latter would be found in the dried residues. A careful examination of all hot springs existing in the vicinity of nitrate beds is needed before one can decide how much weight can be given to this volcanic hypothesis."

Of the above hypotheses the electrical theory has met with more general approval, at least to the extent of being considered probably the chief agent. It is worthy of mention that nitrate ground is readily picked out from barren ground, due to its dark appearance as compared with the latter, when inspected in the early morning before the sun's rays have driven off the moisture of the previous night's fog. This phenomenon is due to the hygroscopic property of nitrate, but is not an unfailing indication.

The composition of the *caliche* (the local name for the nitrate-bearing material) as mined varies from 18 to 65% NaNO_3 , but the general average is between 20 and 25%. When pure it is found in crystalline masses either white or yellow and rarely pink, the last two conditions being due to iodate of calcium and manganese respectively. As might be expected sodium chloride, sulphates of soda, lime, and magnesia are associated, besides 'earthy material'. Nitrates of calcium and potassium, perchlorate of potash, and iodate of soda occur in small amounts. A better idea of the composition of caliche can be obtained from the following analyses:

	Taltal. Darapsky.			Antofagasta. S. H. Loram.		Tarapaca. Agua Santa.	
	1	2	3	4	5	6	7
Nitrate of soda...	31.90	39.400	56.25	25.500	29.350	34.2	43.3
Chloride of soda...	8.00	4.180	2.75	41.860	41.710	32.0	30.9
Sulphate of lime...	7.00	3.250	....	1.970	3.610	6.3	tr.
Sulphate of magnesia	6.90	3.970	....	5.990	0.610	2.0	...
Sulphate of soda...	8.60	.....	34.60	13.750	4.720	8.4	25.3
Chloride of magnesia .....	...	3.870	....	.....	.....	...	...
Nitrate of potash...	...	.....	....	0.545	.....	1.6	...
Perchlorate of potash .....	...	.....	....	trace	0.180	...	...
Iodate of soda....	0.02	0.053	....	0.136	0.104	0.2	...
Moisture	2.40	.....	6.25	2.970	1.330	1.1	...
Insoluble	34.30	45.240	0.01	7.280	17.590	14.0	0.4
	99.12	100.002	99.86	100.001	99.204	99.8	99.9

One of the largest nitrate producers in the province of Tarapaca is the Agua Santa Nitrate & Railway Co., which has been in operation, as a limited liability company, since 1889. Some idea of its importance may be obtained from the total output from the Agua Santa oficina, only, since 1876 (when the steam plant was put in) which is given as 35,000,000 quintals *salitre*, the name for the finished product. Within recent years the annual production of the Company has been at the rate of 1,500,000 quintals. The Company operates a narrow-gage railroad (30 in.), that taps 22 oficinas, including six of the Company proper, and handles about 6,000,000 quintals of nitrate per year. The line begins at Caleta Alta, from which point three incline planes serve the port Caleta Buena. The railroad was built in 1891 and is at present 148 kilometres (92.5 miles) long as a main line and branches; its maximum grade is 3% (average 1%). At Huara it connects with the Pisagua branch of the Nitrates Railway, Ltd., which starts from Iquique; this line is standard gage. The Agua Santa company's oficinas are, in order of their importance: Agua Santa, Primitiva, Valparaiso, Abra, Elena, Democracia, and Irene. The last was but recently completed. The total production for 1912 was 1,492,205 quintals, of which the Agua Santa plant contributed 548,633 quintals; it stands eighth among the 99 oficinas existing in Tarapaca, and the Company ninth among 73 producers in the industry. The following descriptions of mining and leaching refer to the Agua Santa plant, but the observations made cover the general practice in the industry.

Occurrence and Composition of Caliche

In the Tarapaca fields four horizons are recognized in the exploration work. The surface material, called *chuca*, is loose and crumbly material containing porphyry boulders; this is usually less than one foot thick and on its character is based considerable importance in prospecting work—it carries little or no nitrate. Below this comes the *costra* which is similar to the *chuca* in appearance but more solid; the cementing constituents are sodium salts of which sodium nitrate often forms a considerable percentage. It runs as high as 25% NaNO_3 but 10 to 15% is the average; its thickness varies from a few inches to 15 ft. In appearance it frequently resembles a breccia. Where high grade, that is above 14%, it is being mined. Next comes the caliche, or the cleanest nitrate mineral, which, when pure, is found as crystalline masses either white, yellow, or rarely pink; the usual color of caliche is reddish brown. The average caliche mined varies between 18 and 65% NaNO_3 , while picked samples run up to nearly 100%; the thickness is from under an inch to 5 ft., the average would be from 1 ft. to 3 ft. The specific gravity is generally taken as 1.5 for calculation purposes (as only 75% of the mineral is considered as likely to be extracted), although the mineral is 2. The underlying (or 4th horizon) layer is known as *coba*, and consists of a brownish colored

earth mixed with sand and gravel. It contains a slight amount—never in commercial quantities—of nitrate. Below the coba is the igneous rock which is found at varying depths, and in the main valleys are marine beds.

The following analyses, given by Semper and Michels, indicate the constituents of the chuca, costra, and coba. Analyses of caliche have already been given:

	Chuca, %.	Coba, %.
Silicic acid	46.70	25.05
Iron oxide	2.00	1.64
Aluminum oxide	12.42	7.96
Manganese oxide	0.45	0.65
Calcium oxide	9.26	6.82
Magnesium oxide	2.88	1.92
Potassium	1.02	trace
Sodium	1.99	19.93
Sulphuric acid	13.23	20.09
Nitric acid	1.14	2.49
Carbonic acid	trace	1.75
Phosphoric acid	0.85	0.17
Iodic acid	0.25	0.13
Chlorine	1.24	12.98
Moisture	0.85	0.95
<i>Costra</i>		
Sodium nitrate	14.6	6.1
Sodium chloride	27.2	18.0
Sodium sulphate .....	...	20.0
Calcium sulphate	3.8	6.8
Magnesium sulphate	7.5	...
Magnesium chloride	0.4	...
Potassium nitrate	1.7	...
Sodium iodide	0.1	...
Insoluble	42.2	52.0
Moisture	2.6	...

It appears that the costra horizon is not always present in the nitrate fields of the southern districts.

In the early days of the industry, only the high-grade caliche was exploited and considerable was lost in the mining. Present day practice is confined to closer work and selection of probable profitable ground regardless of separating caliche from costra where both can be treated commercially.

The method of exploration is systematic and resembles the sampling of gold placer ground except that drilling machines are not employed. The area controlled is divided into squares usually 100 metres to the side, and holes—begun 9 in. in diameter—are sunk with 'jumper' drills to the coba; the chuca being cleared off prior to drilling. The 'jumper' drills are of 1 1/4 to 1 1/2-in. steel, or iron tipped with steel and range up to 15 ft. in length. As a rule 10-ft. drills are employed. The holes are made conical in shape, the apex being on the surface. When bottomed a light charge of gun-powder (dynamite when going through hard caliche) is exploded in them and the blasted material brought to the surface. Boys are usually employed to enlarge holes in the coba below the caliche. The sample is carefully picked over, before assay, all the coba being discarded. Data are taken not only as to the thickness of the caliche, but also the character and thickness of the overlying costra and chuca. The drill holes are plotted, with their corresponding

caliche contents and thickness, from which results the extent of the nitrate area is obtained. It is usual to assume that between a hole containing commercial caliche and an adjoining barren, or low-grade hole, half of the intervening distance can be allowed to be within the profitable area (the caliche deposition is necessarily of irregular shape and distribution although continuous). The tonnage of caliche is arrived at by multiplying the cubic metres by 2. This gives metric tons. Of this figure 75% is taken as the probable amount that will be extracted in mining. Where the costra is of commercial grade, its tonnage is calculated similarly, except that only 50% is taken as extractable. The full assay values are not used to arrive at an average of the area, deductions being made for losses in treatment. These deductions vary from 30 to 40% of the assay results, depending upon the grade of the caliche and the character of same. The cost of drilling varies from 50 centavos to 2 pesos per foot (11c. to 44c.), according to the nature of the ground and depth of the hole. Churn drills, such as are employed in gold placer ground, or at the 'porphyry' mines, might do the work more rapidly if the material was not of shallow depth as a rule, and possibly cheaper, but the necessity of water, in the work, would be a serious and detrimental factor though the use of compressed air would appear feasible.

Mining Caliche

Mining the caliche consists in first putting down holes similar to the prospecting holes, but with heavier charges of black powder varying from 100 to 1000 lb., according to the nature of the ground to be opened. Dynamite is only employed to break up large blocks of caliche or for sinking shafts. The black powder is home made, from coal 'fines', refuse nitrate, and sulphur. The last was previously brought from Italy or Japan, but is now obtained from the Tacora deposits inside from Arica, Chile. The powder mixture consists of 25 lb. of coal 'fines,' 100 lb. of refuse nitrate, and 25 lb. of sulphur. The cost is about 0.33d. (1c.) per pound of powder. A charge of powder has a heaving or lifting effect, in exploding, thus tending to minimize the making of 'fines.' The blast makes little noise, only a low rumbling effect resembling an earth tremor, and is accompanied by a cloud of dust, sometimes overshadowed by brownish nitrous fumes resulting from the explosion when the powder is wet or badly mixed. Holes, from 10 to 35 ft. between centres and parallel to the working face (and usually at a distance equal the depth to the caliche ahead of it), are prepared in advance of the face and fired as occasion demands. It is sometimes found practical to lower a boy into the holes to enlarge the opening when the coba has been reached. In such holes black powder has a greater lifting effect when exploded. This method is also used for isolated or thick beds of caliche. A working face is begun by laying out a trench, dug to the top of the coba and

continuing it according to the nature and extent of the costra and caliche, the process of extraction is similar to bench mining. The chuna is cleared off and thrown as far back as possible, the costra, however, is stacked up, somewhat like a pack wall. The larger pieces are broken down with a wedged-shaped piece of iron using a 25-lb. hammer. These pack walls of costra are sent to the leaching plant whenever of commercial grade, that is above 14%. The broken caliche usually consists of pieces easily handled by one man. Where large blocks result block holing with dynamite is resorted to. The lump size (the 'fines' being disregarded) is sorted out and piled up on the costra, to be carted away to the nearest loading station. A nitrate field, after exploitation, greatly resembles a battlefield with earthworks erected minus opposing armies and accessories. Mining is done on contract, that is to say the company prepares and loads the holes after which the contractor takes matters in charge. The prices paid are 2 pesos (say 44c.) per cart load (35 quintals) for costra and up to 20 pesos (\$4.40) per cart load for 50 to 60% caliche, according to the difficulty of extraction. There is a sliding scale rate per cart load, based not on the grade of caliche but on the comparative ease of extraction, a higher rate can be afforded for the good quality when difficult to extract. The contractor is paid for his work, not the quality of the caliche.

Losses in Mining

The losses in mining caliche are said to vary from 15 to 25%; when costra is taken out for treatment the mining loss is small but the milling loss is great. To the outsider it would appear that crude methods have been employed in mining; these were begun in the commencement of the industry and custom established same as a standard. The introduction of modern methods, particularly the possibility of steam-shovels in mining, has been suggested, but the general argument against a radical change has been the irregularity of the deposits; lack of technical administration is more to the point. In few instances have technical men been put in charge of operations.

Darapsky, in his work '*Das Department Taltal*', mentions calcium nitrates existing in cavities in limestone in the province of Tarapaca. These have been exploited with underground workings to a depth of 40 ft., until non-commercial nitrate was met. The origin is due to "underground water that has passed through the nitrate region and come to rest in a land-locked depression where it evaporates." In the Salar del Carmen in Antofagasta, which, S. H. Loram states to be of the above origin, nitrate crystallizes upon the surface and is worth removing about every four or five years. It has been cited as a case where nitrate grows and has led to a confusion as to its origin.

The caliche is loaded into two-wheeled carts, usually hauled by three mules, at a cost of 30 centavos (6.6c.) per cart. Sometimes sorting over is done, prior to loading, at a cost of 1 peso (22c.) per cart load. The

length of haul is generally short, and as a rule over light grades. In general, no attempt is made to load from the ground direct into railroad cars, eliminating cart haul, also, a cart driver never walks alongside but is mounted on the left wheeler. As a rule a man can mine and load from one to two carts per day depending on conditions as well as the individual. Where the ground is mined under difficulties the day's pay is the basis employed.

At the loading station the cart is dumped, the contents falling on an incline platform loading directly to



NITRATE FIELD. A, UNLOADING STATION FOR CARTS; B, RAILROAD LINE; C, CART ROAD.

steel side-discharge, hopper-bottom railroad cars, which hold 7 tons each; these are made up in trains, of six to eight, and hauled by (21-ton) locomotives to the *maquina* or treatment plant. The cars are dumped over bins which have little storage capacity as a plant has a limited number of boiling tanks, and when these are filled no more material is brought in from the 'fields'. From the bins chutes lead to crushers, the caliche (or caliche and costra) being reduced to 2-in. size; rolls are also used, placed below the crushers, but no arrangements are made for screening, so that there is an unnecessary making of 'fines'. The ideal product for leaching is the coarse size (about 2 in. diameter) with a minimum amount of 'fines', as the latter tend to cake in the boiling tanks and prevent thorough percolation of the solutions. The treatment of the fine material, separately, is receiving attention and experiments are under way. The crushed material is hauled up an incline, to the boiling tanks, in a three-ton, side-discharge, hopper-bottom, steel car and automatically released, then moving on a slight down grade parallel to the tanks (locally called *cachuchos*). Each series of tanks are trestled, at right angles to their lengths, by two lines of track (30-in. gage); the loaded car moves on a turntable and is 'spotted' where needed. The tanks, made of $\frac{1}{4}$ -in. or $\frac{3}{8}$ -in. iron plate, are 9 ft. wide, 24 ft. long, and $7\frac{1}{2}$ to 8 ft. deep, holding approximately 900 quintals (under 45 tons) of caliche. Each tank has a false bottom, of perforated plate with $\frac{7}{16}$ -in. holes staggered 2 in. apart, that stands 8 in. above the real bottom. Two bottom discharge gates, (each one foot square) serve as discharge for the leached caliche (locally called *ripio*) to 3-ton cars that are run in below the tanks and hauled up an incline to the waste dumps. In the early days of the industry this

contained up to 20% NaNO_3 ; at present the ripio averages from 7 to 10% NaNO_3 . A series of four turns of 3-in. steam coil passes around the sides, inside of the tank. Through this live steam, at 25-lb. pressure, circulates. The material to be leached is heated up to 90° Twaddell. Mother liquor originally from the crystallizing tanks, containing about 30% NaNO_3 and 13% NaCl is run in over the caliche and left 6 hours in contact from the time steam is turned on. Each tank is connected with its neighbor by means of a siphon, which draws off the solution below the false

bottom (called the crinolin plate) and discharges it into its neighbor at a point about two-thirds up the height of the tank. The siphon pipes are so arranged that the liquor must pass diagonally from one end of the tank to the other, and from the top down. The tanks are connected in series of four. Every pipe connection, between the tanks, has a discharge valve for drawing off the solution below the false bottom, and a bottom discharge plug for cleaning out below same. Three other pipe connections exist for admitting cold mother liquor, and wash, and fresh waters.

Pressure and Vacuum at Altitude

By A. W. ALLEN

The elevation of the plant above sea-level must be taken into account when estimating the possible duty of a number of machines used in cyaniding work. The following table of approximate pressures, for different elevations, may prove of use:

Altitude.	Atmospheric pressure per square inch, pounds.	Equivalent in water column, feet.	Equivalent in mercury column, inches.
Sea-level	14.7	34.0	30.0
1,000 feet	14.2	32.9	28.9
2,000 "	13.6	31.7	27.8
3,000 "	13.1	30.6	26.7
4,000 "	12.7	29.5	25.7
5,000 "	12.2	28.3	24.8
6,000 "	11.7	27.2	23.8
7,000 "	11.3	26.1	22.9
8,000 "	10.9	25.0	22.0
9,000 "	10.5	23.8	21.2
10,000 "	10.1	22.7	20.3

The theoretical fixed pressure output from a compressor will decrease to an amount varying with the altitude and also the pressure required. To produce equal volumes of compressed air, at the same gauge pressure, it is necessary to handle increasing volumes of free air according to elevation of the plant above sea-level and gauge pressure required. This increase may be taken as a rough guide in estimating the increased cost of compression; the same ratio referring to the increased expansibility of compressed air at elevation.

The maximum suction lift will decrease, at elevation, in direct proportion to the figures given in the table of water column equivalents. These figures indicate theoretical lifts which are not realizable in practice to within 80 per cent. In pumping solids in water, or other diluent, an allowance must be made in proportion to the specific gravity of the mixture. The actual possible lift is also influenced by the class of pump erected, the care with which the joints have been made in the suction pipe, and a number of other considerations.

For each 1000 ft. of elevation a deduction should be made roughly equivalent to one-thirtieth of the

vacuum obtainable by the same type of pump at sea-level. In vacuum filtration at high altitudes the initial vacuum may be sufficient, but the capacity of the filter will rapidly decrease as the pores of the canvas become clogged; and the necessity for frequent treatment or replacement of the material will become apparent. Expensive and difficult transport may involve a prohibitive cost for the acid cleaning of the cloth. In the latter event, the adoption of a system of pressure filtration should be considered.

The air lift, when properly constructed and operated, may be considered as an ideal expansion engine. The air, at the conclusion of the work, should escape at little above the pressure of the surrounding atmosphere. It follows, therefore, that the extra cost of air compression at an altitude is, in this system of pumping, balanced by the increased expansibility of the air when compressed. Air-lift operations at high altitudes are therefore as economical as at sea-level.

In the Premier pump the air is compressed during the revolution of the spiral; and, since the height of lift is practically dependent on air pressure, it follows that this type of pump is affected by altitude in the same way as the compressor. If sea-level results are expected at an altitude, a spiral of large diameter must be used. The makers suggest a deduction of four inches from the sea-level lift for each 100 ft. of elevation when spirals of the same size are under consideration.

The Hudson River region produced 1,025,308,000 bricks in 1913, valued at \$5,636,061, according to Jefferson Middleton, of the U. S. Geological Survey. Large as these figures are, they show a decrease of 207,879,000 bricks and \$1,497,116 in value compared with 1912. New York City is the leading market for common brick in the United States, hundreds of millions of bricks being used there annually.

Undercutting machines have been an important factor in increasing the per capita production of miners in District VII of Illinois, to 5.1 tons of coal per day, compared with 4.5 tons for the whole state.

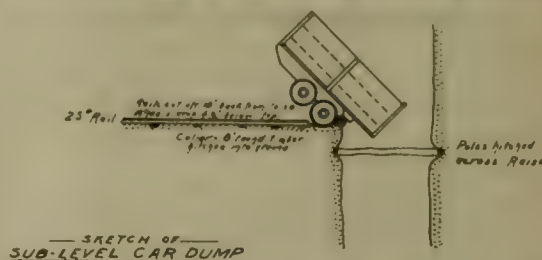
Making Ductile Tungsten

The following abstract of a description by R. W. Moore of the methods used in preparing ductile tungsten which appeared in *Met. & Chem. Eng.* is given by *Chemical Abstracts*. Scheelite is decomposed by HCl, yielding impure WO_3 . This is further purified by solution in NH_4OH , and re-precipitated by HCl. Wolframite is fused with Na_2CO_3 , the mass is dissolved in water, and WO_3 precipitated by HCl. The crude WO_3 from either of the above processes is roughly reduced by heating with C and yields impure tungsten; worth about \$1 per pound, which is used in the steel industry. For making ductile tungsten, the crude WO_3 , which may contain salts of Fe, Mn, Ca, Mo, P, As, Na, and Si, must be further purified by one of the following methods: (1) The crude WO_3 is dissolved in NH_4OH . The solution is filtered and evaporated, yielding ammonium paratungstate crystals. The crystals are washed, dried, and decomposed by heat, leaving WO_3 . This oxide is very pure. (2) The crude WO_3 is dissolved in NH_4OH . The solution is filtered and the WO_3 again precipitated by HCl. This method does not remove P and As. (3) The crystals obtained in the first method are decomposed by aqua regia. The purified WO_3 obtained by any one of the above methods is reduced by heating with either carbon or hydrogen. The reduction by hydrogen is carried out by placing the WO_3 in an electric tube furnace and heating it slowly to about 1000° while a slow stream of pure dry hydrogen is passed through the furnace. The reduced tungsten is in the form of a fine gray or black non-crystalline powder. This powder is placed in a mold and pressed into the form of a square bar. The bar is sintered at a temperature of 1300° in an atmosphere of hydrogen in an electric tube furnace, by which treatment it becomes strong enough to stand ordinary handling. The bar is next placed in an atmosphere of hydrogen and treated nearly to its melting point ($3200^\circ C.$) by passing a large current through it. By this treatment the bar becomes very hard, but not ductile. Then the bar is heated to about $1500^\circ C.$ and swaged while hot into the form of a round bar. The hot swaging is continued until the bar is reduced to a diameter of 30 mm. During the operation of swaging the metal is made ductile. It is now drawn through diamond dies while hot ($600^\circ C.$) until it is small enough for lamp filaments. When tungsten is made into other forms than wire, it is rolled or forged hot, since it is too hard to machine when cold. Tungsten has a high tensile strength, and is not attacked by damp air or any single acid. It is dissolved by a mixture of hydrofluoric and nitric acids.

Railroads in the United States, during the year ended June 30, 1913, carried a total of 2,009,462,000 tons of freight, 300,558,334,000-ton miles. Passengers carried numbered 1,018,283,000, the first year that the billion mark was exceeded.

Car Dump

The accompanying sketch shows a simple car dump used in iron ore mines, in the sub-levels where the ore is dumped into ore-chutes. The rails extend to only 18 in. from the collar of the chute, and a drop of 41.2 in. is allowed for the front wheels of the car. The round timber collar at the chute is shaped so that the



front end of the car frame strikes it when the wheels drop. The car should dump at an angle of 45 degrees. It is evident that the car wheels are close together which, of course, makes for easier tramming on rough tracks. In some mines, where the distance is short, steel wheelbarrows are used in the subs in place of cars. The poles across the raise have saved the lives of many men who fell into the chute.

Expenditure at Panama

Operations at Panama Canal have attracted considerable attention, and now that the waterway is nearly ready for traffic, the following cost of the work should be of interest. To January 31, 1914, according to *The Canal Record*, the total was \$317,397,016, made up by department of civil administration, \$6,833,954; law, \$56,392; sanitation, \$16,961,623; construction and engineering, \$199,937,199; general items, \$89,458,448; and fortifications, \$4,149,400. Details of construction cost to the end of 1913 are as follows:

Gatun spillway.....	\$ 3,431,765	Miraflores locks.....	\$17,566,326
Gatun dam.....	8,690,831	La Boca locks and	
Gatun locks.....	29,189,290	dams	632,999
Gatun hydro-electric plant	568,800	Pedro Miguel to the sea, total....	\$48,851,314
Gatun-Mindí levee.....	106,492	Cristobal, terminal facilities	221,763
Gatun to the sea, total	\$53,756,184	Balboa, terminal facilities	4,555,051
Gatun to Pedro Miguel	86,983,245	Townsites	354,251
Pedro Miguel dams	365,314	Permanent buildings	222,970
Pedro Miguel locks	12,126,012	Power transmission system	449,342
Miraflores east dam	983,252	Oil pipe, lights and buoys	523,162
Miraflores west dam	964,623		
		Total construction cost	\$197,965,955

These costs include administrative and general expenses, but do not include general items, or expenditure for sanitation, hospitals or civil administration.

Power used in the Cobalt district, Ontario, amounts to 13,000 horse-power.

Discussion

Readers of the MINING AND SCIENTIFIC PRESS are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment. Insertion of any contribution is determined by its probable interest to the readers of this journal.

American Investments in Mexico

The Editor:

Sir—I have just read with great interest your editorial in the issue of May 16 on 'American Investments in Mexico,' and I wish to express my appreciation of the same.

It seems to me that you have stated fully and concisely the facts of the case, and your opinion corroborates what I have learned from reliable men who are familiar with present and recent conditions in widely separated parts of Mexico. It is indeed a relief to read such an article after perusing so much inaccurate and foolish writing that one meets in the daily press.

My own experience in western Mexico the past year and a half bears out your conclusions, and I have no misgivings for the future in Mexico. Too many Americans resident in Mexico who ought to know better, and most of the people on this side of the line, have no knowledge of or sympathy with the ordinary Mexican character, which is very necessary to enable one to form a valid opinion of Mexican affairs.

E. P. CRAWFORD.

Silver City, New Mexico, May 21.

Survey Publications

The Editor:

Sir—In a letter from F. L. Ransome in your issue of May 2, 1914, I note that the United States Geological Survey is now, and expects to continue, sending geologists to the various new districts for the purpose of making brief reports, which are promptly issued in bulletin form, and which are later to be incorporated in general summary volumes on the geology and ore deposits of each state. The volume on New Mexico, which has already been published, is most valuable to the engineer and prospector who wishes to obtain information concerning the ore deposits of that state, and I am glad to note that other volumes, for Arizona, Idaho, and Utah, are in preparation. These volumes, and especially the bulletins, should be of considerable value to the prospector, and every effort should be made to call the attention of the prospector to the fact that these bulletins are being published and that they are free. I venture to say that a majority of the prospectors are not aware that such data are available or where they can be obtained, wherefore it would appear most advisable to give as much publicity to the work of the Geological Survey as is possible.

For several years I have been keeping a loose-leaf file of data on practically all of the mines of the United

States, and among these data I find a considerable percentage of references made to the Geological Survey publications, thus indicating to me that the Geological Survey has been fairly active in the examination of the various mining districts. That improvements might be made is always possible, because new conditions arise whereby new information, and also new methods of obtaining and disseminating information, are required.

In some quarters a misconception prevails as to the information that a geologist can supply. I have heard prospectors and even engineers criticize the Survey publications in that they do not tell them just where to find a body of ore. Based on the observations made in the same district and also in other districts, the geologist may be able to indicate in a general way the more favorable points to prospect, but he does not pretend to state definitely just where an orebody is to be found. Only the charlatan with the dipping needle will pretend to do that.

S. F. SHAW.

New York City, May 12.

Inducing Capital into Mining Enterprises

The Editor:

Sir—I have noticed the very good comments appearing in your paper on 'What Is the Matter with Prospecting?' and while this subject is before the profession and public it might be a good idea to take up the kindred subject of the obtaining of money to develop and operate properties on which enough work has been done to warrant the expenditure of further capital.

Much has been written on this subject, and in giving my views and experience, I do it not for the benefit or criticism of those well known engineers and successful promoters whose name on a favorable report will guarantee ample capital for the investment, but rather for those not so well known, who often have meritorious propositions submitted to them and who fail when it comes to getting enough capital to finance their enterprise.

For the sake of elimination, I will divide mining into two heads: coal and iron mining and kindred minerals, and the mining of precious and semi-precious metals.

Coal and iron mining is usually conducted by large interests who use the products, directly, in their manufacturing or railroad plants. Good properties, of this class, are in demand by these interests, who have their own engineers constantly in the field, looking for such properties. There is no complaint concerning the hesitancy of capital to enter this field of mining, as the demand is strong and the supply limited.

It is in the field of precious and semi-precious metal mining where capital seems backward, and where the big howl goes up from the promoters and miners. In this field the demand is light and the supply fairly large. There are, at present, about a dozen large

companies, throughout the world, who make mining a business. These companies are always looking for developed properties, where they can obtain a large return for their money, and as long as the demand among the general public for mining properties is light these companies will continue to dominate the markets and to pick up properties at their own figures or leave them in idleness.

The sale of mining properties, like all other commodities, follows the law of supply and demand, and whenever the demand is light there is no use of the promoter and prospector turning to the larger companies and then becoming discouraged if these companies offer prices which are not commensurate with the value of the property. The promoter must turn to other fields. He must turn to the public and show them that they will get good returns from their money by a company capitalized both with that idea in view and the idea that the owner will get a price commensurate with the value of his mine.

One instance is recalled wherein a merchant bought a small prospect and developed it for a few years. He then had the property sampled by reputable engineers and his ore tested by reputable metallurgists. He found that after paying for all mining and milling equipment and all operating costs and plant depreciation there would be a net profit from the ore in sight of about \$275,000. He offered the mine for sale to a large mining company, which offered him \$75,000 for his property. Of course, he turned down this offer and was highly indignant that such a company should offer him such a meagre figure. He then consulted a small banker. This banker called in another engineer, who checked the owner's figures on the property. This engineer was well posted in financial matters, knew the trend of the public investments, and suggested that the banker sponsor a company of \$400,000 capital. This the banker was willing to do, for a small consideration, so the company was floated by the help of this banker's name and the mining and milling reports of the reputable engineers. The stock was oversubscribed (the stock was sold at par), the owner received \$200,000 for his property, the mine was developed under good management, a mill erected, and the investors received, and are still receiving, good returns on their investment.

It is hard, at any time, legitimately to float a prospect, as it is too much of a gamble in most cases. Therefore, my discussion will not take in that class of property, but will deal with properties on which there has been enough of development work done to warrant a sale being made to the public. The question is how to induce the public to take an interest in the mining of precious and semi-precious metals. Prior to 1907 almost everything was done to discourage the public from entering this field. A little history might serve to illustrate this point.

Precious-metal mining had its first great impetus in this country, from the finding of placer gold deposits in 1849 in California. In those days a man

could take a pick and shovel and sluice, and by working hard could, if he found good ground, make a fortune from his labors without the expenditure of much capital for development or equipment. His gold was readily salable, so he had no reduction processes to contend with. That idea, in regard to all mining, has stuck in the public mind ever since, and when the lode mines were discovered on the Comstock the public thought that the returns would be the same as from placer mining; that little good management was needed, or there was not required much money for development or equipment. As a result, thousands of companies were floated, based on undeveloped or partially developed prospects, most of these companies not having sufficient capital to rightly work their properties. When it was realized that more money was needed, the public could not see it that way, and regarded the properties as worthless, losing money and leaving the prospects undeveloped, a great many of these prospects proving very rich when worked later by mining companies whose managers realized that it took capital and good management to make a mine out of a prospect. The exceptions to this rule, and they are very few, are those properties having high-grade ore from the grass roots. It was the striking of high-grade deposits of the exceptional kind which started the Goldfield and Cobalt booms. Because a few of the companies had this high-grade ore from which they made large fortunes without the expenditure of much capital, crooked and reckless promoters took advantage of this fact in getting money from the public, making the plea that companies with small amounts of actual cash capital could make great fortunes. Believing this and remembering the days of '49, the public was 'stung' to the amount of over \$400,000,000 in 1905 and 1906 by taking stock in companies owning prospects that were either worthless or on which not enough capital or good management had been spent to make a mine.

Since 1907 the public has been pretty well educated as to what real mining is, and what is required before dividends are forthcoming. They have been educated by our mining and daily papers, and by our great engineering societies and our government and state sustained mining bureaus. While these bodies have been working to educate the public along the lines of entering legitimate mining enterprises, the general business of the country is trending to open the eyes of investors to the good returns to be obtained from mining investments.

Formerly the investor put his funds into the securities of railroad and industrial concerns, as these offered a good return upon his capital. However, since the large demands of labor and the advent of regulations imposed by our law-making bodies, this class of securities does not offer such good return as formerly—to illustrate which, one might use the recent New York, New Haven & Hartford episode. Therefore, there was or is a dearth of investment in such securities, and the investor turned to the securities of

power and public utilities companies. Now many of the state legislatures are making laws regulating prices at which power, light, heat, and public utilities, in general, are to be sold, so that profits will be small and the investor will withdraw his funds and with additional savings will seek investment with good returns.

There remains but one line of investment open, to obtain the desired return, and that is the development of the country's natural resources, the development of which will not be retarded by adverse legislation to such a degree as materially to affect the return upon the investment. In this line comes the mining of precious and semi-precious metals, and I believe that from this time on the investor will look more into investing in mining securities.

Another incident, that is not of importance at the present time, is the collection of the personal state tax. The personal property tax in some states is so excessive as to be confiscatory, so that the people pay this tax on only a minor portion of their property. The tax collectors realize this fact and do not ask for an inventory; they take the taxpayer's word. Under the new federal income tax law, one must file an accurate report of all income over \$3000, or \$4000 if he be married and living with his wife, from personal or other property. When the state tax collectors see these inventories filed for greater sums than declared to the state, they may try to collect the full tax on all personal property. To cite an example: One of our states, I understand, claims a tax of $2\frac{1}{2}\%$ on the market value of all personal property. In this state there resides a capitalist who owns \$15,000,000 in bonds of an industrial corporation on which he receives 5%. The bonds are selling at par. Under the state tax he would have to give half of his income to cover this tax, and his investment would then net him $2\frac{1}{2}\%$. His state tax, heretofore, has been based on \$10,000 of personal property. It will be interesting to note if the personal tax collector will base his future taxation on the old \$10,000 or upon the \$15,000,000 inventoried from income under the federal income tax. In most cases semi-precious and precious metal mining stocks do not reach par, on the market, until the dividend reaches about 10%; so if this capitalist had his principal sum invested in mining securities he would receive a net income of $7\frac{1}{2}\%$ after the personal tax, as compared with $2\frac{1}{2}\%$ as at present. A few of the mining stocks do not pay more than 6% on the market value, but these are the larger mining companies and their stocks, based on dividends, do not follow the market trend of the stocks of the smaller companies. Market or personal tax conditions may adjust themselves if the personal tax should be collected in full; but in any case, I believe that mining stocks will have the better end of the argument.

The larger companies, when they want public subscriptions, usually give reports from reliable mining engineers and metallurgists to their prospective investors, and their stock allotments are usually over-

subscribed, simply because they understand their business. Therefore, how can the promoter, working on a smaller scale, expect to interest the public without giving them the detail that the larger companies know is necessary to successful flotations?

A mine with good ore in it is not always a safe investment, as there must be some method to treat the ore and return a profit, especially where the ore is low in grade, when local treatment must be resorted to. The investor now realizes the importance of the reduction process. Being in the metallurgical end, I know that there are more reduction process inquiries out and more ore being tested at this time than there has been for a great many years.

Now that things are trending toward public investment in mining, and the public having been taught the legitimate mining game, it might be well for the promoter to have reports on his property by reliable engineers and metallurgists, and if he cannot sell to the large companies, try the public in smaller units. To the owner there is sometimes more to be gained by taking some stock or convertible bonds for his property than by taking cash payments. This latter method often facilitates the initial financing of the company. The time is ripe, and capital, like all other liquid bodies, will flow along the line of least resistance. Give the investing public a good legitimate property and a square deal, and they will invest; otherwise, you will find them using the great railroad slogan of the day, 'Safety First.'

CARL J. TRAUERMAN.

Butte, Montana, May 10.

Revision of the Mining Law

The Editor:

Sir—I notice there is considerable interest being taken regarding the Mining Code Commission for the revision of our present mining laws among those who are interested and engaged in mining. In your editorial of April 4 you stated rightly that the Commission ought to be composed of more mining men. Most of us believe that new laws should be made, and discussion, by those who are interested in mining, in the mining press of the country, would have considerable weight in the making of the new laws. Strict fundamental laws in regard to location and title is what is necessary, and from my observations I believe the following, if put into law, would be of some help:

1. Location of a mining claim to be made by those only who are citizens of the United States and those who have declared their intention to be such.
2. Size of a mining claim to be 1320 ft. in length by 660 ft. in width.
3. Discovery monument 4 ft. in height or stake 4 ft. in height, with the notice of the location to be at the northeast corner of claim.
4. Boundaries, side and end lines to be marked by stakes, rock, or dirt monuments at least 2 ft. in height and not to be over 100 ft. apart on the side and end lines, the corners to be marked by stakes at least 4 ft.

in height and 4 in. square, marked with name of claim and what corner.

5. Discovery work to consist of a shaft not less than 6 ft. in depth; adit or open cut, not less than 6 ft. in depth at face.

6. To describe accurately the location of claim from some fixed point, like section corner or known prominent place or object.

7. No extralateral rights; vertical side and end lines.

8. Claim to be recorded in 60 days from date of location, location day inclusive.

9. No overlapping of claims.

10. Heavy fine with imprisonment for back dating.

11. The first day of July to be the first day of the year relating to mining locations.

12. The locator or owner of a mining claim to pay the state or Government an annual tax of \$10 per year to hold said claim, said \$10 tax to be paid, if so wanted by owner of claim, in \$5 payments to cover a period of six months, ninety days from date of location.

13. The locator or owner of a mining claim can, if so desired, secure patent for same upon complying with the following requirements: to have paid the tax for three consecutive years; found mineral in place; made improvements to consist of at least 1000 cu. ft. of rock or dirt removed from excavations made by shaft, adit, or tunnel from surface or underground workings as development work; price of land \$10 per acre, to be paid the Government.

14. To reserve all mineral rights on subsequent agricultural filings, with certain surface reservations, these mineral reservations to be had by complying with the mining laws in force at the time said agricultural filings are made.

15. No location of mineral ground can be made by proxy or power of attorney and only in name of the actual locator.

When one goes deeply into the subject, he will find in the present mining laws and rulings nothing to commend them. The public wants laws enacted and put in force that will benefit the mining industry and be of some help to those that are engaged in it. Under our present laws, an alien can locate, hold, work, and sell any number of mining claims, but cannot get a patent. Changing the size of a mining claim from the present size to one of 1320 ft. in length by 660 ft. in width would be much better and more beneficial both for title, patent, and in other ways. The change in size would allow the location of a mining claim to be made in certain legalized subdivisions of surveyed sections; fully 50 per cent of subsequent locations and patents would be designated by the subdivisions of sections, doing away with the heavy survey cost and tying up the claim proper for all time.

The first day of July of each year would be the most convenient day for the start of the mining year in relation to mining locations. There are always a great number of locations made on the first day of the year in all of the mining districts, and in most of the

places the ground is covered with deep snow.

But the greatest change for the good of those who do own mining claims would be the annual tax of \$10 per claim, something on this order is the only thing which would give one an absolute good title for an unpatented mining claim. The present system of requiring \$100 assessment work is not only evaded but is wasteful; in a majority of cases it is like making the owner of a mining claim throw \$100 into the fire and burn it up for the privilege of holding the claim one year, for all the good it does. Some claim it makes more development, but from my observation I believe it retards good development. In most places the work is done in some soft place where a certain amount of work can be done the easiest. It does not give the owner of the ground a good title; the claim is always open to 'jumpers'; the owner can swear he did the work, the others can swear he did not; there are a thousand bad features in this part alone. The only thing that should give title would be the tax receipt. People have owned and worked certain claims for a great number of years, and then suddenly, through some small technical ruling about the work, have lost the claim. There would not be any more claims held than now—maybe not as many. What work would be done would be true development under an annual tax. Poor, uncivilized, and revolutionized Mexico has us beat many ways on this. I notice some writers in discussion favor the Canadian laws relating to mining; but deliver us from those laws—one-man commission and the like. Many will remember how they construed those laws some years ago, repudiating the valid claims of the Americans in the Atlin district. Also, when the boom was on around Dawson, when claims were located by numbers, as 'one above' or 'two below discovery,' men stood in line for hours in that beautiful Italian climate to put their claims on record, only to be told 'Claim already located and recorded.' In South Africa and some of the colonies it is very nearly prohibitive for an individual with small means to hold and own mining ground.

In our agricultural laws a homesteader knows just where he stands, his requirements, and definite legal subdivisions of his land. This is what is needed for mineral lands—laws that are not to be so construed that white can be made black. Much of the future prospecting and mining will be done in ground where mineral deposits do not show on the surface. Results will be had from diamond-drilling, deep workings, and the like. The revision to be enacted should be made to construe laws not only for the present but for the future. It is only a short time before new laws will be enacted, and I believe like the fellow that said when he spit his fuse: 'Now is the time to holler—not when the shot goes off.'

FRANK P. DAVIS.

Fluorine, New Mexico, April 15.

[We believe with our friend that now is the time to have your say about changing or not changing the mining laws. Who else speaks?—EDITOR.]

Concentrates

Most of these are in reply to questions received by mail. Our readers are invited to ask questions and give information dealing with the practice of mining, milling, and smelting.

Potash shipments from Germany in 1913 were 1,166,600 metric tons, of which 531,300 tons was exported for foreign consumption.

The co-efficient of expansion of platinum is about the same as that of glass. This fact accounts for the general use of the metal as a connection between the outside and inside of an incandescent lamp.

Poisoning water hyacinths in Gatun lake, Panama, is now being done. A solution of 25 lb. of arsenic, 25 lb. of soda, 25 gal. of water boiled for one hour, is mixed with 425 gal. of water, and then sprayed on the plants. In about ten days, a plant so treated is apparently dead.

Sharpening drill steel by machines is economical and generally satisfactory, though some miners do not like bits produced by a machine. On the Rand, it is said that 80% of the bits employed in the Main Reef mines is sharpened by hand, although there is an economy of about \$9.36 per 1000 bits in sharpening by machines.

Cyanamid is a dry, grayish black, pulverized material, which is made by combining pure atmospheric nitrogen with calcium carbide at a temperature of 1100 to 1200 C. Its principal use is as a source of nitrogen in mixed fertilizers. The world's output for 1914 is estimated at 275,000 tons, worth at wholesale prices about \$14,000,000.

Mine bell signals should be posted in the station of each level in some conspicuous place. Generally the signals are printed on white duck cloth, or on oilcloth. In Kalgoorlie mines, the salt water eats out the ink, and recently the cloth signs at the Perseverance were replaced by enameled steel plates, on which the lettering stands out in blue on a white background. These plates are neat, and are practically indestructible with ordinary wear and tear.

A black bug or beetle, locally called the slag-bug, is found around the Montana smelters in the summer, and its favorite place of attack is the back of the neck of the smelterman, where its nip or pinch causes some discomfort and strong language. A similar insect is found at Kalgoorlie, Western Australia, where it delights in diving into heaps of hot ash from boilers and roasting furnaces. It also nips hard and goes under the name of slag beetle, asbestos beetle, or salamander.

Steamers engaged in the ore-carrying trade of the Great Lakes total about 400, which have a capacity of

55,000,000 tons of ore per season of seven to eight months. They also carry large quantities of coal, grain, copper, and salt. The Pittsburg Steamship Co. owns 105 boats. During 1912, ore was transported an average distance of 1000 miles, for as low as 50c. per ton, boat owners paying the unloading charge of 10c. per ton. Some of the newer boats are as follows: *Col. J. N. Schoonmaker*, 617 ft. long and 14,000 gross tons; *W. P. Snyder, Jr.*, 617 ft. and 14,000 tons; *Thomas F. Cole*, 605 ft. and 12,000 tons; *L. S. De Graff*, 605 ft. and 12,900 tons; and *W. B. Kerr*, 605 ft. and 12,300 tons. A boat of 10,000 tons is usually loaded in six hours; but 9456 tons was run into the *Corey* in 1911 in 25 minutes. The



A LAKE ORE CARRIER.

W. P. Palmer was unloaded of 11,000 tons in 2 hours, 58 minutes. The accompanying picture of an ore steamer was recently taken near Marquette, Michigan.

The presence or absence of smoke at the top of any stack is not of itself a proof that the plant is being inefficiently or efficiently run, or even improperly or properly operated, although it is popularly so considered. Many boilers which are being operated with little or no smoke would show low over-all efficiency if tested; whereas others from which much smoke is being emitted would show that the fuel is being economically utilized according to Samuel B. Flagg of the U. S. Bureau of Mines, Pittsburgh. Such cases may be said, however, to be the exception rather than the rule, as the smoky stack is usually an indication of inefficient or improper operating conditions. This statement is borne out by results of many tests conducted at the government fuel-testing plant at St. Louis in 1904-1906. If the requirements for complete combustion of coal are complied with, it is obvious that smoke will be prevented, for the reason that smoke is an indication of incomplete combustion. The requirements are: (1) that the necessary air for combustion be supplied; (2) that the gasified fuel and air be intimately mixed; and (3) that the mixture be at a temperature at or above that at which the combustible gas will ignite or burn.

Special Correspondence

LONDON

PROPERTY OF THE BURMA MINES, LIMITED.—GEOLOGY, EXTENT OF VEINS, METAL CONTENT, AND ORE RESERVES.—WORK TO BE DONE.—ORE SHIPMENTS.

The event of last week in May was the public rehabilitation of the Burma Mines, Limited, by H. C. Hoover and his friends. This Company was formed by Bewick, Moreing & Co. in 1906, as a reconstruction of a company registered in 1904 to acquire a lead-silver mine, and heaps of ancient lead slags at Bawdwin, near Lashio, in the Northern Shan States of Burma, not far from the Chinese border. The treatment of the lead slags yielded some profit, but the funds so obtained, together with considerable additional capital, were spent in reopening and exploring the mine. Development was hindered by the large amount of water, and it was only by driving a drainage adit that further work was made possible. The orebodies were discovered to be of great extent, and to consist of mixed sulphides similar in character to those of Broken Hill, Australia. The Burma Corporation was formed six months ago by Mr. Hoover to help finance the Company. This Corporation has now issued 100,000 shares, bringing the total issued capital to £577,410 and has given a call on 200,000 further shares. A pamphlet has been issued containing a report on the properties signed by the technical committee of the Corporation, which is composed of R. Gilman Brown, Theodore J. Hoover (alternate A. F. Kuehn), and E. Heberlein. From this report I extract the following information:

The ore-channel of the Bawdwin mine is from 350 to 500 ft. wide, and has been traced for 8000 ft. The active work by the ancients, and by the present Company, has been confined to the northern 4000 ft. The ore occurs in nearly vertical shoots with a hanging wall of feldspathic grit, and a foot-wall usually of rhyolite, and sometimes of feldspathic grit. The ore-channel is covered by more recent sedimentaries, which have been eroded at the northern end so as to expose the ore. The rocks in which the orebodies are found have been called the Bawdwin series, and the overlying sedimentaries the Banyan series. The ancient workers had mined the outcrop of oxidized lead ore apparently with the object of extracting the silver. The work started by the present owners has been devoted to the development of the sulphide zone, and may be roughly divided into three parts, namely, the vertical shaft, Chinaman adit, and Tiger adit sections. The vertical shaft has been sunk to 434 ft., at a point 1400 ft. from the north end of the ore-channel. Cross-cuts have been driven at the 102 and 171-ft. levels, intersecting old workings. The 300-ft. level is virgin ground. A cross-cut is now being driven at the 430-ft. level. In this portion two lodes have been proved, called the Burman and the Shan. In the 300-ft. level, the Burman lode for a distance of 190 ft. has an average width of 31 in., assaying 33% lead, 10% zinc, and 37 oz. silver per ton, with a trace of copper. The vertical shaft cut the lode at 410 ft. The Shan lode is parallel to the Burman, about 150 ft. to the east. At the 300-ft. level a cross-cut proved the lode to contain copper as well as lead and zinc. The assays showed 99 ft. on the northern side, 4.1 ft. thick, to average 11.2% lead, 1.5% zinc, 1.9% copper, and 8.4 oz. silver, while 150 ft. of the southern part averaged 17 ft. thick, and assayed 15.4% copper and 7.8 oz. silver.

The Chinaman tunnel enters at a point 3650 ft. south and 100 ft. west of the vertical shaft, and intersects the ore-channel 1887 ft. south of the shaft, at a horizon corresponding approximately to the 171-ft. level in the shaft. The core of the Chinaman orebody consists of zinc-lead sulphide, about 500 ft. long and 44½ ft. wide, assaying 29.6% zinc, 26% lead, and 27.6 oz.

silver per ton. This core is enveloped by ore higher in lead, to a thickness of 20 ft., and assaying 24% lead, 14.2% zinc, and 17.5 oz. silver. Then comes a zone of ore of lower grade, 70 ft. wide. The total length of the orebody on the 171-ft. level is 1187 ft. The lower-grade ore is not included in the estimate of reserve: It averages 7% lead, 5% zinc, and 5 oz. silver. Two other smaller orebodies have been cut in the cross-cuts.

The Tiger adit is being driven with the object of providing a working entry to the mine. Its portal lies on the Sterne river, at a point convenient for access to the Company's smelter at Nam Tu. It will be about 6000 ft. long, and will enter the ore-channel 500 ft. below the Chinaman adit and 650 ft. below the collar of the vertical shaft.

The estimates indicate 1,154,000 tons of ore as reasonably assured, with further excellent prospects at depth. The most profitable method of ore-treatment is being studied, but in the meantime the zinc-lead ore is salable to European smelters, who during the past few months have taken 7488 tons. The profit to the Company on the sale of the ore in this way would be \$9.60 to \$12 per ton, with the value of the total metal contents at \$62.40 per ton. The purposes to which the present issue of capital is being devoted are: the completion of the Tiger adit, the rebuilding of the branch railway, the erection of a concentration plant, the installation of a hydro-electric power-plant and sufficient development to render possible the extraction of 300,000 tons of ore annually. It will take 2½ years to complete this program, and during the time it is intended to ship 2500 to 4000 tons of zinc-lead ore per month, and to continue smelting either on picked lead ore or on the copper-silver ore.

NEW YORK

DEVELOPMENT COMPANY OF AMERICA, SOME HISTORY.—BRADEN PLANT TO BE ENLARGED.—CHILE COPPER CO.'S PROPOSALS.—ANACONDA LEACHING PLANT.—DOME LAKE.—OIL INDUSTRY.

The suit, filed last week in the Supreme Court, of the Development Company of America *v.* the Southern Pacific Railroad Co. for violation of agreement, reveals rather interesting history of the Development company. It was organized in 1901 by George B. Beaton and consisted of a group of investors from the Middle West and New England, who were successful business men and bankers, but without experience in large-scale mining. The ambitions of the organizers were entirely out of proportion to their resources and experience, and it was not long before they controlled, through stock ownership, the Tombstone Consolidated Mines Co., Ltd., the Imperial Copper Co., Congress Consolidated Mines Co., Ltd., Poland Mining Co., Gila Copper Sulphide Co., Lookout Copper Co., and the Southern Arizona Smelting Co., besides holding a large interest in the London Arizona Copper Co. and its subsidiary, the London Range Copper Co. In 1910 the Company formed the Arizona, Mexico & Gulf of California Railroad Co., to continue the 22-mile long connecting line of railway built by the Imperial Copper Co. This line ran from Redrock, on the Southern Pacific, through Sasko to Silverbelle, Arizona, and it was the intention of the Development Company to continue it on to Puerta Lobos, on the Gulf of California, in order to give it direct communication with Tidewater. The Imperial Copper Co. made quite a little copper, producing 10,000,000 lb. in 1909. The Tombstone proved a bad investment, however, for although the Tombstone company installed one of the largest pumping plants in the country to unwater the mine, it was never able to get the water out, since apparently the underground levels had some mysterious connection with the Pacific ocean or some other equally inexhaustible supply. The complaint against the Southern Pacific company is based on the fact that, in 1910, when the Company was involved in the height of its high finance, F. W. Murphy, then president of

the Company, made an arrangement with Judge Lovett of the Southern Pacific for a loan of \$500,000 on the note of the Company, and, furthermore, that the Southern Pacific would buy \$2,500,000 of the capital stock of the Development Company, making payments of \$500,000 every quarter until paid for. Relying on this agreement, Mr. Murphy notified the creditors of the Development Company that it would be in funds on the date agreed for the making of the loan, and instructed them to draw on the Company on that date. The money was never forthcoming from the Southern Pacific, and as a result the Imperial Copper Co., as well as several other of the subsidiary companies, was thrown into bankruptcy, while the railroad construction had to be abandoned. Finally the Empire Trust Co. foreclosed on \$1,500,000 of the Development Company bonds, and sold all the stockholdings in the subsidiary companies which had been deposited as collateral. As a result, the Development Company of America practically went out of existence. It is not probable that anything will come out of the present suit, which is merely an attempt to save a little out of the grand wreck. The Development Company was capitalized at \$7,000,000 and had outstanding nearly \$4,000,000 in 6% debentures. The Tombstone was the heaviest load on the Company. The financing of the whole scheme was faulty from the beginning, and it was not remarkable that it came to grief.

property, Pope Yeatman has given out a statement to the effect that the reserve will in all probability amount to nearly 300,000,000 tons of 2.1% ore, and accordingly suggests that the 10,000-ton plant now under construction be increased to 30,000 tons per day. No statement has yet been made as to whether this plan will be carried out. In all probability the actual results of the 10,000-ton mill will be awaited before beginning construction of the larger one. A good many engineers think that the management is displaying almost foolhardy courage in building so large a plant without first testing the process on a working scale in a small plant. On the other hand, it must be said that the success of some of the operations depends on their being carried out on a large scale, and the results obtained in a small plant would not be a conclusive test of what could be done with a larger one. The Chile Copper Co. already has a bond issue of \$15,000,000 authorized, and if more funds are required for construction, presumably this issue and the amount of stock will be increased.

The Anaconda is decreasing its output, while the construction of its leaching plant for the sand tailing and the slime concentration plant is under way. Treatment of all low-grade ore at Great Falls is to be discontinued, and all the milling will be concentrated at Anaconda, thus making a considerable saving in freight rates on the low-grade ore. This



BRADEN CONCENTRATING PLANT, MOLINO, CHILE.

The Braden Copper Co. intends to increase its plant in Chile to a capacity of 10,000 tons per day, or three times the present capacity. This is a natural step, following the large increase in the ore reserve which has been announced during the past year. Providing the money for these increases is another matter, however, in the present state of business, and it is announced by the management that the financing necessary to carry out the program of expansion will not be attempted until next fall. A similar expansion seems to be planned for the Chile Copper Co., which, it will be remembered, has a developed ore reserve of approximately 200,000,000 tons of 2.1% ore. Since his recent return from the

ore will be concentrated according to the flow-sheet worked out at the Great Falls plant, and the sand tailing will be sent to the leaching plant now under construction. The slime tailing cannot be treated by leaching for obvious reasons, and will be sent to the round table plant. The thin pulp goes to 28-ft. settling tanks, and the thickened pulp is drawn off and sent to the round tables which have 20 decks made of cement. The fine table concentrate, containing 8% copper, contains so much water and is so fine that it is dewatered on filters before being sent to the smelting plant.

The Dome Lake shareholders have authorized the sale of 100,000 shares of treasury stock at 50c. per share, and Temis-

Lanning and Hudson Bay interests have agreed to take all of this issue that is not subscribed for by shareholders by June 9. The new issue will bring the capitalization to \$50,000 shares. There is a 10-stamp mill, and it is reported that this will be put in operation soon. Development is in progress, and it is understood that the position of the Company is good.

The interest in mining in New York, to use a hibernianism, centres largely in oil production. The dealings in Standard Oil subsidiaries have become the leading feature of the Curb market in Broad street, which was for so long the chief arena for dealings with the smaller mining companies. The oil companies are nearly all making good profit, even in spite of the present depressed state of business. The continual development of the oil industry also helps to keep up interest in oil shares. The petroleum industry in Mexico, Venezuela, and Colombia are well known. It may not be so generally known that the drilling for oil is in progress in South Australia, and Australians hope to develop an important petroleum industry there. Some oil exploration in South America has been vigorous of recent years, and the latest report is that an important discovery of oil has been made in Bolivia, on the eastern slope of the Andes. The Standard Oil continues vigorous development of its new venture in China, and a large number of experienced oil geologists have been sent to carry on scientific study of the fields.

BOSTON

ALASKA GOLD MINES SHARES.—FALCON-WORCESTER OIL CO. AND EXCELSIOR CONSOLIDATED GOLD MINING CO.—STEPHEN R. DOW.—DAVIS-DALY AFFAIRS.—DRILLING IN MICHIGAN.

Officials of the Alaska Gold Mines Co. recently publicly deprecated the extravagant booming which has been given that stock in a market way. One of them expressed the opinion that the rise which the stock has already had to between \$28 and \$29 per share has been too rapid. A prominent Boston market operator, whose name it is unnecessary to mention, recently distributed 'tissues' on State street stating that he believed "Alaska Gold will go to 150, perhaps 200, 250, or 300," his exact words being used. He stated also that "he had investigated Alaska from top to bottom." The president and management of the Alaska Gold Mines are not expecting annual profits of more than \$2 at present, and later on of not over \$3.50 per share. With a mill of 20,000-ton daily capacity, the Company would earn, calculating the estimated rate of earnings, between \$6 and \$7 per share. It is doubtful that shares could ever sell at \$300 each, or even above the price of Amalgamated, which pays \$6 dividends, selling around \$72.

Samuel Klous, of Worcester, who has the management, in association with Worcester capitalists, of the Falcon-Worcester Oil Co., of Falcon, El Paso county, Colorado, and the Excelsior Consolidated Gold Mining Co. of Meadow Lake district, Nevada county, California, is now in the West looking after the initial drilling of the oilfield, and the opening of the mines. He has employed Henry J. Gray, of Denver, to take the local management of the mines, and J. W. Marshall, of Denver, has the local management of the oil company. State Oil Inspector Duce, of Denver, recently visited the Falcon field, which is at the junction of the Rock Island and Colorado & Southern lines, adjacent to the town of Falcon, and estimates that a flow of oil would come in at about 1700 ft. Numerous indications of oil and gas have been met with in drilling two wells down to between 1000 and 1100 ft., and the Worcester interests are confident that they will be able to develop a new oilfield in a district where transportation and market conditions are good. The gold mine management contemplates devoting its attention for the next year or two to blocking out ore underground.

Stephen R. Dow, who misappropriated about \$300,000 belonging to the Indiana, Franklin, North Lake, and Algoma

companies, in the Lake country, of which he was president, lost his case on appeal before the Massachusetts Supreme Court and is obliged to serve in Charlestown state prison his sentence, pronounced over a year ago, of not less than eight nor more than twelve years. The jury found him not guilty of larceny as alleged in the indictment, but guilty on 24 counts of fraudulent misappropriation of the funds of these corporations while acting as their president. Dow was formerly a member of the Boston Stock Exchange, and rose from the position of office-boy to one of the most daring copper speculators Boston has ever known.

Davis-Daly shares on the Boston Curb recently sold down to 1/16c each, a price of \$258,000 for the Company's entire outstanding capital. At this level the gambling element began to wonder if it was not a good speculation, and some concentrated buying set in. Since then the first installment of 25c. on the 50c. assessment has been paid. W. L. Creden, the manager, has made a careful study of the ground in which Davis-Daly is located for several years, particularly with reference to the course of the Rarus fault system, which has been so important in Butte ore development. The Davis-Daly is situated in the heart of Butte, from the business section point of view, 320 acres underlying the city, but it lies south and west of the proved mineralized system of Butte hill. Mr. Creden is confident that in sinking the Colorado shaft from 2000 to 2600 ft. he will open good ore. At \$10 par, Davis-Daly is an assessable stock, and \$9.50 per share will have been paid in when the present assessment has been met.

The most extensive campaign of drilling ever conducted in the Lake district, perhaps, has been done by the Mayflower and Old Colony companies, proving the Mayflower lode continuously over both properties, which are right in the heart of the copper country. About 75 drill-holes have been put down an average depth of 1500 feet.

WASHINGTON, D. C.

MINING LEGISLATION SLOW.—FUEL PURCHASE BILL.—NEW MINING DEVICES PERFECTED BY THE BUREAU OF MINES.—REPORT OF NATIONAL CONSERVATION COMMISSION.

Mining legislation in Congress remains at a standstill, waiting for an opportunity to be considered, which is not likely at this session, save in the bill to create a commission to codify the mining laws. This has passed the Senate and is now on the calendar of the House under another form, not differing much from the bill passed by the Senate. Of more immediate moment is the acceptance by the House of the clause in the Clayton anti-trust bill forbidding reduction works, and mine owners and operators, and the like, from not selling, when they are selling, their products, whatever they may be, to whomsoever shall reasonably and responsibly apply to buy. The clause was amended in the House last week to include water power, electric power, gas, and oil.

A new bill, introduced by Congressman Foster of Illinois, chairman of the House Committee on Mines and Mining, provides for the uniform selection and purchase of fuel to be used by the United States Government. All these purchases, whether coal, oil, or wood, are to be made or contracted for in accordance with recommendations and specifications prepared by the U. S. Bureau of Mines, whose duty it is to make investigations of fuel-burning equipments, the handling and storing of fuel, itself receiving full reports related to the subject from the departments of the Government. Payments for fuel are to be made in conformity with a statement, to be furnished by the Bureau, of the unit price to be paid. An appropriation of \$75,000 per year is provided to make the law effective.

Engineers connected with the U. S. Bureau of Mines have perfected six devices, five involving the saving of life and

one saving the waste of natural mining resources. A patent has been applied for every one of them, but is declared only to retain these devices for the people without payment of royalty and to prevent any commercial concern from gaining a monopoly in their manufacture. The most important of the inventions is the apparatus worn by miners while following disasters to effect rescues. It supplies oxygen to the rescuer, permitting him to enter poisonous gas and carry on his work for two hours. The study of perfecting apparatus to enable such work to be done had been entrusted to William E. Gibbs, consulting engineer of the Bureau, and the application for the patents is the result. Caustic soda is used in the apparatus in taking up the poisonous exhalations of the breath, being so adjusted as to permit a continuous flow of the expired air. The experiments made with the device are said to have been quite successful. A new type of valve accomplishes the reduction of the oxygen pressure from 2000 lb. per square inch to the proper amount needed. The wearer of the apparatus regulates it according to his needs. The weight of the breathing apparatus is reduced by 40%. The third invention is a collapsible mine cage, invented by George S. Rice; and J. W. Paul has invented an electrical signaling device for use in shafts following disasters. A person descending a shaft is enabled by it to signal to the hoisting engineer. If the man on the cage is overcome and the apparatus falls from his hands, a circuit is immediately closed and a gong in the engine-house gives a sudden warning. Applications have been made for patents for processes of extracting vanadium, uranium, and radium from ores such as carnotite. These processes are the results of studies in the Denver laboratory of the Bureau of Mines, and reduces, it is said, the cost of their recovery and prevents a monopoly which goes with the secret process now used for making them. It is estimated that these new processes will cut the cost of radium fully one-half, and perhaps more.

Gifford Pinchot, as president of the National Conservation Association, which has its headquarters in Washington, has made his report on conservation legislation in Congress for the year, and, of course, it embraces mining legislation, which conservation likes to patronize. The Association has opposed coal-leasing legislation, which could have been the entering wedge for the leasing of other mining properties so far under the ownership of the Government. The Association has, in particular, opposed the bill of Senator Myers of Montana granting to the Republic Coal Co., a subsidiary of the Chicago, Milwaukee & St. Paul Railroad, more than 2000 acres of coal lands, officially estimated to contain over 10,000,000 tons of high-grade coal. The price fixed in the bill was \$82,000. Mr. Pinchot says that investigation has shown that the coal was worth about \$30,000,000. It is declared by him that the passage of the bill would have meant a reversal of the federal government's leasing policy. Mr. Pinchot still urges that the members of his Association use their influence to pass the Ferris Alaska coal-leasing bill, which involves the payment of a royalty to the Government. He also favors the radium bill, which is now dead, and also the water-power legislation, which has become quite a piece of legislation through the Ferris bill recently reported to Congress and of interest to mining men, for it has no small bearing on their industry.

TORONTO, ONTARIO

GEOLOGY OF THE CALGARY OILFIELD.—LIMITED QUANTITY OF THE 'WHITE OIL' PROBABLE.—AREA OF THE FIELD.—DEPTH OF WELLS.—SPECULATION IN OIL SHARES WATCHED.

Reginald W. Brock, Canadian Deputy Minister of Mines, who has just returned from an inspection of the Calgary oilfield, has issued a statement as to the real value of the find at the Dingman well, in reference to the question of the

existence of extensive oil deposits in the locality, which ought to render investors cautious. Mr. Brock, who is a recognized authority on the geological formations of oilfields, states that while the development strengthens the opinion always held by the Canadian Geological Survey that the Northwest affords a promising field for oil prospecting, it does not establish the existence of an important commercial field. The well, while much more profitable as a producer than a similar well yielding crude oil, is not as satisfactory an indication of the presence of oil in large quantities. Oil was met with at a depth of 2700 ft. and quickly rose to a height of 2000 to 2200 ft. in the well, being accompanied with gas, the escape of which occasionally causes a spurt of oil from the mouth of the well. The oil is a 'white oil,' like the small amount of oil found higher up in the well last fall, and is about 64.5 B., almost pure gasoline. In its crude state it is a satisfactory substitute in motors for refined gasoline. As the well has not been equipped with a pump, it was not known what the daily capacity would be, but the small amount bailed out had no effect on the level in the well. The previous find of white oil was regarded as representing the lighter and more volatile portion of a deposit which had filtered off from the main body, and the encountering of the same oil in greater volume leads to the supposition that the drill has made an approach to an oil reservoir. Mr. Brock is inclined to doubt whether there is any considerable quantity of the high-grade oil itself, as in other fields white oils have, as a rule, only occurred in limited quantities. The find, therefore, while encouraging, has not demonstrated the occurrence of oil in extensive commercial quantities.

The most important feature of Mr. Brock's observations, in view of the large area staked for prospecting and the number of purely speculative enterprises in the field, is his account of the geological formations of the neighborhood, showing the comparatively limited extent of the possible oil-bearing area. The Dingman well is situated at the base of the foothills, on the apex of a saddle-like fold in the rocks that makes a sort of lip to the great basin of rocks underlying the plains. This fold is a mile or so wide, dipping steeply on both its eastern and western limbs. Its direction is northwest and southeast, and it is cut off by a fault or break in the rock on its western limb. This is followed by several small folds, before the rocks become disturbed and broken toward the mountain front. The folds bring to the surface rocks lower in the scale than those found on the basins. While the Tertiary formation occurs on the plains, and the eastern and western limbs of the Dingman fold, the surface rock on this fold is the underlying Cretaceous. The possible oil-bearing rocks are low down in the latter formation, and the altitude of the rocks is favorable for the discovery of oil as it will rise to the highest point permitted by conditions underground. This consideration determined the location of the Dingman well on the apex of the fold. The geological structure limits the field for prospecting with any reasonable hope of success to a comparatively narrow belt, with a trend roughly parallel to the mountains. To the east of this, not only is the structure unfavorable, but the possible oil-bearing rocks were too deeply buried for the oil horizon to be reached by the drill, while westward the broken ground in the foothills limits any possible oil zone.

Investors are reminded that drilling in these formations is unusually expensive, and that to reduce the speculative element within commercial bounds it should only be undertaken under intelligent technical direction. Before investing, everyone should be assured that the company has sufficient capital to put down several wells, and that an engineer of repute has examined the ground and will locate the holes, and that he has pronounced it worth prospecting.

According to the latest reports, there were 57 oil companies operating in Calgary with a total capitalization of \$46,386,-

000, with many others applying for incorporation. The provincial government of Alberta has taken action to prevent the publication of misleading advertisements, either in the newspapers or in office windows, etc. There is a penalty of \$250 for this offense, and the company convicted of it is liable to have its charter canceled. The Western Dominion Railroad has undertaken to construct a line from Calgary to the oilfield which will be carried on south to the American boundary, where it may be met by a branch of the Chicago, Milwaukee & St. Paul. The depths of the leading oil wells in the Calgary field are as follows: Dingman, 2718 ft.; McDougall, Segur, 2450 ft.; Black Diamond, 1580 ft.; United Oils, 1570 ft.; British Alberta, 1520 ft.; Southern Alberta, 800 ft.; Monarch, 640 ft.; Federal, 480 ft.; and Western Pacific, 300 feet.

MARQUETTE, MICHIGAN

ORE SHIPPING SEASON NOW ON.—PROSPECTING UNDER WAY.—
MINING NOT AT FULL CAPACITY.—CHARCOAL BLAST-FURNACES.—METALLURGY OF IRON ORES.

In the Lake Superior iron-ore districts, the shipping season has begun in earnest, although not at such a pace as in 'boom' times. As is usual in dull years, some old operators are doing little except maintaining their organization, while some of the smaller and more aggressive companies are hurrying their stockpiles away as fast as the steamers arrive.

As is also usual, dull times do not seem to affect extensive and expensive development work, and M. A. Hanna & Co., the Longyear interests, Pickands, Mather & Co., and several other companies are sinking shafts, stripping overburden, and equipping new mines. Diamond-drill exploration, on the contrary, is not so popular, due to several unfavorable features, one of which is the attitude of the state tax department in relentlessly raising assessments on new properties according to the 'Finlay system.' Another drawback is the fact that while Michigan's iron-ore territory has by no means been fully explored, nearly all the more convenient land has, and also some of the isolated tracts where swamps and inaccessibility make for expensive exploration. Jones & Laughlin, which concern neglected acquiring new properties until its old ones were nearly worked out, is doing a little quiet exploration, and the alert Cleveland-Cliffs Iron Co. is keeping its geological and diamond-drill departments at work. The Steel Corporation, with one or two exceptions, is keeping Michigan mines at low ebb, as it owns many of these properties or leases them on easy terms; but is maintaining a large production in Minnesota on account of the enforced conditions of the Hill iron ore leases, which stipulated that an increased tonnage should be mined from its lands every year and shipped over the Great Northern railway, all of which is a reminder of the astuteness of the 'empire builder,' James J. Hill. This is the last year of the Steel Corporation's holding of the Hill lands, which it is no doubt glad to release, as a royalty of \$1 per ton is out of proportion to the present low prices being paid for the ore.

The Cleveland-Cliffs Iron Co.'s charcoal blast-furnaces at Marquette, Gladstone, and Newberry, are either out of blast or will be soon, to permit of several months repairing, and to allow pig iron sales to catch up to stock on hand. It is no secret that the charcoal iron business has been for some time operating on a low margin, due to the dwindling of the differential in price paid for charcoal iron over ordinary pig, and both in Michigan (where also the Lake Superior Iron & Chemical Co., in which many British investors are interested, has several plants) and in Alabama in the South the industry is lagging. The companies interested have introduced elaborate and secret methods of utilization of the by-products from the charcoal kilns for the manufacture of drugs, and have hired German experts to direct their chemical works, which in some cases exceed in magnitude the iron-

making plants, but the returns have not been as great as was expected.

John T. Jones, of Iron Mountain, the inventor of a new process, 'step-furnace' for 'metallizing iron ore' and increasing the iron content of ores, has transferred his experimental work to Marquette, where he will continue operations in the metallurgy of iron. It is understood that the Boston and Chicago men who are now financing Mr. Jones, under a new arrangement, include the Longyear interests. One of his previous backers was George St. Clair, of Duluth, mine-owner and operator. Mr. Jones began his experiments at Iron Mountain six or seven years ago, where he had a horizontal cylinder like a tube-mill, but much longer, which was slightly inclined and revolved slowly. Iron ore fed in the upper end mixed with gas from the distillation of coal which entered the lower end, producing a nodulized spongy product



CHARCOAL IRON BLAST-FURNACE OF CLEVELAND-CLIFFS IRON CO.,
MARQUETTE, MICHIGAN.

high in iron. Since then he has tried the furnace at the old Kloman mine at Republic, and with copper ores in the West. A fortune has been spent in overcoming the practical difficulties, of which the furnace lining has given the greatest trouble. The new plans call for a vertical stack instead of a horizontal cylinder. Mr. Jones has been assisted by his son, and he has worked very hard with the experiments. His friends and also the many people interested in low-grade iron ores are watching his results closely.

General Mining News

ALASKA

CHISANA

According to C. F. Boggs, who arrived in Cordova at the end of May, it is estimated that the season's clean-up will be worth \$500,000. C. Range has a steam thawing plant, and is recovering \$300 to \$500 per day from the mouth of Big Skookum creek. Dahl is getting from \$1.25 to \$2 per pan on Riolyte creek, three miles below the mouth of Bonanza. Sluicing is to be started on all claims from the mouth of Bonanza to No. 10, also on other creeks. There are about 600 men in the camp.

CIRCLE

Owing to the heavy run of ice and water in the Yukon river, the town of Circle was badly damaged about May 14.

FAIRBANKS

Warm weather during the second week in May allowed sluicing to be commenced on Fairbanks creek. The dredge had not started, but is expected to commence during June. James McGann recently arrived from the Kuskokwim district, described in this journal of May 30, after 'mushing' about 800 miles on foot. He stated that work there is quiet, and some parts are discouraging. On the afternoon of May 10, the ice broke up in the river at Fairbanks.

IDITAROD

Considerable damage was done by the break-up of ice in the Iditarod river on May 10, resulting in a flood and the burning of the Northern Commercial Co.'s warehouse.

KETCHIKAN

On Prince of Wales Island, near Hollis, is situated the Ready Bullion mine, 295 ft. above sea-level. The orebodies are quartz in diorite and porphyry, and the vein being worked consists of 10 in. of quartz and 20 in. of altered porphyry, the latter averaging \$13 gold per ton. Work to date totals 2000 ft. A mill consisting of an 8 by 10-in. Blake crusher, five 1000-lb. stamps, amalgamating plate, and a concentrating table, driven by a 5-ft. Pelton wheel, recovers 90% of the gold content, the recovery being \$33 per ton. A Chilean mill and cyanide plant may be added.

NOME

Sluicing has been started on some of the claims, and winter dumps are being cleaned-up. There is a shortage of water so far, as the weather has been cold. The Bering sea was solid on May 25. The steamer *Corwin* had to discharge its cargo on the ice several miles from the town, from whence it was sledged to the beach.

SEWARD

The sale of 18,000 acres of ground for \$150,000 has been made by J. Murray, who has gone to the Cache Creek district, on the Kenai river. The new owners will install two dredges next season. Mr. Murray has ordered a dredge from San Francisco, which will be delivered at Knik this summer. It will then be sent in to Cache creek next winter.

ARIZONA

COCHISE COUNTY

At 1500-ft. in the Copper Queen property, the Sacramento orebody has been blocked out for 150 by 350 ft., all of which is of good grade sulphide. It has not been decided how to mine this ore. To prepare for the extraction of the Dividend top slice orebody, a large storage chute of concrete has been completed at 400 ft. in the Ozar shaft. It is of a new design, in that it is funnel shaped from 200 to 400 ft., and 30 ft. above the bottom is a set of baffles which will break up and help to

dry sticky ore dumped into the chute. The test concentrating plant should be ready by the end of June.

GILA COUNTY

An experimental plant for the leaching of copper ore is being erected by the Miami Copper Company.

MARIKOPA COUNTY

S. H. Brockunier, of Nevada City, California, has just completed examinations of the Steele and Moore tungsten mine at Cave Creek, and the Ed. B. Williams tungsten mine near Kingman, Mohave county. The Pittsburgh Tungsten Mines Co. has purchased the Cave Creek property on the strength of Mr. Brockunier's report, which was based on six months development of the property. It is understood that a mill will soon be erected.

MOHAVE COUNTY

The annual report of the Tom Reed Gold Mines Co., covering 1913, shows that 48,110 tons of ore averaging \$24.09 per ton was treated, with 97.05% recovery. Operating costs of mining, milling, etc., were \$7.52, and other charges \$1.13, making a total of \$8.66 per ton. A winze is now down nearly 1000 ft. depth. In a drift on the 950-ft. level, the vein assays from \$20 to \$40 per ton. No. 44 dividend has been declared.

CALIFORNIA

AMADOR COUNTY

A station is being cut at 2350 ft. in the Fremont mine, near Amador City. At 2300 ft. the orebody is said to be developing well. Dividends totaling \$20,000 have been paid this year, and \$234,000 to date.

BUTTE COUNTY

Two boats of the Oroville Dredging Co. recovered \$2729 during the week ended April 30.

CALAVERAS COUNTY

As mentioned in this journal of May 16, the Royal mine has been sold by R. E. Whitcomb, who had an option on it, to Fordyce & Co., of Boston. The mine is developed to 1100



SURFACE PLANT OF ROYAL MINE.

ft., and has been favorably reported on by W. A. Farish, R. F. Wells, and other engineers. E. P. Jennings of Salt Lake City, recently examined the mine. A large tonnage of \$3 ore has been opened. Past returns from the 120-stamp mill show that 123,000 tons yielded gold worth \$455,690, or \$3.72 per ton. The new company will have a capital of 300,000 \$5 shares, of which 150,000 will be in the treasury. The accompanying halftone shows the surface plant of the property.

MODOC COUNTY

Six feet of ore assaying up to \$80 per ton has been cut in the Modoc mine, owned by Chicago people.

NEVADA COUNTY

A Poynter rock-drill tester, described in this Journal of August 2, 1913, is being installed at the Empire mine.

SHASTA COUNTY

It is not possible to resume work in the Midas mine where a fire started at 1200 ft. several weeks ago. Blowers are to be installed to clear the mine of gas. The owner of the mine, W. H. Roberts, has sold it to the Victor Power & Mining Co., adjoining. Redding and San Francisco people have taken an option on the American mine, adjoining the Gladstone. James Doyle is to be superintendent.

SIDNEY COUNTY

The Western Gold Mines Co. has been organized in Grass Valley to work the Eastern and Western Cross quartz claims on Kanaka creek, between the Tightner and Plumbago mines. Work is to start in a few days.

COLORADO

EAGLE COUNTY

According to the state mine inspector, John R. Curley, mining is dull. The Lady Belle and North Dakota properties, the principal producers of the district, are shut down awaiting installation of a mill that will enable the owners to ship a much lower grade of ore. The other mines are still being developed, but in none of them has any amount of shipping ore been found, although a number of them are now in favorable looking formations. Should the Lady Belle and Dakota companies erect a good mill, there is no doubt that a great deal of ore will be mined in the territory now under exploration, but until the mill is installed there will be but little mining done in the Brush Creek district.

GILPIN COUNTY

In the Bezant mine, in Leavenworth gulch, on the 225-ft. level, there is 20 ft. of ore 2½ in. wide, containing from 0.5 to 20.27% uranium oxide, showing strong radio-activity by the electroscope. This mineral has apparently cut out the gold and silver content. In the east part of this level, 100 ft. from the shaft, a streak of rich sulphide ore with gold and silver has been opened.

Melting snow has resulted in several properties in the district being temporarily shut down.

TELLER COUNTY (CRIPPLE CREEK)

Gold production of the district in May is estimated as follows:

Plants.	Tonnage.	Average value.	Total.
Smelters, customs	4,160	\$55.00	\$228,800
Golden Cycle, company and customers	31,300	20.00	626,600
Portland, Colorado City	9,800	22.00	215,600
Portland, Cripple Creek	19,600	2.57	40,372
Stratton's Independence	11,752	2.96	33,686
Colburn-Ajax	4,000	7.75	31,000
Gaylord-Dante	1,500	4.00	6,000
Wild Horse	1,200	2.80	3,360
Kavanaugh (Jo Dandy)	1,900	1.30	2,470
Free Coinage (estimate)	625	3.00	1,875
Isabella	550	2.10	1,155
Total	86,387		\$1,190,918

This was a small increase over April. The Portland local mill treated 2000 tons more than any previous month, while there were increases at the Colburn, Gaylord, Wild Horse, and Kavanaugh mills. New mills are contemplated, but there is no construction under way at present. The total output of the Isabella property, lessees and company, was 1855 tons averaging \$20 per ton. The Elkton yield was 1125 tons. Dividend No. 87, of 3c. per share, has been paid by the Golden Cycle company. The total for 1914 is \$270,000. The Vindicator's

total output was about 3700 tons worth \$115,000. The main shaft is down 1800 ft. Lessees at the United Gold Mines produced about 900 tons averaging \$20 per ton. The property of the Cripple Creek and Gold Hill Tunnel & Development Co. has been sold to G. Hammond for W. H. Spurgeon for \$5750.

IDAHO

The U. S. Government has just offered for sale two tracts of timber on Lol creek, within the Clearwater national forest, aggregating 600,000,000 ft. of saw timber and 350,000 cedar poles, together with a considerable amount of material for piling, shingles, and posts. A large part of the timber is Idaho white pine, but the stands include yellow pine, lodgepole, spruce, western larch, Douglas fir, cedar, and white fir. The prices, which represent the lowest rates which will be considered for the saw timber, range from 50c. per 1000 ft. for Douglas fir, western larch, and cedar, to \$3.50 for green white pine. The prices of poles range from 5c. to \$2.40 each, depending upon the size. Full particulars may be obtained from the district forester at Missoula, Montana, or from the forest supervisor at Orofino, Idaho.

BLAINE COUNTY

The first shipment of ore from the Nan Aug mine, 12 miles from Hailey, has been received at Salt Lake City. Lessees have opened a shoot 180 ft. long, which averages 60% lead, 70 oz. silver, and \$4.50 gold per ton. K. C. Woolley is in charge.

SHOSHONE COUNTY

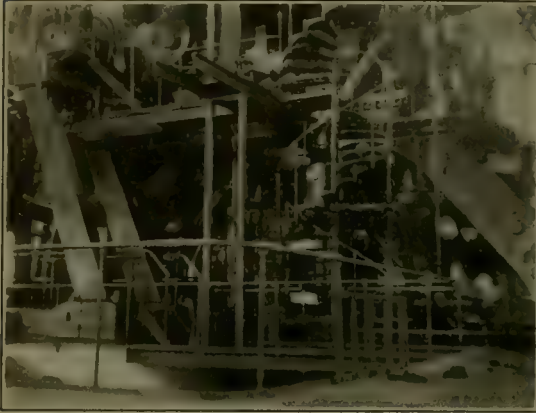
A bond and lease on the Handsplike group of copper claims will probably be given to Cecil Murphy of Kellogg by the owners, the Little North Fork Copper Mining & Milling Co. The property is 12 miles above Enaville. A royalty will be paid on ore mined. Better roads are necessary for transport. Four sets of lessees are working in the Yankee Boy mine, on Blg creek.

Shrinkage stoping will be started at the National copper mine, at Mullan, in place of the ordinary system as at present. It is then hoped that the 500-ton mill will be fully supplied.

Residents of Wallace now claim that results of the disastrous forest fires in northern Idaho in 1910 are being made evident in the changed flow from a watershed then burned over, which furnishes the water-supply of the town. This basin included an area of approximately 2000 acres, and was formerly well timbered with trees from 50 to 200 years old, according to Forest Service bulletins. These were almost wholly destroyed by the fires of 1910. From this watershed the city gets its supply, not only for domestic purposes, but also for the development of electricity for power and light, so that the maintenance of a considerable flow is essential to the city. It is stated that before the fires the flow of the stream at its lowest stages was never below 1000 miner's inches, the unit of measurement which has been used; but since the fire the records show that the minimum flow has fallen to about 250 miner's inches, and it is now necessary for the company which furnishes water, light, and power to expend a considerable amount of money each year in developing power from steam, and to use a considerable part of this power in pumping water. Records of the weather bureau at Wallace show that the precipitation for the years since the fire has been about normal for the region. This seems to demonstrate to the townspeople that the unevenness in the flow must be due to the destruction of the forest cover of the watershed, and not to any change in climate or precipitation. In view of the situation, the Forest Service has undertaken to reforest the denuded watershed. Some planting has already been done, and eventually all of the watershed which is included within national forest boundaries is to be reforested. The people of Wallace are taking an active interest in the work.

MICHIGAN**Houghton County**

At the Calumet & Hecla smelter at Hubbell, No. 9 and 10 furnaces have been started, owing to increased production from the mines. The Mineral Range railway, which serves nearly all mines save the Quincy, Copper Range, and Calumet & Hecla,



VERTICAL PUMPING ENGINE AT CALUMET & HECLA STAMP-MILLS,
LAKE LINDEN, MICHIGAN.

hauled 373,040 tons of mineral products in May, compared with 302,760 tons in April and 391,240 tons in May 1913.

MONTANA**Fergus County**

From August 27, 1912, to December 31, 1913, the Barnes-King Development Co. produced 49,726 tons of ore, yielding \$414,594. The net profit was \$129,906.

SILVERBOW COUNTY

Development in the North Butte mine is resulting in excellent returns. At 2400 and 2600 ft. the Edith May vein assays about 9% copper, with good silver content. The Snowball vein is improving steadily. At the Tuolumne the shaft is down 2475 ft. The zinc concentrating plant of the Timber Butte Milling Co., south of Butte, will start work in a few days. Its capacity is 450 tons per day, and it will treat ore from the Elm Orlu mine, adjoining the Black Rock mine of the Butte & Superior.

NEVADA**Churchill County**

The report of J. A. Burgess, superintendent of the Nevada Wonder Mining Co., shows that 3730 tons of ore was milled during April with a total net profit of \$22,114. An extraction of 93.5% was made in the mill. Development totaled 660 ft. of driving, cross-cutting, and raising, and 207 ft. of shaft-sinking divided among three shafts. The Nevada Wonder shaft has reached a depth of 1339 ft., and sinking has been stopped for the present. The cross-cut on the 1300-ft. level is now being driven toward the vein, and has reached a point 122 ft. from the shaft. It is expected that the vein will be cut at about 350 ft. from the shaft. A new head-frame has been built at the Hidden Treasure shaft, and a small electric hoist installed. Cross-cutting will be begun at this shaft in a few days on the 700-ft. level for the purpose of prospecting the vein. Sinking is still in progress at the Wonder Extension shaft, which is down 477 ft. It is planned to sink this shaft to 800 ft. before cross-cutting to the vein. At this depth a connection will be made with the 1000-ft. level from the Nevada Wonder shaft.

ESMERALDA COUNTY

Ore from the Jumbo Extension is now being treated at the Goldfield Consolidated mill. In May, 2780 tons yielded a net profit of about \$20,000. The gross value of 922 tons from the Florence, in April, was \$29,914, of which \$15,398 was profit. About 850 tons was treated in May. Water at 1750 ft. in the Atlanta is too great for the present pumps to cope with, and work on the vein at that level has been suspended until larger pumps are installed in the Merger shaft. In the Sandstorm-Kendall mine, 344 ft. of development was done in May. Three cars of ore averaged \$45, \$57.70, and \$88.90 per ton, respectively.

HUMBOLDT COUNTY

A new goldfield has been opened at Haystack, west of Winnemucca, between the Western and Southern Pacific railroads. The name comes from a lone haystack-shaped 'butte' standing on the level desert. The place was discovered by R. D. Maxfield, who leased his five claims to W. J. Merryfield and others of Winnemucca. Rich ore was opened by the new owners, the Haystack Mining Co., and a shipment of 30 tons made. This Company has let several leases. Tiernan and Geiger have had assays up to \$37.20 per ton from their Grenada claims. Between 40 and 50 people are in the camp, including some well known Nevada miners.

LINCOLN COUNTY

A report on the Day-Bristol Consolidated Mining Co., of Pioche, has been filed in the district court by the receiver, H. E. Freudenthal. The following ore shipments were made: Company, January 1, 1913, to January 14, 1914, 6550 tons, worth \$15.84 per ton; Hillside lease, 125 tons worth \$19.04 per ton; Tempest lease, 84 tons worth \$28.21 per ton; Iron Mine lease, 508 tons worth \$15.78 per ton; and National lease, 258 tons averaging \$16.28 per ton. The report deals with wagon-haul costs, royalties, and other data.

Ore shipments from Pioche during the past fortnight amounted to 86 cars, of which the Prince Consolidated contributed 71 cars.

LYON COUNTY

The Mason Valley smelter received 4530 tons of ore during the week ended June 3, of which 1891 tons was from the Mason Valley mines, 1023 tons from the Nevada-Douglas, and 1616 tons of other custom ore.

NYE COUNTY

Nine mines at Tonopah produced 11,227 tons of ore worth a total of \$291,290, during the first week of June. At 1200 ft. in the Midway, the cross-cut has opened 4 ft. of good mill ore. At 600 ft. in the Desert Queen claim of the Jim Butler, a large tonnage of good ore has been developed. In May, the Extension mill treated 4673 tons, yielding 99,666 oz. silver bullion. At the Desert mill of the Tonopah Mining Co., 2750 tons of \$18 ore was treated during the week, with 92% recovery.

UTAH**SALT LAKE COUNTY**

It is said that another transport tunnel is to be driven into Bingham, starting from Pine cañon, a distance of 12,500 ft. This is expected to cheapen mining and ore transport to the International smelter. The cost would be about \$415,000.

WASHINGTON COUNTY

An extensive deposit of borax is reported to have been found in this county, and in the Arizona 'strip,' by prospectors sent out by F. M. Smith, of California.

WASHINGTON**STEVENS COUNTY**

Three wide veins are showing in the Security copper mine at Chewelah, of which L. K. Armstrong of Spokane is manager. A hoist and compressor have been installed. A party

of 75 Spokane mining and business men visited the Chewelah district last week. James A. Buff, mining editor of *The Spokesman Review*, published an account of the work done there. The United Copper mill is treating 75 tons of ore per day, and crude ore shipments to smelters amount to 25 tons. One hundred men will soon be employed, and the output raised to 125 tons of milling and 75 tons of shipping ore. The raise to the 600-ft. level is through, and ventilation improved. The Copper King smelter made a trial run, but was stopped for repairs to the blower. No. 1 adit is in 1000 feet.

WYOMING

FREMONT COUNTY

The Atlantic City gold mining district is described in *Bulletin 7*, by L. W. Trumbull, the state geologist. The area was examined late in the fall of 1913. It is 24 miles south of Lander, which is a railway terminus. The average altitude is 7800 ft. above sea-level. Gold was discovered near South Pass in 1867. Considerable capital was attracted to the mines, but support was withdrawn. Since 1877, the district has not been prosperous. The rocks are generally schists, slates, and quartzites, with the later intrusives, andesite, diorite, and granite. The veins are all of quartz, found in schists, diorite, andesite, and granite. The Duncan is the only mine producing gold. The mill is described by D. C. Kelso, the superintendent. An all-sliming process is used at a cost of \$2.70 per ton. The estimated output of the district is \$4,137,000 from lode mines, and \$1,725,000 from placers. There are numerous relics of old stamp-mills and arrastres. Early milling was done without proper knowledge of the subject. Mining costs are low, but power costs are high. The Beck Milling Co. (Duncan mill) has installed a gasoline engine. Diesel engines could be worked, using oil from the Dallas field. Electric power may be obtained from the Boysen, or Popo Agie plants.

CANADA

ALBERTA

(Special Correspondence.)—Calgary is a live town since oil was found in the Dingman well at 2740 ft. The oil is very high grade, being from 60 to 64°B. The well gushed several times to about 40 to 60 ft. above the derrick floor, but this never lasted more than a minute at a time. There are about sixty oil companies operating now. Every store front is a broker's office, while shares are being dealt in on the curb. A number of stupid people have drawn their savings and speculated in companies whose holdings are anywhere from 2 to 60 miles from the producing well.

Calgary, May 20.

Automobiles are now successfully using the Dingman oil direct, it only being strained to clear it of sand before being charged into cars.

BRITISH COLUMBIA

New York people have bought the Golden Belle claims on Sheep creek. A number of other properties in the province have been sold. In April, Le Roi No. 2, at Rossland, shipped 1530 tons of ore and 168 tons of concentrate, returning \$20,884 for the quantity paid for. Expenses were \$21,100. The Van Roi, at Silverton, during April treated 2128 tons of 13.3 oz. silver, 1.9% lead, and 4.9% zinc ore, worth \$13,967. Expenses were \$14,448. The Surf Inlet mine, on Princess Royal island, is under option to the Tonopah-Belmont Development Co., of Nevada. It can be worked entirely by adits. The vein is from 10 to 50 ft. wide. There is plenty of timber and water power available.

ONTARIO

In order to remove the mud from Kerr lake, the sides will be washed clean by hydraulicking, water coming in by a 6-in. pipe. Trenching in the lake has revealed a 3½-in. vein for 75 ft., which assays up to 5000 oz. per ton. One unit of the Fountain Falls plant of the Northern Ontario Light &

Power Co. is in commission, and 1500 hp is available for Cobalt. The plant contains 2 Morris water-wheels of 1500 hp each driving two 1250-kva. generators at 150 r.p.m. This Company has four stations supplying the Cobalt district. During the year ended April 30, the Buffalo Mines Ltd. revenue was \$974,082. The net income was \$389,783; dividend paid, \$600,000; deficit, \$270,217; previous surplus, \$624,028; and surplus for 1914, \$352,811. Cash on hand in hand amounts to \$50,229.

Electric power for the Kirkland Lake district is now available from the Charlton plant. This consists of two generators of 545 hp each, driven by separate water wheels. The Tough-Onkes shaft is down 320 ft. At 220 ft. the ore shoot is 220 ft. long. The Walsh claims, in Munro township, controlled by the Taylor syndicate, are said to have been sold for \$36,000. A report on the Dome Lake property during the first five months of 1914 shows that the shaft is down to 336 ft. At 200 ft. a cross-cut was driven to No. 3 vein and an ore-pocket cut out at the station. At 180 ft. a cross-cut was driven 410 ft. to No. 1 vein, which shows good ore at other levels.

YUKON

During the week ended May 16 the Canadian Klondike company's dredges recovered 1110 oz. gold. A heavy run of ice and water, the worst since 1898, passed Dawson on May 15, and did a good deal of damage on the waterfront.

KOREA

The May clean-up of the Oriental Consolidated Mining Co. produced \$169,000. In March the mills treated 23,550 tons, yielding \$172,932, with a profit of \$83,042. The Kuk San Dong mill was hung up the full time, there being no ore for it; also, for the same reason, the Candlestick mill only worked 23 days. In April the mills treated 24,123 tons, the Kuk San Dong being down for the period, yielding \$155,771. Recovery at the Taracol cyanide plant was 85%. The Okuras power-plant was stopped 12.83 hours, when the mills were driven by steam. There is plenty of water, but the Korean farmers want rain badly.

MEXICO

MEXICO

The Esperanza Mining Co.'s (American company) report for 1913 shows the following results:

Ore mined, tons	85,843
Ore and tailing treated, tons	207,442
Value of yield	\$1,459,764
Total profit	491,232
Dividends	217,500
Construction, exchange, etc.	69,425
Surplus to 1914	303,289
Dividends paid by Esperanza, Limited (English company)	206,400

The limits of the San Carlos vein are nearly known, and lower levels on the San Rafael vein have shown nothing profitable. Further prospecting is to be done. Ore reserves are estimated at 113,500 metric tons, containing a working profit of \$417,000. There is also 85,000 tons of possible ore in old workings. Tailing re-treatment should yield a profit of \$240,000.

SONORA

Operations at Cananea, according to latest advices, are gradually getting back to where they were before the recent shut-down and the exodus of Americans. Four or five blast-furnaces and both reverberatories are working. Miami concentrate is again being shipped to Cananea for treatment and is no longer going to Bisbee for smelting as it did during the shut-down.

Owing to favorable reports from the authorities in northern Mexico, the Mines Company of America may reopen the Creston-Colorado and El Rayo mines.

Personal

FRED J. POPE is at Douglas, Arizona.
 D. H. BROWNE is in San Francisco.
 CARL A. ALLEN is at Golconda, Nevada.
 C. W. MERRILL has gone to the Yosemite.
 J. W. MERCER has been visiting California.
 RALPH STOKES was in San Francisco recently.
 W. W. MEIN is expected in San Francisco, June 15.
 KARL EILERS has gone to Europe for a summer holiday.
 W. W. CUTLER is at the Ridder Concession, Asiatic Siberia.
 CARL A. ALLEN is examining mining property near Golconda, Nevada.

J. P. LIPPINCOTT, of the Los Angeles aqueduct, was in San Francisco last week.

J. D. HUMPHREY was given the degree E.M. by the University of Santa Clara, June 10.

C. B. LAKENAN, general manager for the Nevada Consolidated is in San Francisco.

R. A. CONRAD, of the El Favor Mining Co., Hostotipaquillo, Mexico, is at Trenton, Missouri.

F. E. PIERCE has left the service of the New Jersey Zinc Co. to open an office for consulting work in New York.

RALPH ARNOLD and HARRY JOHNSON are to examine the Flathead district of Alberta during the current month.

V. G. ZEFFEL, associated with the Marshall interests in London, and until recently field manager in South Africa, is making an examination in northern Idaho.

OSCAR H. REINHOLD recently made an examination of a nickel prospect in the Coyote mountains and also inspected the Barrett dam-site for the city of San Diego.

W. A. THOMAS, who has had charge of sales of mining machinery for the Westinghouse Electric & Manufacturing Co., has resigned to take up practice as a consulting engineer in Pittsburgh.

FRANK M. SMALE, manager for the Portland Gold Mining Co., of Cripple Creek, recently visited the Coeur d'Alenes, Idaho, and Butte, Montana, for the purpose of investigating the economical electric haulage systems of those districts.

CHARLES F. RAND, president of The Spanish-American Iron Co., and past president of the American Institute of Mining Engineers, has been made a member of the Order of Isabella Catolica and decorated by the King of Spain with the Grand Cross of a Knight Commander.

Obituary

WILLIAM R. PERRIN, best known to mining men as the manufacturer of the Perrin filter-press, died at Chicago, June 2. Born in Indianapolis in 1860, he removed to Chicago before he was of age, and after some years spent in the stockyards established himself as a manufacturer of machinery in 1888. With branch works at Toronto, he manufactured for both the American and Canadian markets, but found time for active service in church, Y. M. C. A., and similar work.

ROBERT D. GRANT, born at Sunbury, Pennsylvania, in 1864, of Scotch parentage, died June 4 at his home at Los Angeles. In 1889 he took a position with the Parrot Silver & Copper Co., becoming general manager in 1899. He later became identified with the Sioux Consolidated group of mines in the Tintic district. In 1905 he formed the American Mines & Exploration Co. and later bought an interest in the Ray Consolidated Copper Mines of Arizona and led to the present development at Ray. In this he was associated with Seeley W. Mudd and Philip N. Wiseman. Mr. Grant was known as a successful mining man of the highest character and integrity and leaves a host of friends.

Society Meetings

JUNE

American Institute of Electrical Engineers	22 or 26
American Society for Testing Materials	23-27
American Society of Mechanical Engineers.....	end of June
Franklin Institute, Philadelphia	end of June
Society for the Promotion of Engineering Education	29 to July 2

JULY

Northern California and Southern Oregon Mining Congress, Ashland, Oregon	9-10
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AUGUST

American Institute of Mining Engineers, Salt Lake City	10-14
Canadian Mining Institute, Rocky Mountain branch, Banff	
Lake Superior Mining Institute, Marquette, Michigan...	17

SEPTEMBER

American Chemical Society, Montreal	8-11
American Institute of Electrical Engineers.....	not fixed
Colorado Scientific Society, Denver.....	3

OCTOBER

American Institute of Electrical Engineers.....	9
American Iron and Steel Institute	23-24
Colorado Scientific Society, Denver.....	3

NOVEMBER

American Institute of Electrical Engineers	13
Colorado Scientific Society, Denver.....	7

DECEMBER

American Institute of Electrical Engineers	11
American Society of Mechanical Engineers	7-8
American Museum of Safety	11-20

The Columbia branch of the AMERICAN INSTITUTE OF MECHANICAL ENGINEERS, the Spokane branch of the AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, the Spokane branch of the AMERICAN SOCIETY OF CIVIL ENGINEERS, the engineering faculty of the UNIVERSITY OF IDAHO, and many engineering students of the University of Idaho met at Pullman, Washington, on May 16. Each section conducted a program. The program for the mechanical engineers consisted of papers by A. M. Balfour of Republic, N. C. Fassett of Spokane, P. S. Anderson of Spokane, D. C. Livingston of Dixie, Idaho, and C. H. Loux of Rossland, British Columbia. Mr. Moody, of Spokane, delivered a paper before the civil engineers, followed by discussion from the floor. R. S. Daniels and L. A. Lewis, of Spokane, and M. K. Akers, of the department of electrical engineering, delivered papers before the electrical engineers. A feature was the paper on 'Power Development Along the Spokane River,' by C. F. Uhden, chief engineer for the Washington Water Power Co., before the general session in the college auditorium, at which all the engineers were present.

The U. S. CIVIL SERVICE COMMISSION announces an open competitive examination, on July 13, for assistant mining engineer, for men only. Those passing this examination will be eligible to fill vacancies in the Bureau of Mines, for service in the field, in relation to coal mining or metal mining, at salaries ranging from \$1800 to \$2400 per year. The duties of these positions will include, in one case, investigations in relation to coal mines, and in another case in relation to metal mines, particularly such as concern the causes of mine accidents or waste in mining, and the suggestion of remedies therefor. It is desired to procure the services of persons having a broad training in mining, particularly underground experience.

The Metal Markets

LOCAL METAL PRICES

San Francisco, June 11.

Antimony	9 - 9 1/2c
Electrolytic copper	15 - 15 1/2c
Pig Lead	4.15 - 5.10
Quicksilver (flask)	\$38.50
Tin	39 - 40 1/2c
Spelter	6 1/2 - 6 3/4c
Zinc dust, 100 kg zinc-lined cases, 7 1/2 to 8c, per pound.	

EASTERN METAL MARKET

(By wire from New York.)

NEW YORK, June 11.—As will be seen by reference to the metal prices, there has been no change during the week. Copper is quiet, lead is firm, and spelter is dull. Business on the Stock Exchange in shares is about one-fifth of the total sold on the same day of last year. Unfilled orders of the Steel Corporation on May 31 were 3,998,160 tons, a decrease of 278,909 tons, compared with the end of April. Tin is strong at 31 to 31.25c, antimony is dull at 7.25 to 7.37c, and iron is quiet. Lead and spelter are dull at St. Louis, at 3.80 and 4.82 1/2c, respectively. In London, copper is quiet, tin is firm, and bar silver is firm at 26 1/4d. (52 1/2 cents).

SILVER

Below are given the average New York quotations in cents per ounce, of fine silver.

Date.	Average week ending
June 4.....	56.50
" 5.....	56.12
" 6.....	56.25
" 7 Sunday	
" 8.....	56.62
" 9.....	56.50
" 10.....	56.87

Monthly averages.

	1913.	1914.		1913.	1914.
Jan.	53.01	57.58	July	58.70	
Feb.	61.25	57.53	Aug.	59.32	
Mch.	57.87	58.01	Sept.	60.53	
Apr.	59.26	58.52	Oct.	60.88	
May	60.21	58.21	Nov.	58.76	
June	59.03		Dec.	57.73	

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.	Average week ending
June 4.....	3.90
" 5.....	3.90
" 6.....	3.90
" 7 Sunday	
" 8.....	3.90
" 9.....	3.90
" 10.....	3.90

Monthly averages.

	1913.	1914.		1913.	1914.
Jan.	4.28	4.11	July	4.35	
Feb.	4.33	4.02	Aug.	4.60	
Mch.	4.32	3.94	Sept.	4.70	
Apr.	4.26	3.86	Oct.	4.37	
May	4.31	3.90	Nov.	4.16	
June	4.33		Dec.	4.02	

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date.	Average week ending
June 4.....	4.88
" 5.....	4.88
" 6.....	4.88
" 7 Sunday	
" 8.....	4.88
" 9.....	4.88
" 10.....	4.88

Monthly averages.

	1913.	1914.		1913.	1914.
Jan.	6.88	5.11	July	5.11	
Feb.	6.13	5.22	Aug.	5.51	
Mch.	5.94	5.12	Sept.	5.55	
Apr.	5.52	4.98	Oct.	5.22	
May	5.23	4.91	Nov.	5.09	
June	5.00		Dec.	5.07	

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask

or two must expect to pay a slightly higher price. Average weekly and monthly quotations in dollars per flask of 7 1/2 lb. are given below.

Week ending	May 28	June 4	June 11
May 11.....	39.00		39.00
" 21.....	39.00	39.00	38.50

Monthly averages.

	1913.	1914.		1913.	1914.
Jan.	39.37	39.25	July	41.00	
Feb.	41.00	39.00	Aug.	40.50	
Mch.	40.20	39.00	Sept.	39.70	
Apr.	41.00	38.90	Oct.	39.37	
May	40.25	39.00	Nov.	39.10	
June	41.00		Dec.	40.00	

TIN

New York prices control in the American market for tin, since the metal is almost entirely imported. San Francisco quotations average about 5c per lb. higher. Below are given average monthly New York quotations, in cents per pound.

Monthly averages.

	1913.	1914.		1913.	1914.
Jan.	45.04	37.85	July	40.70	
Feb.	44.07	39.76	Aug.	41.75	
Mch.	46.95	38.10	Sept.	42.45	
Apr.	49.00	36.10	Oct.	40.61	
May	49.10	33.29	Nov.	39.77	
June	45.10		Dec.	37.57	

Tin statistics in May were as follows, as given by L. Vogelstein & Co. of New York: supplies of standard metal from all sources, 11,744 tons; deliveries of standard metal, 8876 tons; visible supplies, 19,465 tons, of which 5115 tons is in England, 2380 tons in Holland, 1841 on the Continent, and 1778 tons in the United States, while 4559 tons is in transit from the Straits, and 232 tons from Australia, the balance being afloat from other points. Average prices in May were 33.25c, per pound. New York, and from £156 15s. to £143 per ton, London. Visible supplies were 2868 tons greater than in April, and 1788 tons more than in May 1913.

COPPER

Quotations on copper as published in this column represent average wholesale transactions on the New York market and refer to electrolytic copper. Lake copper commands normally 1-5 to 1-10c, per lb. more. Prices are in cents per pound.

Date.	Average week ending
June 4.....	13.75
" 5.....	13.75
" 6.....	13.75
" 7 Sunday	
" 8.....	13.75
" 9.....	13.75
" 10.....	13.75

Monthly averages.

	1913.	1914.		1913.	1914.
Jan.	16.54	14.21	July	14.21	
Feb.	14.93	14.46	Aug.	15.12	
Mch.	14.72	14.11	Sept.	16.23	
Apr.	15.22	14.19	Oct.	16.31	
May	15.42	13.97	Nov.	15.98	
June	14.71		Dec.	14.25	

COPPER PRODUCERS' ASSOCIATION REPORT

The Copper Producers' Association statement for May shows a decrease in production and increase in stocks on hand. The details are as follows:

	Pounds.
Stocks of marketable copper of all kinds on hand at all points in the United States, May 8, 1914.....	70,337,001
Production of marketable copper in the United States from all domestic and foreign sources during May.....	142,308,287
Deliveries for consumption, May.....	55,594,170
Deliveries for export, May.....	72,710,477
Stock of marketable copper of all kinds on hand at all points in the U. S., June 2.....	84,342,641

Recent changes in surplus have been as follows, in pounds:

	Increase.	Decrease.
May 1913.....	8,974,883	
June.....	14,569,619	
July.....	690,330	
August.....	15,280,308	
September.....	8,531,043	
October.....	2,773,288	
November.....	15,363,047	
December.....	43,509,138	
January 1914.....	4,142,182	
February.....	8,924,833	
March.....	13,762,533	
April.....	5,727,682	
May.....	14,005,610	

Copper consumption of Germany during the first four months of 1914 was 76,358 tons, of which 69,434 tons was imported from the United States.

The Stock Markets

SAN FRANCISCO STOCKS AND BONDS

(San Francisco Stock and Bond Exchange.)
June 10.

BONDS

Listed	Bid	Ask	Unlisted.	Bid	Ask
Associated Oil 5s.....	96½	99	Natomas Consol. 6s.....	—	20
Natomas Con.....	—	34½	Pac. Port. Cement 6s.....	100	—
Unlisted.			Santa Cruz Cement 6s.....	85	—
General Petroleum 6s.....	34½	37	Union Oil.....	86½	87½

STOCKS

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Amalgamated Oil.....	79	—	General Petroleum.....	41	—
Associated Oil.....	38½	40	Noble Electric Steel.....	50c	—
Im Port. pfd.....	80	84	Natomas Consol.....	1½	—
Giant.....	—	83	Pac Port. Cement.....	60	94
Pac. Cst. Borax, com.....	—	57½	Riverside Cement.....	—	63
Sterling O. & D.....	—	14	Santa Cruz Cement.....	40	—
Union Oil.....	68½	69	Stand. Port. Cement.....	—	24
West Coast. pfd.....	—	112½			

NEVADA STOCKS

(By courtesy of San Francisco Stock Exchange.)
June 11.

Atlanta.....	\$ 46	Montana-Tonopah.....	\$ 80
Belcher.....	29	Nevada Hills.....	32
Belmont.....	125	North Star.....	28
Con. Virginia.....	14	Ophir.....	15
Florence.....	48	Pittsburg Silver Peak.....	28
Goldfield Con.....	140	Round Mountain.....	32
Goldfield Oro.....	10	Sierra Nevada.....	11
Halifax.....	75	Tonopah Extension.....	255
Jim Butler.....	100	Tonopah Merger.....	47
Juniper Extension.....	23	Tonopah of Nevada.....	675
MacNamara.....	63	Union.....	35
Mexican.....	10	Victor.....	39
Midway.....	24	West End.....	85
Mizpah Extension.....	28	Yellow Jacket.....	34

CALIFORNIA STOCKS

(Latest Quotations.)

	Bid	Ask		Bid	Ask
Argonaut.....	\$4.00	—	Kennedy.....	\$7.50	—
Brunswick Con.....	120	—	Mountain King.....	045	—
Bunker Hill.....	130	—	South Eureka.....	125	—
Central Eureka.....	011	015			

COPPER SHARES—BOSTON

(By courtesy of J. C. Wilson, Mills Building.)

June 11.

	Bid	Ask		Bid	Ask
Altoque.....	40	41	Mohawk.....	\$4½	46
Ariz. Commercial.....	4	4½	Nevada Con.....	14	14½
Butte & Superior.....	39½	39½	North Butte.....	24½	24½
Calumet & Arizona.....	65	65½	Old Dominion.....	47½	48½
Calumet & Hecla.....	410	415	Oscoda.....	76½	78
Copper Range.....	36	37	Quincy.....	57	58
Daly West.....	14	14	Shannon.....	54	54½
East Butte.....	10½	10½	Superior & Boston.....	11	2
Franklin.....	44	44½	Tamarack.....	35	36
Granby.....	82	82½	U. S. Smelting, com.....	31	34½
Greene Cananea.....	31½	32½	Utah Con.....	10½	10½
Isle Royale.....	29	21	Winona.....	2½	2½
Mass Copper.....	4½	5	Wolverine.....	40½	41½

NEW YORK CUBB QUOTATIONS

(By courtesy of E. F. Hutton & Co., Kohl Building.)

June 11.

	Bid.	Ask.		Bid.	Ask.
Braden Copper.....	7½	7½	McKinley-Dar.....	77c	82c
B. C. Copper.....	1½	1½	Mines Co. Am.....	2½	3½
Con. Cop. Mines.....	1½	1½	Nipissing.....	6	6½
Davis-Daly.....	12	12	Ohio Copper.....	4	5
First National.....	2	2½	Stand. Oil of Cal.....	327	329
Hollinger.....	17	17½	Tri Bullion.....	¼	¼
Iron Blossom.....	14	14	Tulamee.....	1	1½
Kerr Lake.....	43	43½	United Cop. com.....	5	5
La Rose.....	1½	1½	Yukon Gold.....	2½	2½
Mass. Valley.....	2	3			

NEW YORK STOCK EXCHANGE

(By courtesy of J. C. Wilson, Mills Building.)
June 11.

	Bid	Ask		Bid	Ask
Amalgamated.....	\$ 71½	71½	Miami.....	8 22½	22½
Anaconda.....	31½	31½	Nevada Con.....	14½	14½
A. S. & R., com.....	63½	63½	Quicksilver, com.....	1	2
Calif. Pet., com.....	19½	20	Ray Con.....	21½	21½
Chino.....	40½	40½	Tenn. Copper.....	34	34½
Guggenheim Ex.....	53½	55½	U. S. Steel, pfd.....	109½	109½
Inspiration.....	16½	17	U. S. Steel, com.....	61½	61½
Mexican Pet., com.....	62½	63½	Utah Copper.....	56½	56½

Gold and Silver Transactions

Gold continues to be exported to Europe, and on June 10 the value sent to Paris from New York was \$6,500,000. There has been considerable competition in London on account of the demand for gold for European governments. Writing on May 28, Samuel Montagu & Co. make the following remarks: "The outstanding feature is the cessation of the demand on behalf of the Russian Government, the chief competitor in the market for a long time past. A considerable amount of gold has been engaged in New York for shipment to Paris, the effect of which has been to prevent orders being sent to London. In the absence, therefore, of Continental inquiry, the Bank of England is likely to obtain the bulk of the bar gold, over £1,250,000, which arrived this week. The shipment to India was £162,000. During the week the net influx was £199,000. There were some further arrivals of sovereigns from Brazil, but these were intercepted and sent to the Continent. The imports of gold into Germany during the first four months of this year was about £3,380,000, and the exports about £595,000, making the net imports £2,785,000.

"Silver has been weak. In the absence of any support of consequence from those quarters whence buying orders usually emanate, prices continued to fall from point to point, until ground was reached at 25.94d. (51.88c.) for cash delivery on May 25. It is curious to notice that the same figure was touched momentarily on December 1, 1913, as a consequence of the final collapse of the Indian Specie Bank. On the recent occasion the price rallied ¼d. on the following day, a rebound much less sharp from that in December last. The improvement was continued, a further rise of ¼d. being recorded yesterday, followed by a reaction of ½d. today. The primary cause of the collapse in prices has been the remarkable disinclination of buyers to enter the market, the entire absence of speculative interest, and unexpected large supplies from Mexico. The latter consisted of consignments probably considerably belated, which had been dispatched south from Mexico City by the railway which spans the isthmus of Tehuantepec and terminates at Coatzacoalcas, or Puerto Mexico, whence transport was made by steamer. As these consignments represented accumulations, the aggregate was substantial—rather too much, in fact, for so inanimate a market, to face unexpectedly and to bear with equanimity. When the burden had been shouldered, the low level then reached provoked buying orders, with the result that prices responded sharply to the improved tone of the market. The stock in Bombay has decreased from £525,000 to £470,000. The offtake is rather less at 100 bars per day. The holdings in Shanghai by banks and others consist of £5,840,000, in 'sycee' or currency, an increase of £27,500. The holding of bars remains at about £38,000. No shipment has been made from San Francisco to Hongkong during the week."

SILVER TRANSACTIONS on the New York Stock Exchange in May totaled 4,685,762, against 7,068,338 in April, and 5,418,952 and 12,832,000 in May of 1913 and 1912, respectively. The value of bonds dealt in in May 1914 was \$43,404,000, compared with \$55,751,000 in April, and \$41,820,000 and \$60,500,000 in May of 1913 and 1912, respectively.

IDLE CARS in the United States and Canada total 241,803.

Company Reports

WALLAROO & MOONTA MINING & SMELTING CO., LTD.

This is a well known copper company operating in the state of South Australia, and the report is for the year 1913. In the Wallaroo mine, the shaft is now down to 2550 ft. The 2210 and 2430-ft. levels opened fair copper ore. In the Moonta mine a winze was sunk below 1200 ft. and a south drift from another shaft connected at 1440 ft. From the winze the 1320-ft. level was driven 185 ft. south, opening 4½ ore. De-

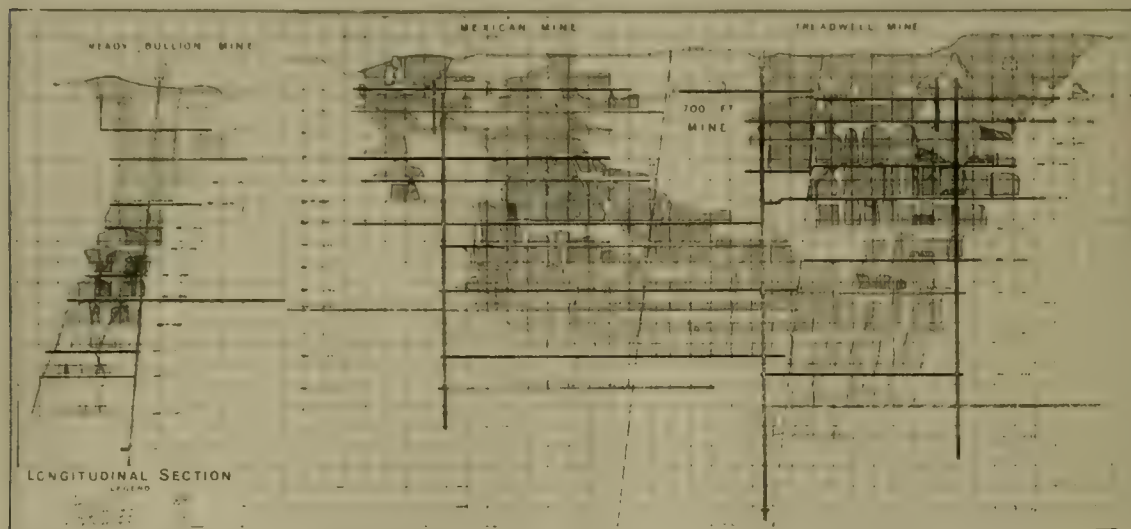
South Lower Contact and Murray veins, the latter being the best shoot opened in the mine. While ore reserves are not estimated, the future of the property is quite satisfactory. A good deal of new equipment was added to the surface plant.

ALASKA MEXICAN GOLD MINING COMPANY

ALASKA TREADWELL GOLD MINING COMPANY

ALASKA UNITED GOLD MINING COMPANY

Reports for these well known Companies for 1913 are now to hand, and as they are all under the same control, and in charge of Robert A. Kinzie and E. P. Kennedy, general and assistant general superintendents respectively, the results of



LONGITUDINAL SECTION OF MINES ON DOUGLAS ISLAND, ALASKA.

velopment totaled 5257 ft. in both properties. Ore mined was 161,374 tons averaging 3%, sorted down to 60,649 tons of 8.54%, and 6421 tons of 12.29% ore. There was 52,789 tons of old tailing treated by leaching producing 965 tons of 78.3% copper precipitate. The smelter treated 70,671 tons of mixed ores, matte, and precipitate, producing 7112 tons of refined copper, 2161 oz. gold, and 1000 oz. silver. The flotation process gave a high recovery on old tailing, leaving a residue of 0.3% copper. Costs were \$5.60 per ton for mining, \$1.42 for ore dressing, 25c. for transport, \$1.98 for smelting, and 18c. for general expenses. The year's profit was \$259,000, and \$268,000 was paid in dividends. The surplus is \$787,000.

TONOPAH EXTENSION MINING COMPANY

This Company has declared a dividend of 7½c. per share, amounting to \$70,750, payable on July 1. Results during the year ended March 31, 1914, are as follows:

Ore treated, tons	58,022
Silver output, ounces	760,412
Gold output, ounces	8,070
Average value of ore per ton	\$ 12.008
Revenue from bullion	615,780
Cost of mining and milling, etc., (\$8.953 per ton)....	519,501
Profit, including rents, etc.	97,839
Depreciation	17,440
Net profit	\$ 80,399

According to the general manager, John G. Kirchen, development amounted to 16,091 ft., making a total to date of 71,770 ft. Mining costs were increased 45c. per ton by the large footage completed, this cost being \$5.78 per ton. Work has been done to 950 ft. Ore was extracted from the North,

the past year are suitably reviewed together. The reports are complete in every detail of mine development, mill work, labor costs, and mine plans. A central hoisting shaft is being prepared in the 700-Ft. Claim for all the mines, as referred to below.

Development in the Mexican to 1460 ft., totaled 1668 ft., also several thousand feet of diamond-drilling in greenstone, slate, diorite, and schist. As soon as the 2100-ft. level from the Central shaft has reached the orebody, a drift will be turned east and continued through Mexican ground, and in the future, all ore developed and stoped from this level will be trammed to and hoisted through the new shaft. When at the surface, this ore will be crushed and distributed to the mills by the electric haulage system which is now in operation at the Central shaft. On the 660, 990, 1100, 1210, 1320, and 1460-ft. levels of the Mexican mine 1685 samples taken averaged \$2.30 per ton. Ore reserves below 1100 ft. amount to 430,939 tons in place and 385,943 tons broken in stopes. The total of 816,882 tons averages \$2.53 per ton, against 1,040,631 tons of \$2.75 ore in the previous year. At a point in the main east drift of the Ready Bullion mine of the Alaska United company, 1324 ft. from the east end line of the Mexican mine, a concrete bulkhead has been built, so that in case of fire, flood, or other emergency, it could be closed, thus preventing water or gases going from one mine to another. It is hitched 30 in. into the solid rock, and is 12 ft. thick of reinforced concrete. Through the centre a 24-in. opening was made, which can be closed automatically by a heavy cast-iron door, if there is a pressure of water on either side. The cost was divided between the two companies.

In the Treadwell mine, development to 1750 ft. totaled 4893

ft., also 3482 ft. in the United company's 700-Ft. Claim down to 2100 ft., including 330 ft. of shaft work. As was explained in the report for 1912, it is the intention to leave a solid pillar of ground between the 1750-ft. level of the Treadwell mine and the top of the stopes from the 2100-ft. level. The work of opening the latter level has been started from the Central shaft, three shifts being employed. This shaft is down 2271 ft. On the 600, 750, 1250, 1450, 1600, and 1750-ft. levels, 3815 samples were taken, averaging \$3.29 per ton. Ore reserves amount to 1,978,759 tons in place, and 1,114,549 tons broken in stopes, a total of 6,093,308 tons averaging \$2.67 per ton, against 6,977,958 tons worth \$2.72 in 1912.

The Alaska United operates the Ready Bullion and 700-Ft. Claim mines. In the former, development to 2200 ft. totaled 3997 ft., also several hundred feet of diamond-drilling in chloritic schist, diorite, black slate, calcite, and greenstone. The main shaft is 2326 ft. deep on the incline. On the 1350, 1500, 1650, 1800, and 2000-ft. levels, 1760 samples were taken averaging \$3.29 per ton. Ore reserves are estimated at 1,433,334 tons in place, and 275,328 tons broken in stopes, a total of 1,708,662 tons worth \$2.31 per ton, against 1,721,521 tons of \$2.82 ore in 1912. In the 700 Ft. Claim, 5418 ft. of work was done, mostly by the Treadwell company, also 274 ft. of drilling in slate with narrow dikes of diorite. The Central shaft was sunk 330 ft. in waste. A total of 2116 samples was taken averaging \$2.82 per ton. Broken ore in stopes amounts to 275,660 tons, and 1,005,815 tons in place, assaying \$2.46 per ton, against 1,154,273 tons worth \$2.63 in 1912.

Results of the three Companies are best shown in tabulated form:

	Alaska Mexican.	Alaska Treadwell.	Alaska United.
Stamps working	120	540	240
Ore crushed, tons	227,112	886,057	448,427
Concentrate saved, tons.	4,796	17,603	10,147
Gold by amalgamation...	\$225,369	\$1,221,643	\$ 552,541
Gold by cyaniding concentrate	264,328	1,136,780	491,002
Revenue from all sources	496,007	2,420,015	1,054,018
Operating profit	171,797	1,223,438	385,065
Balance from 1912	40,000	225,000	70,000
Available for distribution	211,797	1,448,438	455,065
Dividends paid	180,000	1,000,000	414,460
Depreciation	21,552	400,208	30,050
Balance to 1914	10,245	48,230	10,555
Reserve fund	93,909	205,826	201,810
Cash and special fund (cash)		371,679	
Supplies		499,331	
Costs, per ton milled:			
Mining and development	\$0.9070	\$0.8271	\$1.0452
Milling	0.2510	0.2476	0.2462
Cyaniding concentrate...	0.0923	0.0880	0.0966
Offices at San Francisco, London, and Paris....	0.0260	0.0207	0.0131
Taxes, legal, bullion....	0.0336	0.0264	0.0291
Operating cost	\$1.3099	\$1.2098	\$1.4302
Construction	0.0348	0.0435	0.0177
Operating and construction	\$1.3447	\$1.2533	\$1.4479
Loss on dwellings, etc....	0.0829	0.0982	
Total costs	\$1.4376	\$1.3515	\$1.4479
Net profit for 1913	\$0.7564	\$1.3808	\$0.8790

Output to date:

Ore treated, tons.....	3,820,446	13,867,789	4,827,342
Gold	\$10,428,713	\$33,964,625	\$10,121,223
Profit	3,827,923	15,674,258	2,392,370
Dividends paid	3,273,381	13,785,000	1,576,750

On October 11, 1913, a fire started in the head-frame and

crusher-house of the Treadwell mine, and in spite of 11 streams of water under 200-lb. pressure, the structure was destroyed. The Central plant has since handled all of the ore. A number of primer houses were used at the various mines, but a central house was built to minimize accidents, and save cost in handling explosives. The second unit of the Nugget Creek hydro-electric plant was started. It consists of a 2350-kva. Westinghouse alternating-current generator; 60-cycle, 3 phase, and 0.85 power factor, driven by a 3800-hp. Pelton-Doble double overhung type tangential water-wheel running at 300 revolutions per minute.

CROWN RESERVE MINING COMPANY, LIMITED PORCUPINE-CROWN MINES, LIMITED

The Crown Reserve company operates at Cobalt, and controls a gold mining company, the Porcupine-Crown Mines, Ltd., at Porcupine, Ontario. The report covers the calendar year 1913. The general manager, Samuel W. Cohen, reports the following as to the Crown Reserve: development amounted to 5345 ft.; stoping, 394,489 ft.; and ore broken, 56,982 tons. The Carson vein, a heavy producer of silver, maintained its size, but metal contents were low. From the 200-ft. level the Gear vein No. 14 produced 500,000 oz. Development was promising. High-grade ore was opened at 100 and 150-ft. on No. 17 vein, and a raise from 100 ft. for a height of 62 ft. broke into the bottom of Kerr lake, which had been drained. Rich ore was opened throughout the raise. Stoping on Ross vein No. 24 produced 325,000 oz. Work on No. 29 vein proved a good length at 200 ft. The North vein has not proved very valuable. No. 2 vein is one inch wide at 100 and 150 ft., and produced 135,000 oz. Other prospecting was promising.

The Dominion Reduction Co. treated 29,543 tons of milling ore for the Company, averaging 17.71 oz. per ton, at a cost of \$4.23 per ton, or 23.81c. per ounce. Shipments of ore were 313 tons containing 1,138,896 oz. The total yield was therefore 1,776,678 oz. worth \$1,056,272. The average price received for silver was 59.45c. per ounce, while the cost was 23.02c. per ounce. The mine profit was \$647,316. Balance from 1912 was \$821,393; net profit from silver mine, \$528,288; net profit from Porcupine-Crown Mines, \$308,877; and interest, \$9336; making available the sum of \$1,667,894. Dividends paid were \$795,966, and after deducting costs of the Silver Leaf lease, the surplus is \$844,616.

In the Porcupine-Crown Mines company, the Crown Reserve holds 60% of the shares. The manager, Maurice W. Sumner-Hayes, reports as follows: In the mine, work amounted to 3441 ft., making 5922 ft. to date; stoping totaled 142,643 cu. ft.; and diamond drilling was 2739 ft. Costs of prospecting were 60c.; development, \$1.17; and ore breaking, \$2.11 per ton. On the 100-ft. level the ore-shoot is 465 ft. long, averaging 35 per ton over 4 ft. At 200 ft. it is 570 ft. long; at 300 ft., 610 ft. long; 218 ft. of 30 ore over 4 ft. at 400 ft.; and a winze sunk below the latter level opened 5 ft. of 570 ore. Ore reserves are estimated at 72,472 tons assaying \$25.66 per ton.

During the year, 15 stamps and cyanide plant were added to the existing 5-head mill. Tests showed that the Dorr continuous decantation process was the best for the ore. The plant started in November, and has been treating 100 tons per day, with 96% extraction, at a cost of \$1.50 per ton. During 1913 the original and completed plant treated 19,754 tons of ore averaging \$20.30 per ton. Save for the last six weeks of the period, treatment consisted of amalgamation only, which saved 85 per cent.

The revenue was \$275,039, and operating profit \$150,573.

ALGOMAH MINING COMPANY

This Company is opening a mine in Michigan. Development was in progress in 1913 until the strike in July caused a shut-down. The main shaft has reached a depth of 415 ft. During 1913, \$22,500 was spent on development. The assets of the Company are given in the balance-sheet at \$855,000.

Book Reviews

EXCAVATING MACHINERY. By Allen Boyer McDaniel. McGraw Hill Book Co., New York. P. 326. Index. For sale by the *Mining and Scientific Press*, San Francisco. Price \$3.

This is an exceptionally comprehensive work dealing with an interesting phase of engineering construction. The author has treated his subject in ten chapters and two appendices, each chapter being devoted to one specific type of excavator. In addition to discussing the structural details, peculiarities of design and correct application of each, the author has succeeded in compiling a great deal of data concerning the actual use of each in various localities. A quantity of cost data is given in each case which adds very materially to the value of the work. This is one of the best works of its kind that has come to this desk and will constitute a valuable addition to the libraries of all engineers and contractors.

AMERICAN ELECTRICIANS' HANDBOOK. Compiled by Terrell Croft. McGraw Hill Book Co., N. Y. P. 692. Index. For sale by the *Mining and Scientific Press*, San Francisco. Price \$3.

This work is intended especially for practical electrical men, wiremen, contractors, linemen, superintendents of small plants, operators, and construction engineers; in short for the type of man who is called upon to install and use the apparatus that has been designed by the electrical engineer. The preparation of the subject matter has been a process of compilation, the greater part of the data having been taken from the notes of the compiler. Many abstracts are given from standard books and from technical magazines. Theoretical questions have been avoided as much as possible, the data presented being confined entirely to established practice as it existed up to the time of publication. The subject matter is divided into six sections under the general headings of Fundamentals, Generators and Motors, Outside Distribution, Interior Wiring, Transformers, and Illumination.

ELEMENTS OF WATER BACTERIOLOGY. By S. C. Prescott and C. E. A. Winslow. P. 318. John Wiley & Sons, New York, 1913. For sale by the *Mining and Scientific Press*, San Francisco. Price \$1.75.

The book was originally prepared in 1904 for students of biology and sanitary engineering at the Massachusetts Institute of Technology. To cover advances in the science it was revised in 1908. Because of further advances and because of the publication in 1912 of the revised edition of 'Standard Methods of Water Analysis' by the American Public Health Association, the third edition has been prepared.

The book is a very satisfactory and modern treatise on water bacteriology. This is especially true with respect to sanitary water analysis. The recent recommendations of the Committee on Standard Methods are discussed. The authors do not agree with the recommendations of the Committee that the 37° count should replace the 20° count, but agree with the resolution adopted by the Laboratory Section of the American Public Health Association at the Washington meeting, that both determinations should be made in ordinary routine water examination.

The chapter dealing with the isolation of pathogenic bacteria dwells especially on the recent methods for the isolation of typhoid bacillus. The authors believe that the whole group of lactose-fermenting bacilli is significant and that the lactose bile fermentation test is sufficient identification of the colon group for ordinary sanitary purposes. The specific identification of *B. coli* is therefore not necessary in routine tests. A new chapter dealing with the sanitary study of shell fish has been added. The book as a whole is a very satisfactory treatise, valuable both to the student and to the practical worker in the field of water bacteriology.—E. B.

Recent Publications

MINING INDUSTRY OF PART OF NORTHERN ONTARIO, 1913. Compiled by Arthur A. Cole for the Territorial and Northern Ontario Railway Commission. P. 74. Ill., chart, index. Toronto, 1914. This contains a lot of valuable information on gold and silver mining in this province, which will be abstracted from time to time.

U. S. Geological Survey publications. Washington 1914. Minerals Resources of the United States, 1913.

PRODUCTION OF CHROMIUM IRON ORE, 1913. By J. S. Diller. P. 13. Ill.

PRODUCTION OF BAUXITE AND ALUMINUM, 1913. By W. C. Phalen. P. 29. Ill.

PRODUCTION OF SAND-LIME BRICK, 1913. By Jefferson Middleton. P. 8.

PRODUCTION OF MICA, 1913. By Douglas B. Sterrett. P. 11.

Professional papers:

CRETACEOUS DEPOSITS OF THE EASTERN GULF REGION, AND SECTIONS OF ENOCYRA FROM THE EASTERN GULF REGION AND THE CAROLINAS. By Lloyd William Stephenson. No. 81. P. 77. Ill., 21 plates, charts, maps, tables, index.

GEOLOGY OF LONG ISLAND, NEW YORK. By Myron I. Fuller. No. 82. P. 231. Ill., maps, charts, index.

UPPER CRETACEOUS AND EOCENE FLORAS OF SOUTH CAROLINA AND GEORGIA. By Edward Wilber Berry. No. 84. P. 200. 29 plates, index.

JURASSIC FLORA OF CAPE LISBURNE, ALASKA. By P. H. Knowlton. No. 85-D. P. 16. 8 plates.

RESINS IN PALEOZOIC PLANTS AND IN COALS OF HIGH RANK. By David White. No. 85-E. P. 19. 18 plates.

GEOLOGY OF THE PITCHBLende ORES OF COLORADO. By Edson S. Bastin. No. 91-A. P. 5. Ill. This will be covered in another issue of this journal.

Water-Supply Papers:

STREAM-GAGING STATIONS AND PUBLICATIONS RELATING TO WATER RESOURCES, 1885-1913. Part I. North Atlantic Coast drainage basins. Compiled by B. D. Wood. No. 349-A. P. 31.

GROUND-WATER FOR IRRIGATION IN THE VICINITY OF WICHITA, KANSAS. By O. E. Meinzer. Preliminary report. No. 345-A. P. 9.

GROUND-WATER FOR IRRIGATION IN THE VICINITY OF ENID, OKLAHOMA. By A. T. Schwennessen; with a note on GROUND-WATER FOR IRRIGATION ON THE GREAT PLAINS, by O. E. Meinzer. No. 345-B. P. 13. Map.

UNDERGROUND WATER OF LUNA COUNTY, NEW MEXICO. By N. H. Darton, with RESULTS OF PUMPING TESTS, by A. T. Schwennessen. No. 345-C. P. 16. Map.

GROUND-WATER FOR IRRIGATION IN THE VALLEY OF NORTH FORK OF CANADIAN RIVER, NEAR OKLAHOMA CITY, OKLAHOMA. By A. T. Schwennessen. No. 345-D. P. 11. Map.

SURFACE WATER OF THE UNITED STATES, 1911. Part VI. Missouri River Basin. Prepared under the direction of M. O. Leighton by W. A. Lamb, W. B. Freeman, and Raymond Richards. No. 306. P. 374. Map, index.

SURFACE WATER SUPPLY OF THE UNITED STATES, 1911. Part IX. Colorado River Basin. By Robert Follansbee, W. B. Freeman, and G. Clyde Baldwin. No. 309. P. 266. Map, index.

SURFACE WATER SUPPLY OF THE UNITED STATES, 1912. Part II. South Atlantic coast and eastern Gulf of Mexico basins. By W. E. Hall and C. H. Pierce. No. 322. P. 98. Ill., map, index.

SURFACE WATER SUPPLY OF THE UNITED STATES, 1912. Part IV. St. Lawrence River Basin. By C. C. Covert, A. H. Horton and W. G. Hoyt. No. 324. P. 149. Ill., index.

Industrial Progress

Locomotive Cranes

Among the machines and appliances which not many years ago were looked upon as superfluous and as having a limited application, but which today have come to be recognized as standard equipment in the conduct of large scale mining and smelting operations, the locomotive crane may be prominently mentioned. This machine, which is fast finding favor among the operators, has been adapted to various uses by the miner and smelterman and has proved itself to be a great labor saving and cost reducing machine. In construction work the crane supplies an efficient means for the handling of machinery and materials and after the smelter or mill has been completed, the crane is employed for the handling of supplies and products. In the handling of ore in open-cut mining operations the locomotive crane is invaluable for lifting



LOCOMOTIVE CRANE IN OPERATION.

drills, handling broken ore and waste, lifting cars, and moving supplies. In bench operations the crane is well adapted for the transfer of drills, supplies, etc., from one level to another. In the illustration is shown an Ohio locomotive crane used for reclaiming and loading.

With the increased use of cranes of this type the requirements have become more exacting as to material and adaptability. The breakages in parts usually involved castings and materials of fragile nature, which resulted in delays and cessation of work while repairs were being made. This objection was increased by the manufacturers frequently charging heavily for any repairs or spare parts, which led to no little dissatisfaction. The modern crane has been modeled and built with the object of simplicity in design and durability in construction, providing accessibility to all parts of the machinery and representing such construction as will render the crane almost immune to injury with ordinary care. In the Ohio crane this feature has been given careful attention, and in order to make it as immune to injury as possible steel castings are employed where gray iron castings are the ordinary practice.

The capacity of a locomotive crane is based upon the maximum safe working load which the crane can handle at a 12-ft. radius; that is, horizontal distance between the crane's axis of rotation and a perpendicular line through the centre of the hoisting hook or grab bucket, as the case may be. The cranes are built for standard-gage railroad track, 4 ft. 8½ in.,

but wider gage may be had if so desired. The main base of the Ohio is one large steel casting, this being used to avoid breakage and the common annoyance from loose bolts. The turntable revolves upon four bevel steel rollers of large diameter. The steel track upon which they operate is 3 ft. diameter. In that the machine is very heavy, counter-weights and scrap iron ballast are dispensed with.

Vertical tubular boilers are used and the engines are of the horizontal double cylinder non-reversing type. The cylinders are jacketed with magnesia blocks which are covered with sheet steel. The boom is of structural steel and operated by a heavy bronze worm gear keyed to the boom drum shaft and engaging a steel worm with heavy turned threads. Cast iron sheaves, plow steel rope, steel fall-blocks, cast iron drums, bronze bearings, forged steel shafting, cone friction clutches, foot brakes, steel gear, compression grease cups, oil cups, wells, and channels are all given careful attention in locomotive crane construction with the result that the finished crane is adapted to meet the hardest of working conditions. The Ohio Locomotive Crane Company at Bucyrus, Ohio, represented on the Pacific Coast by the Edward R. Bacon Co., San Francisco and Los Angeles, is producing what is claimed to be one of the most modern types and one which embodies the results of years of experience in crane construction and design.

The GENERAL ELECTRIC Co., of Schenectady, New York, is supplying the Alaska Gastineau Mining Co. at Sheep creek, Alaska, with 35 additional motors ranging from 7½ to 300 hp. The Anaconda Copper Mining Co., Butte, will install 23 additional induction motors ranging from 5 to 20 hp., with starting compensators and 10 oil switches. The Tomboy Gold Mines Co., Telluride, Colorado, will place in operation in its mines a 4-ton electric mining locomotive which was recently purchased from this Company. The Arizona Copper Co., at Clifton, will add to its electric equipment at 150-hp. induction motor and two 3-bearing 17½-kw. motor-generator sets. The Anaconda Mining Co., Butte, Montana, has purchased for installation in the plant of the International Smelting & Refining Co., Miami, Arizona, two 200-kw. 3-bearing synchronous motor-generator sets. The Alaska Treadwell Gold Mining Co. has ordered three additional 75-hp. induction motors with compensators. The Champion Copper Co., Painesdale, Michigan, will place three new 4-ton electric mining locomotives in operation at its plant, all of which equipment is being supplied by the General Electric Company.

MORSE BROS. MACHINERY & SUPPLY Co., of Denver, has recently purchased the entire stock of machinery and supplies of J. H. Wilber, the largest machinery dealer in Cripple Creek, Colorado. This purchase consists mainly of hoisting engines, boilers, compressors, drills, steel, and all articles used in and about a mine. It has also purchased the tunneling plant of the Karns Tunneling Machine Co., at Magnolia, Colorado, consisting of Imperial type air-compressors, boiler, rail, pipe, etc. This plant was only in use about three weeks. A complete 100-ton cyanide plant, crushers, rolls, steel cyanide tank, etc., at Creston, Colorado, known as the Loungridge mill, has also been purchased. This mill was in operation less than sixty days, was completely equipped with electrical drive, electrical generator station, and the material practically new.

The HARDINGE CONICAL MILL Co. is in receipt of a 'repeat' order for two 8-ft. Hardinge mills from the Caucasus Copper Co. of South Russia; also for two 8-ft. mills for the Spassky Copper Co. of Russia.

New bulletins of the CHICAGO PNEUMATIC TOOL Co. include No. 152, 'Chicago Galting Drills'; No. 153, 'The Chicago Sinker'; No. 154, 'The Chicago Stoper'; No. 172, 'Chicago Plug and Feather Drill'.

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EDITORIAL

STEAMSHIP disasters, such as the sinking of the *Empress of Ireland* come home to us when we learn that among those lost were personal friends, and men in many lands have been saddened by the knowledge that among those lost in the *St. Lawrence* were A. E. Barlow and his wife. Canada has produced a select group of tireless and fearless explorers who have been more than mere traversers of the wilderness; men who join to physical courage the knowledge and insight of the scientifically trained. Among them Barlow ranked high. He not only went through the wild places of the earth, but he brought back knowledge that served as the basis of industry, and among geologists and mining men his loss will be felt keenly.

MINERAL PRODUCTION in Mexico is decreasing rapidly. The figures for the present fiscal year reflect the unsettled state and the trying conditions through which the country is passing. It is disheartening to record a decrease in production of over \$53,000,000 for the first eight months of the present fiscal year. In the general decline over this period the gold exports dropped \$9,041,961, silver \$30,007,376, and copper \$17,961,101, according to statistics compiled by the Mexican government. Oil is the only mineral product which shows an increase, the exports for the period under review totaling \$12,612,569 as compared with \$6,543,688 for the corresponding months of the preceding year. The recent activity of the Constitutionalist forces in the vicinity of Tampico will no doubt occasion a decline in the petroleum output, although it is to be noted that no wanton destruction of property has occurred in the oilfields nor does it seem likely to occur.

THE DEUTSCHEN PLATINWERKE meeting held at Düsseldorf was the occasion for the reading of a report upon the Westphalian platinum deposits, noted in our issue of January 31, 1914, by Mr. W. Hommel of the Clausthal mining academy. It is pointed out that the platinum occurs with lead, zinc, antimony, and nickel, and not in a colloidal state as previously supposed. As evidence of the successful treatment of these ores by a new process, there was exhibited a 500-gram bar of platinum. This bar resulted from the treatment of 25 tons of ore. One ton of concentrate from the 25 tons of ore also yielded about 11

per cent nickel. Mr. Hommel estimates that the cost of production, including mining, will be about \$4.80 per ton. As the world's platinum production is at present entirely from alluvial deposits, the Westphalian deposits of platinum *in situ* have been generally regarded with extreme skepticism. It will be interesting to note what effect, if any, this evidence of an important new field will have upon the industry. If the large bodies of ore assaying 5 grams platinum are highly profitable, as claimed, it would seem that a part solution has been found at last for the problems due to ever-increasing cost of the metal and decreasing sources of supply.

CANADIANS are even more excited than the Japanese over recent petroleum discoveries, and there is an oil 'boom' on at Calgary that rivals Beaumont days. The new Dingman well has not yet been tested, and California men look wise when they see the 1000-gallon (not barrel) tank that has been provided to receive and store the oil when the pump starts. However, the oil is of high grade, 64.2 Baumé, and there is a strong flow of gas, estimated at 2,000,000 cubic feet. Our Toronto correspondent summarized last week the report upon the area by Mr. R. W. Brock, a most competent and cool headed observer. This may be supplemented by stating that at 2000 feet the well would be near the bottom of the Judith river. This formation consists of fresh-water sediments and contains thin coal beds. Beneath it is the Clagget, which, in Montana and south of the international boundary, contains considerable organic matter. Still lower is the Benton shale, which in Colorado and northward has yielded oil at a number of points. The Calgary oil is of such exceptional high grade that it is best interpreted as a diffusion product produced by migration from some underlying body of crude oil. So far it offers encouragement to drill further, though the probability of a big supply in the Dakota sandstone has been overestimated by our friends of the North, if experience in the United States is a guide. The particular anticline being tested at Calgary indicates a field about 700 feet wide and three to ten miles long. The geology of the region suggests additional areas for prospecting, but on the whole, we think the farmer who traded 80 head of cattle for a receipt for stock to be issued in a company still to be formed, without learning whether the particular land to be prospected was 10 or 30 miles away and over anticline or syncline, was a trifle precipitate; just a trifle.

VOLUNTARY ARBITRATION is proposed by the United States Commission on Industrial Relations, which has submitted a tentative draft for a bill creating a national board of mediation and conciliation to deal with strikes and lock-outs in any part of the country that seems likely to involve the federal government. The bill expressly denies to the board any compulsory powers of arbitration or prohibition of strikes. It thus avoids conflict over any question of

state or interstate jurisdiction. Within the past year Congress has been called upon to investigate strikes in the states of West Virginia, Michigan, and Colorado, and precedent for a federal board is found in the Anthracite Coal Strike Commission of 1902 which settled difficulties in Pennsylvania. All efforts at conciliation in recent strikes have failed, and if the federal government is compelled to intervene after a crisis has been reached, it is better that it have a permanent board representing the entire nation and having the confidence of both employers and employees, which board can be asked to intervene at the inception of such disputes. The bill is modeled after the plan of the Newlands act creating the present board of conciliation and mediation for dealing with railway disputes. The success of the Newlands act in the railway field suggests that a similar agency might avoid other strikes, or at least prevent them reaching that state of violence which has become so common. Strikes have become an all too frequent source of disturbance in mining, and their results have in most instances been so unfavorable to both employee and employer that sane arbitration of the differences between capital and labor should be welcomed by both.

China's New Mining Regulations

Many of our readers will remember that in the treaties which were made following the outbreak in 1900, it was specified, among other things, that China should prepare a code of mining regulations which would permit foreign capitalists to enjoy the same rights in China as they do in other countries. This was especially provided in the Mackay treaty of 1902. In carrying out the terms of this treaty, delay after delay has occurred. Sets of regulations have been drawn up by bureaus at Peking and submitted to the representatives of the treaty powers, only to be rejected. In the latest reorganization of the government at Peking, Chang Chien has been appointed Minister of Commerce and Industry, and has created a Bureau of Mining, of which D. T. Yang is the head, and the distinguished director of the Geological Survey of Sweden has been appointed adviser to the Mining Bureau. Minister Chang has exhibited a great deal of interest in the development of the mineral resources of China and has given out various suggestions as to their development. Among others, a new set of mining regulations has been drawn up. These have to be submitted to the treaty powers, but they are so much an improvement over any that have previously been composed that they stand some chance of being sanctioned. The regulations are too detailed and require too much space to give in full, but it will be worth while to summarize some of the most important features.

Chapter I covers general rules and provides that citizens of the Republic of China may secure mining rights, and citizens of foreign nations may also secure

them when doing joint business with citizens of China. Foreigners wishing to engage in mining must present to the Director of the Mining Supervision Office a certificate by their consul showing that they are willing to abide by Chinese mining regulations. Salt and petroleum are reserved as government monopolies, but the various other kinds of mineral substances are open to general exploitation. In the case of coal, metals, and precious stones, the mining rights are separate from the ownership of the land. In the case of the non-metallic minerals the ownership of the mining rights goes with the ownership of the land.

Chapter II defines areas on which mining may be conducted. As in all previous regulations, it is provided that mines may not be opened in close proximity to tombs, temples, fortifications, and public utilities without permission. The distances, however, are much decreased, a maximum of one-third of a mile now being the rule. It is provided that the claims shall be bounded by vertical planes. A coal-mining area is allowed a minimum of 54 acres and up to 1180 acres. The areas allowed for other mines vary between 10 acres and 540 acres.

Chapter III deals with mining rights. This contains a great many clauses, and is rather complex. It is interesting to note that the petitioner for a mining area must prove that the area for which he applies does contain the mineral which he wishes to exploit. Provisions are made for conflicts and also for the exploitation of two different minerals in the same area by different groups. Where more than one person applies for mining rights for the same area, they must be given to the first applicant. There are possibilities for a good deal of difficulty in the regulations. Thus, for example, Article 20 says "mining rights should not be surrendered to others in part." What effect this might have on the sale of stock in a mining company is open to question. Similarly, Article 44 says that the operators of mining enterprises "should from time to time submit the working plans, drawings, and explanations, to the Director of the Mining Supervision Office for decision. The possessor of the mining right shall operate the mines according to the plan and description passed by the Director of the Mining Supervision Office. With regard to the plan and description for the above, no change shall be made without the approval of the Director of the Mining Supervision Office."

The presence of such a trouble-making clause in the regulations is, of course, clear evidence that the persons who drew them up are without any competent knowledge of mining. It would be entirely impossible for any government bureau to undertake the detailed supervision of the work of operating every mining company in China. The greatest difficulty, aside from the delay which might be entailed by an attempt to enforce this clause, is the fact that neither the Minister of Commerce nor the present head of the Mining Bureau has any knowledge of mining whatever, Mr. Yang being a graduate of a law school in Japan.

and it is highly probable that such a condition is likely to persist. The difficulties of a company which tries to secure approval of its plans from officials who know nothing of mining are easy to imagine. The mining right may be canceled if the operations are not conducted with reasonable diligence, if the tax is not paid, or if suitable precautions for the safety of employees and the public are not followed. It may also be canceled "if the plans and descriptions submitted are not followed" or "if the mining enterprise injures the public interest." It is evident that these last two provisions open a fertile field for the oppression of mining operators by the officials, and, indeed, the whole series of regulations have the air of being drawn up more with the idea of developing 'squeeze' than of developing the mineral resources.

Chapter IV deals with the land used for mining purposes and provides that the proprietor of the mine may, under proper regulations, use the land of others in order to carry on his own necessary operations. An adequate security may be demanded by the owner of the land for any such use of his property. Chapter V deals with miners, their duties, wages, compensation, injury, and so on.

Chapter VI deals with mining taxes. It provides for two classes of tax: on the area and on the output. The area tax for metal mining amounts to \$0.45 per acre per year. This is in addition to the ordinary land tax, which is paid everywhere throughout China. On the product of metal mines, $1\frac{1}{2}$ per cent of the market price at the mine shall be collected as tax. For non-metallic minerals, 1 per cent is collected. The regulations do not clearly explain whether the tax is on the gross or net value of the output.

Chapter VII covers provisions for policing the mines, and it similarly contains clauses which might lead to a good deal of difficulty on the part of the operator. Thus article 86 provides that the Minister of Commerce or Director of the Mining Bureau may demand the employment or change of experts employed by the mine operator. Chapter VIII deals with judgments, complaints, and lawsuits. Article 93 provides that if foreign citizens in partnership with Chinese citizens in mining affairs have any dispute, the case must be settled by the decision of the Director of the Mining Supervision Office. It is scarcely probable that in the present state of government in China the treaty powers will agree to any such stipulation as this.

Chapter IX deals with punishments for violations of the provisions of the regulations, and closes with a provision that contracts and agreements previously made for the raising of foreign capital shall continue in force according to the conditions under which they were made.

While on the face of it the new regulations look much more favorable than any that have so far been proposed, as a matter of fact they fall a long way short of leading in any practical degree toward the adequate development of Chinese mineral resources through the aid of foreign capital.

The Miner As A Pioneer of Civilization

By T. A. RICKARD

It is a common saying that agriculture and mining are the two basic industries. When man rose above the brutish individualism of his primordial state and began to develop the social instinct, he turned to the soil, in order to win food for his family. He paused in his migration; the soil held him; it gave root to his rudimentary community; it gave him the chance to enlarge his energies. His tracks became highways; his rivers, avenues of trade; and as his traffic expanded, so his imagination widened, until, out of the crudities of communal development grew the complexities of civilization.

But the nomadic habit lingered; the spirit of the hunter survived in man: a wanderer and a wonderer he stood beneath the starry dome or the forest arch not knowing whether he were a guest or a captive in the domain of Nature. The hills beckoned; the seas called; the more venturesome left the tents of the tribe in search of material wherewith to fashion their implements. They sought iron for weapons, copper for tools, gold for ornament, and found them in various guise in the earth under their feet. They became miners. To those who delved successfully came power. Throughout the ages the more energetic and adventurous broke from the plough and forsook the cattle in order to explore and to exploit. They furnished the metals from which the artificers fashioned engines of power and machines of intelligence. They won the materials for a social structure that, based on stone and built in iron and copper, soared in many-storied tracery of steel to towers radiant with light and vibrant to the sky—towers so far above the common ground that man almost forgot his lowly origin and claimed kinship with the stars.

Basis of Civilization

Civilization was developed on a metallic basis, not as regards money, for credit is the expression of an advanced state of society, but as regards implements and instruments, machinery and transport, facilities of living and of communication, all of which required the use of metals. The need of them and the consequent market for them induced enterprising men to probe the hills and scour the deserts in search of the mineral deposits that are distributed with such perplexing irregularity in the outer crust of the earth. These deposits were not to be found near the smiling cornfield or the gentle hillslope, but in regions where geologic unrest had produced inequalities of contour and ruggedness of aspect, where the surface was bare of soil and the mountains exposed their heart of rock. The miner, therefore, left the sheltered valley and plunged into the outer wilderness. And in his wanderings, he found not only the metallic ore that was the immediate

object of his quest: he also discovered new tracts of agricultural land, and new dwelling places for his tribe. Returning home, he told the farmers and shepherds that fertile fields and lusher meadows were awaiting them across the range. They migrated thither, while he again adventured afar across the world, ever pioneering the advance.

This bare outline of a familiar story has already been punctuated by you with memories of the romance that has marked your own national expansion. The story of mineral exploration and racial migration is peculiarly the heritage of our people, the Anglo-Celts. It is the *motif* that runs through the drama of English and American history, more particularly during the last hundred years. Even in its barest outline it serves to suggest that the miner is the pioneer of industry and the herald of empire.

Early Discoveries

The first social organizations around the shores of the Mediterranean sent their prospectors to the hinterlands of Europe, Asia, and Africa. The gold of Ophir, the copper of Sinai, the silver of Laurium were part of the web and woof of those early civilizations. The mines of Iberia gave Hannibal the sinews of war against Rome, and the gold of Dacia strengthened the resources of Rome under Trajan. But the greatest adventure was that of the Phoenicians who passed through the Pillars of Hercules into the western ocean in order to reach the far Cassiterides, the tin islands that in turn were to produce those Cornishmen to whom this earth is one big mine. After Carthage and Rome, in turn, had been overthrown, the mining industries of the known world were disorganized. Desultory operations persisted in Hungary, Spain, and Saxony, but the Middle Ages to the miner were as dark below ground as above. Even the discovery of America, which marked the beginning of a new world movement, was not connected with a real advance in mineral exploitation, although associated with the gaining of gold and silver. It is true, the wave of Spanish conquest broke over the American continent, penetrating the treasure-vaults of Mexico and Peru. But the Spaniard devastated, he did not develop. He gathered the harvest that the patient Indian had sown by the laborious toil of centuries. Cortez and Pizarro were filibusters, not explorers; they were pirates, not miners. The *conquistadores* were no pioneers of industry; behind them arose the smoke of ruin and the dust of destruction. Even the great sea-captains of Elizabeth were but the sequel to an epoch of spoliation. After them, and in their wake across the sea, came the men who from Cornwall and Devon, from Saxony and the Harz, brought the technique of mining to the new

world, applying it peacefully to the mineral development of Mexico, Peru, and Chile, all along the regions previously ravaged by European freebooters.

But the great era of mineral exploration came with the discovery of gold in Australia and California. It was the prelude to a worldwide migration, an enormous expansion of trade, a tremendous advance in the arts of life, and the spread of industry to the waste places of the earth.

The color of energy began to tint the blank spaces on the map. The western half of the North American continent, all of Australia, the southern half of Africa, the northern half of Asia, were invaded, penetrated, and explored by those in search of gold, or other metals, and as each successive mineral discovery was made by the miner he called upon his fellows to come and take a hand in the good work. He was the scout far ahead of an army of development. Trade follows the flag, it is true, but the flag follows the pick.

Let us recall the story of that odyssey, and see for ourselves what human progress owes to its adventurous forerunners.

Discovery of Gold in California

First we turn to the American argonauts, the men who sought the Golden Fleece in California. Even the dates in this story are fragrant with romance, for gold was discovered by James W. Marshall on January 24, 1848, and the treaty of Guadalupe Hidalgo, which ended the first Mexican war, was signed on February 2. In other words, California was ceded to the United States 9 days after the great discovery, which, at that time, was not known to either government, fortunately for both of them, and for many others. Marshall had built a saw-mill for John A. Sutter at Coloma on the south fork of the American river, only 35 miles north-east of Sacramento. When the mill was ready to start, Marshall saw that the tail-race, or ditch leading the water from the wheel, was not deep enough. He proceeded to deepen it by opening the floodgates to full capacity, so that the swift current would scour the bottom. The water was allowed to run all night. In the morning Marshall noted the effect, and while doing so he saw several yellow nuggets. He hammered one of them, and decided that it was metal; he bit it and found that it was soft; he boiled some of them in a kettle and proved them insoluble in water. Thereupon he went to Helvetia, or Sutter's Fort, to tell his *patron* that he had found gold. Sutter tested the metal with nitric acid, some of which he found among his apothecary stores; he read the article on gold in his copy of the *Encyclopedia Americana*; he weighed the nuggets and compared them with coins; whereupon he also pronounced it gold.

That marked the beginning of the Golden Age in the foothills of the Sierra Nevada. Others found gold in near-by streams; the news traveled to the Atlantic seaboard, and thence to Europe. An excited migration began across the plains, over the Panama isthmus, around Cape Horn. The young, energetic, and adven-

turous hurried to the Eldorado that promised to fulfill the dreams of Raleigh's day. In 1851 California yielded \$81,294,700 in gold. It was no idle imagining, but an astounding fact. Nor does the output of precious metal measure the full consequence of the event. Cities were born, new avenues of commerce were created, the valleys of the Sacramento and the San Joaquin became the granaries of prosperous communities, the unknown territory in the middle of the continent was traversed and explored, the Great West leapt into vigorous life and became an integral part of the American domain. Moreover, among those enriched by the mines were men of initiative and imagination; like Balboa they stood on a peak in Darien; they saw the Pacific and the Atlantic as surely as he did, and to more purpose; they built a transcontinental railroad and tied California to the Union with links of steel.

You may say that most of these adventurers were not miners. I demur. What is a miner? He is the man who does the work of a miner, and that is, to extract ore from the ground. Most of the young and lusty men that rushed to California had never seen a mine, but that does not matter? They went to do the work of mining, and with the washing of the first panful of gold-bearing gravel they won the badge of Agricola. They had the machinery most used in mining: human muscle; they had the science most approved in that ancient art: organized common sense; they achieved the fundamental purpose of mining: to exploit mineral profitably. They came, they worked, they conquered; and from their labors has arisen a great and glorious commonwealth.

The Victorian Goldfields

Among those that went to California was E. H. Hargraves, an Australian, who was led by the analogy of geologic conditions to suspect the occurrence of gold in his own country, New South Wales. Returning thither, he was able on April 3, 1851, to inform the Colonial Secretary that gold existed at Lewis Ponds and other localities. He furnished ample proof of his statement, and was suitably rewarded. Hargraves was a man of exceptional intelligence, and the discovery that he made was among the least fortuitous of those that have changed history. It led immediately to search for gold elsewhere in the Australian colonies, then consisting of a few small and scattered settlements along the southeastern coast. In August of the same year a discovery at Buninyong, near Ballarat, started the first big rush to the Victorian goldfields. Sailors left their ships at anchor in Port Philip bay; clerks jumped off their stools to rush to the diggings; every able-bodied man shouldered his blanket and trudged through the bush to engage in the treasure hunt. After all the local population had stampeded, the news reached Europe and incited another economic Hegira. The gold seekers came in ship-loads and they expected to find gold in pailfuls; indeed, many of them were simple enough to believe that gold in quartz meant gold in double pints. They had much to learn, and most of

them learned it without delay from the severest of all teachers, *Der Herr Oberbergat Professor Experience*. In the year 1853 Victoria yielded \$54,882,000 in gold.

From the mining-camps eager explorers plunged into the bush, or eucalyptus forest, which, like a sea of perennial foliage, then covered the habitable portions of the Australian continent. Outside them they found the grassy uplands on which the Australian was to grow a later golden fleece, and beyond these pastoral tracts they invaded the never-never land in which the rivers lose their way. The alluvial mining for gold was the beginning of a new era, it led to the discoveries of tin in Tasmania, of golden ironstone at Mount Morgan, of silver-lead ore at Broken Hill: it started a widespread mineral industry on the island continent; with it came a rapid growth of population of a kind superior to that of the first settlements; agriculture waited on mining, the need for food-stuffs stimulated husbandry, towns arose as if by magic, hastily constructed camps became permanent communities, a new civilization swept the aborigines into the interior, razed the primeval forest, furrowed the soil, cleaved the quarry, built docks, warehouses, and dwellings. Australia was born again. Captain Cook sailed along the coast and placed Australia on a naval chart; Har- graves placed her on the map of the world.

Among the more remarkable explorations of a later day I may instance Western Australia. The interior of that State is an arid plateau; it is the oldest land surface in the globe, and represents the basal wreck of a larger continent. It had been crossed by several parties of explorers, in the hope of finding some oasis in the desert or some outlet of the rivers that fail to reach the sea. In 1887 a discovery of gold was made by Anstey at Yilgarn. This attracted a few prospectors, who scattered farther inland. In October 1892 Bayley and Ford found a rich outcrop 500 miles from the coast, at Coolgardie. The outcrop was 50 feet long, 6 feet wide, and 5 feet high, spangled with coarse gold. In the March following they sold their claim for £6,000, and a sixth interest. During the ensuing year the new owners extracted 25,872 ounces of gold from 48 tons of ore, which, therefore, averaged 539 oz. per ton. That started the 'boom'.

Then was seen a strange spectacle. The sandy plain was covered with a monotonous scrub, sparse enough to be traversed easily, yet tall enough to restrict the view and render it easy for the careless to lose their bearings. Many were 'bushed', and perished miserably. Emerging from tracts of stunted forest, the gold-seeker found stretches of sand and spear-grass or else shallow depressions with clay bottoms from which the mirage lured him to unslakable thirst. Water was scarce, and uncertain at the best; a new peril faced the miner; early in the development of this region he learned to dig a hole to salt water and distill the brine in a rough apparatus. But a lack of the prime necessity of life was a grim factor in the search for gold.

With the whisper of each new discovery, crowds of

reckless men plunged into the outer desolation. Eager horsemen jostled those on awkward camels, whose swinging gait carried them past the mob of diggers trudging wearily forward. The incident known as the Siberia rush is typical of those days. The name Siberia is a biting satire, for the temperature is that of Tophet. A man came into Coolgardie one night with a story that gold had been found at a spot 30 miles to the north. The rumor vibrated like wireless telegraphy through the tents and corrugated iron shanties. Quietly one arose and another followed. Scores started on horses or on camels; hundreds went on foot, carrying their 'billies' and blankets on their shoulders or trundling their packs in wheelbarrows. Some took the wrong direction, and of these many lost their way and died miserably in the bush. Four hundred reached the scene of discovery. The only water available was in a 'soak' or water-hole seven miles distant. It was soon drained dry by the thirsty diggers. News came to Coolgardie that a water famine was imminent. A government official promptly dispatched a dozen camels bearing water to the succour of the adventurers. In the meantime, most of them, aware of the danger impending, had started to reach the nearest 'condenser' or distillation plant. Many died on the way, and many more would have perished save for the water brought by the camel-train. Nevertheless, in a few days there was another stampede in another direction. Thus the goldfield was explored. *Sic Etruria crevit.*

South Africa

We go next to South Africa. The Phoenicians sailed round it; the Portuguese landed on its shores; the Dutch founded sundry little settlements; but it was the finding of diamonds and gold that proved the 'open sesame' to the portals of the Dark Continent. Dutch hunters had roved northward from the Cape to the Vaal and the Orange; later Boers had trekked beyond both of these rivers; but none among them had imagined that diamonds were mingled with the pretty garnet, jasper, and agate pebbles bordering the stream. In 1867, in the hamlet of Hopetown, a child found a shining stone and played with it. The mother gave it to a Dutch neighbor, and he in turn asked an Irishman to ascertain what it was. But no one thought it worth anything until a local official noted that it scratched glass. Thereupon it was sent to a mineralogist, who did not hesitate to label it a diamond. But it led to nothing. No others like it were found immediately in the same locality. In March 1869—two years later—a Griqua shepherd found a magnificent diamond near the Orange river; it weighed 83½ carats, and was sold by him for 500 sheep, 10 oxen, and a horse. Subsequently, it brought £25,000, and became known as 'the Star of South Africa.' Indeed, it was the dawn of a new era. With that discovery began a great rush to the banks of the Vaal. At first from the neighboring parts of South Africa and then from every quarter of the globe there thronged a motley mob of fortune-hunters. The majority were men of British descent,

but even the stolid Boers were attracted, every European nation was represented, and with them all shades of black and brown, from the undiluted negro to the mezzotint half-breed. To all of these the winding shallows of the Vaal were as the valley of Sindbad the Sailor.

Kimberley and De Beers

Meanwhile, bigger discoveries had been made on the farmlands of the Dutch squatters, for it had been proved that the distribution of the gems was not restricted to the alluvium of the river flats, but extended through the surface soil and calcareous cement into the yellow and blue ground constituting the matrix of the diamond. Of these mines, the Kimberley and De Beers were the most important, and on their development hinged events of historic significance.

Among those attracted to the diggings were two remarkable men: an Oxford student named Cecil John Rhodes and a young Hebrew from London called Barnett Isaacs, famous later as Barney Barnato. One became identified with the De Beers, and the other with the Kimberley mine. Both of them saw that consolidation was imperative if the diamond market was not to be glutted. They fought strenuously for control; and Rhodes, backed by Alfred Beit, won. On July 18, 1889, the deal was closed by a cheque for £5,338,650, which was the price of the Kimberley mine. Since then the De Beers Consolidated has distributed £30,000,000 in dividends, and redeemed debentures to the value of £4,822,705.

Kimberley became a distributing point for the adjacent mineral region. In 1884 the De Kaap goldfield was discovered, whereby the districts of Barberton and Pilgrim's Rest came into existence. In 1885 Laurenz Geldenhuis found gold in shale on the hills north of the farm Roodepoort. Later in the same year Arnold detected gold in conglomerate lying on the farm Langlaagte. Both of these finds were made on the Witwatersrand or White Waters range. In December, Harry Struben, who had learned something of mining at Kimberley and Pilgrim's Rest, erected a 5-stamp mill, and with that the exploitation of the Rand may be said to have commenced. On July 18, 1886, the goldfield was proclaimed. The sober veldt sprang into busy life, and the greatest gold-mining industry of the modern world came into being. In the next 25 years the Rand produced £309,872,000 worth of gold, the maximum annual output being in 1912, when it was £37,182,795 from 25,486,361 tons of ore.

Rhodes and his partners participated in that development, but the diamond discoveries had an even wider influence, for they provided capital and energy for the extension of industry into the very heart of Africa. This brings us to the story of Rhodesia.

It was the ambition of Rhodes, always backed generously by Beit, to paint the map red. He worked and schemed to found a new empire in the northern hinterland—a word of which Rhodes was particularly fond. At that time German and Portuguese colonial expan-

sion seemed likely to absorb the vast interior made known by the explorations of Livingstone and Stanley. This threatened the future of that South African Union which Rhodes had in mind. By obtaining a concession from Lobengula, chief of the Matabele, who dominated the weaker tribes, he got a foot-hold. With this, in 1888, he incorporated the British South Africa Company, under royal charter, and by the purchase of concessions obtained by other adventurers, he consolidated a great tract of grazing and mining territory under the British flag.

Two years after the Chartered Company was formed, a military expedition was sent by Rhodes to Mashonaland, the southern part of this new country, to cut a road through the bush for 430 miles, from Tuli to Salisbury, which was founded on September 12, 1890. The members of this expedition, having accomplished their task peaceably, disbanded and went to work as prospectors. They uncovered the mines of the Gatooma district. In this case the discovery was not made in the usual way by tracing the gold of the river-bed or the detrital quartz on the hillside to its source in a vein or lode. The prospectors were guided by ancient workings, made by a forgotten people, probably of Arabian origin. And though the first operations were not successful, owing to lack of transport and supplies, they laid the foundation of a prosperous business. The men who did this work were preëminently the pioneers of industry; they were actually enlisted as the Pioneer Corps; they were guided by a famous elephant hunter; they were commanded by a mining operator, now chairman of several London companies; the rank and file included a large number of men familiar with mining at Kimberley and Johannesburg. Literally, they prepared the way for others, and started the mineral exploration that opened the interior of South Africa to orderly development and civilized habitation from the Cape of Good Hope to the sources of the Nile.

West Africa

West Africa as a mining region is identified historically with the Gold Coast, a traditional source of wealth. Herodotus speaks of the Carthaginians as receiving gold from native tribes that traded with wild people on the west coast of Africa. During the medieval period Europe obtained most of its scanty imports of gold from this source. Successive traders made an effort to lay hands on the legendary treasure of the region. But they proved abortive. A malarial shore and a dense jungle blocked the passage of the white man. Nevertheless, during the earlier half of the 19th century the export of gold is estimated to have averaged £350,000, or \$1,750,000 per annum, all of it the gleanings of native workers. Not until 1880 did real mining begin, on the initiative of an intrepid Frenchman, Marie Joseph Bonnat. An orphan, first a shoeblack and subsequently a *chef* in a Paris hotel, he met there two ivory-hunters to whom he offered his services for one year without pay. He was engaged, and went with

them to West Africa. When they retired from business, two years later, they bequeathed their equipment to him. Thereupon he went into business on his own account. On one of his ivory-hunting journeys he was captured by the Ashantis and remained a prisoner in the king's kraal for three years, until released by Sir Garnet Wolseley, in 1874, on the occasion of the Coomassie campaign. While a captive he saw the king's treasures of gold and heard of the diggings on the Tarkwa range. When liberated, he obtained a concession from the king of Eastern Wassau, and returned to Paris, where, in 1877, a company called the Côte d'Or was organized by him to operate the mines now known as the Taquah and Abosso. Forthwith other traders obtained concessions and took them to London, where two or three companies were formed. But these early enterprises did not prosper. As was the case in Rhodesia at first, the lack of transport, the scarcity of supplies, and sickness among the pioneers crippled operations. Bonnat himself did not live to see the fruit of his labors; he died at Taquah in 1881. His was a gallant spirit worthy to rank among the best of the heroic forerunners of civilization.

As a sequel to gold mining in West Africa came the clearing of the bush, the training of the natives, the building of a railway, and the introduction of sanitary reforms. Then followed the finding of tin on the highlands east of the Niger, where now a thriving industry is established. This, in turn, has admitted light and air into the tropical jungle, facilitated the establishment of cocoa, rubber, and cotton culture, and brought a dark corner of the earth within touch of the vitalizing forces of industrial progress.

The Story of the Yukon

And now, for our last illustration, we go to Canada. The story of the Yukon is so recent as only to need recalling. That remote corner of the North American continent was slow to be unveiled. The mountains guarding the coast discouraged the Russians who crossed the sea from Kamchatka; the main range barred the way of the English fur-traders and French *voyageurs* who came overland. In 1843 the Russian Zagoskin ascended the Yukon as far as the Tanana, and about the same time Robert Campbell, an agent of the Hudson's Bay Company, descended the river to its confluence with the Porcupine. But the only object of these intrusions into the inhospitable wilderness was the trade in furs. No whisper of gold was heard.

The first gold to come from the Yukon consisted of two nuggets obtained from an Indian in 1880. Small parties of prospectors began to test the creek-bottoms. Encouraging discoveries were made, but none of them was remarkable; moreover, the precarious food supply and the shortness of the season checked enthusiasm. In 1896 the annual output of gold was about \$1,000,000, of which only \$300,000 came from Canadian territory, for the more productive diggings were on the Alaskan, or American, side of the boundary, which is about 50 miles below Dawson, where the waters of the Klondike

mingle with those of the Yukon. Up to that time this vast watershed was of no particular consequence as a mining region. Then suddenly, out of a clear sky, came the tremendous shout of a great gold discovery.

The First Gold

On July 14, 1897, the steamship *Excelsior* arrived at San Francisco bringing miners laden with sacks of gold. They told stories of a new Eldorado in the North, in the valley of the Klondike, on the edge of the Arctic. Again the world heard the bugle-call of adventure. The response was instant. During the following winter 33,000 people landed at Skagway on their way to the Klondike. An eager procession climbed the passes that led over the coast range to the headwaters of the Yukon, down which they voyaged in boats and rafts to Dawson. The horrors of that scramble are almost forgotten. Men, and women also, devoid of experience, physically unfit, laden with packs, toiled up the long ascent in a frenzy to lay hands on the gold. Before this mob reached the diggings the richest ground had been located by the miners and traders previously in the country. Yet some of the newcomers also fared well. The romance of the rush was not with the luckless wasters, the greedy courtizans, or the drunken desperadoes, but with the quiet strong men who greatly endured and nobly overcame the trials of an unaccustomed life, and returned home to become leaders in a peaceful community.

In 1898, the Klondike yielded \$10,000,000, and in 1901, \$22,000,000. The total output so far has been \$150,000,000.

The story of the discovery remains to be told. In the summer of 1896 Robert Henderson, a Nova Scotian, who had mined in Colorado, found gold across the divide from the Klondike. At this time George Carmack, a squaw man, being short of fresh meat, went up the valley of the Klondike in search of moose. Two Indians went with him. Turning up one of the tributary creeks, they worked their passage through the thick underbush and the thicker mosquitoes until fatigue necessitated a halt. While resting, the two Indians panned the gravel and found gold. Crossing the divide, Carmack and his Indian friends visited Henderson's camp, but they said nothing to him about their discovery, for he showed a dislike of Indians. Returning, they found more gold on the same creek, now famous as Bonanza. Thereupon, Carmack and each of the Indians located a claim. That was on August 17, 1896. Putting the gold they had panned into a cartridge-shell, they hastened down the Yukon to Forty-mile, which was the nearest recording office.

This event opened a new province to human industry. Within a couple of years big steamers were ploughing the waters of the Yukon, a railway had been constructed over the coast range, the telegraph had linked the northern frontier with the nerve centres of the world, and new communities had arisen in the very heart of a vast solitude. It was not long before agriculture was started close to the Arctic circle and chil-

dren played where lately moose and caribou had roamed at will. Once more, the miner had started the springs of life and called a new world into being.

The Lure of Gold

Other examples of pioneer work might be instanceed, did time permit. You will have noted that the lure of gold was the incentive to most of these explorations. The reason is obvious. Gold is a metal occurring in nature in a nearly pure state; in its alluvial form it is readily separable from the river gravel, and even from its matrix in the rock it is extracted by easy methods. Moreover, it commands a high price, and a free market, so that it can be transported in small bulk and sold in unlimited quantity. Gold mining, therefore, has been the prelude to the exploitation of the base metals existing in complex ores. The simple operations of the gold miner have preceded the establishment of economic conditions favorable to the more complicated business of winning the other metals.

The British empire and the American commonwealth alike have advanced in the track of the miner. He made the Great West a part of your heritage; he conquered the Overseas Dominions more truly than the soldiers of the King. The curtains that hid Central Africa were parted momentarily by the slave-trader, the elephant hunter, and the missionary, but when these emerged those curtains closed again. It was left to the miner to place his candle so that like "a good deed in a naughty world" it might illumine a path for human industry. The primeval forests, the sunlit valleys, and the grassy plains of Australia remained as they were in the morning of time until the prospector called for his own people to come thither across the sea. The fur-trader traversed the snow-clad plains and penetrated the pine-clad mountains of the Canadian Northwest; the salmon-fisher sailed into the long estuaries; but neither of them touched the heart of that great lone land. Not until the pick of the miner awoke echoes that had slumbered since creation did the vast solitude respond to the pulsations of human endeavor. Hunters, traders, even soldiers and farmers, crossed the prairies from the Mississippi to the Rocky Mountains, and adventured over the desert to the Pacific Coast. They carried the flag, and they hoisted it over the new domain, but it was an empty conquest and a vain annexation until the miner spoke the word that set the world aflame.

The Track of the Prospectors

After the prospector has come the mining engineer. The scout has gone in advance of the captain of industry. Those of you that have crossed the range in winter know how the leader breaks the trail by leaving foot-prints into which his followers tread, step by step, greatly to the safety and ease of their travel. That is what the mineral explorer has done for the mining engineer. That is what the mining engineer has done for those behind him. Some of you have been prospectors as well as engineers.

"Have you known the Great White silence, not a snow-gemmed twig a-quiver?"

"Have you broken trail on snowshoes, mushed your buckles up the river?"

"Have you marked the map's void spaces,

"Felt the savage strength of brute in every thow?"

Again, I ask you to recall how you threaded the pathless forest on your way to examine a new mineral discovery. On the trees at intervals you have seen that the bark was chipped. The trail has been "blazed" by the prospector, making it easy for you and others to follow. That is what the miner has done in a larger way for civilization. He has done it with geographical exuberance and equatorial amplitude. From "the stark and sullen solitudes that sentinel the Pole" to the "steaming stillness of the orchid-scented glade" in the Tropics, he has left his mark. You know that. No need for the prospector to complain to you, like Kipling's explorer:

"Well I know who'll take the credit; all the clever chaps that followed—

"Came a dozen men together—never knew my desert fears;

"Tracked me by the camps I'd quitted, used the water holes I'd hollowed.

"They'll go back and do the talking. They'll be called the Pioneers!"

No; not by the men of the Columbia School of Mines, who have shared the prospectors' camp-fire, his blankets, his flapjacks, his bacon and beans. You will give credit to whom it belongs. To the man with the faith of a child and the heart of a viking, to the man who has tramped and toiled until he heard "the mile-wide mutterings of unimagined rivers and beyond the nameless timber saw illimitable plains"; to the miner who has crossed the last range of all and lies in the only prospect-hole he could not dig; to the man who was the herald of empire and the pioneer of industry; to him who blazed the trail.

Revival of the Platinum Industry in the Urals

After predicting the obvious exhaustion of the platinum placers of the Urals for years, a note from that region states that in the near future the Nikolaie-Pavadinisk district will be an important centre for the production of platinum in the Urals. With its transfer into the hands of a responsible company investigations are being conducted under the guidance of Professor Dynpark and a comprehensive survey is being made. The platinum deposits within the limits of the district referred to have long been known and exploited to a limited extent. But the new owners have decided in view of the splendid results of the investigation, to operate on a much larger scale. On the river Nyasma and others, dredges are being built, one of these is of the American type (Marion) and is driven by electricity. It would appear from reports that the reserves of platinum in the Urals are not so limited as many believe.



The Buckhorn Mines Company's Power Plant

By E. H. LESLIE

While the use of the locomobile type prime mover is by no means an innovation in steam power-plant engineering, having for many years been in successful operation in European countries, and Germany in particular, its advent in this country is marked with the initial installation at Beowawe, Nevada. Here two 350-hp. units are in successful operation supplying power for the Buckhorn mines and mill, the electric power generated at Beowawe being transmitted a distance of 35 miles to Buckhorn.

This type of engine, as will be seen from the illustrations, bears more semblance to a modern traction engine, which has been inverted and remodeled for stationary power purposes, than any of the standard types of American steam-engines. The surname of this type of engine, 'locomobile,' suggests its progenitor, and in fact it is an adoption of locomotive type power-plants to stationary requirements. The two Buckhorn units have a capacity of 350 hp. each. The engines are compound, the high-pressure cylinder being 11 $\frac{3}{4}$ in. diameter, and the low 23 in., with a 20-in. stroke, and are operated condensing.

The boiler plant upon which the engine is superimposed presents many interesting features. The boiler tubes are mounted as shown in Fig. 1, and are easily removed from the shell of the boiler and another inserted if occasion demands. The illustration shows a set of tubes which have been removed, and furnishes an idea as to the boiler construction. In the operation of the plant, the engine has been 'shut-down,' the boiler replaced, and the engine again under steam in ten hours. While this record is itself a good one, a

still better record will be possible under present operating conditions, which provide for having a spare boiler readily accessible. Since the beginning of operations it has been necessary to replace one boiler. This is attributed to the fact that the boiler was used for sinking a well before the power-plant was put into commission, and in so doing it was necessary to use a boiler water which was extremely alkaline and also contained considerable oil from the pumps. Since the removal of this boiler, no further troubles have been experienced. It is hoped that a permanent supply of pure artesian water for boiler purposes will soon be obtained.

The Fire Box

The fire-box end of a unit is shown in Fig. 2. At this plant California crude oil is used for fuel, and is fed in by two injectors. The fuel oil is delivered at the plant in standard tank cars and discharged into a steel sump tank of 8000 gal. capacity, and from which it is pumped by means of a duplex 6 by 4 by 6 Platt Iron Works oil-pump to the storage tank. The storage tank is of corrugated iron and has a capacity of 50,400 gal. (5 earloads). The oil is heavy California petroleum of 16°B. In cold weather it is often necessary to heat the oil before it can be pumped. From the storage tank the oil flows by gravity to a small feed tank on the inside of the building from which it flows to the burners. There are two nozzle-injector burners for each unit. Oil and steam are admitted through the nozzle. The steam, being under a high pressure, atomizes the oil and acts as an inject-

tor in drawing the oil from the fuel tank, heating, atomizing, and injecting it into the furnace. With the exception of the pump for raising the oil from the sump to the storage tank, the handling of the fuel oil is by gravity. Under present working conditions, the two units require about 1550 gal. of fuel oil per day, or about 1 lb. of oil per brake horse-power hour. While the engines have a capacity of 350 hp. each, under present working conditions the load is about 350 b-hp., or 275 b-hp. on each unit. With an increased load there would undoubtedly be a better fuel economy and increased thermal efficiency. The present fuel oil consumption, however, is by no means excessive, and compares most favorably with the oil-fired boiler and steam-engine combination in general use.

Engine Pumps

The boiler feed water pump and condenser pump are in tandem and on the same drive at the side of the boiler, and are driven by a belt which is connected with the main engine and generator shaft. The pumping device is most efficient, and the vacuum is kept at about 75 cm. An injector is held in reserve for boiler feed and is shown on the left of the boiler in Fig. 2. The boiler feed water heater is also shown in the same illustration. The exhaust steam from the low-pressure cylinder is drawn by the vacuum pump through the feed water heater, in which are the feed water coils from the feed water pump and

connecting with the boiler.

The steam as generated passes to the steam dome and from thence to the super-heater, which is seen in Fig. 3 as the extension of the boiler proper. The steam from the dome enters at the rear of the super-heater and passes through a system of coils, which are given a super-heat by excess furnace gases. The steam then is conducted through an insulated pipe, shown in Fig. 3 from the super-heater to the engine proper.

The smoke and burned gases pass from the super-heaters through a brick-lined conduit under the engine-room floor to the stack, which is of steel and 160 ft. high. A damper for regulating the draft is placed in the brick conduit and turned by a key in the floor of the engine-room.

The steam as delivered at the high-pressure cylinder has a temperature of 720°F. In the design of this type of power-plant, every effort is made to maintain high temperatures, and toward this end super-heat, compactness of design, and thorough insulation have tended toward higher thermal efficiencies than those shown in the average boiler and steam-engine combinations. While as yet no indicator cards have been taken, and it is impossible to know either the mechanical or thermal efficiency of the plant, the load and fuel consumption are evidence of a satisfactory performance in this respect.

For synchronizing the two units of the plant a retarding device is placed on each unit, by which the



FIG. 1. BOILER TUBES.



FIG. 2. FIRE-BOX END OF ENGINE.



FIG. 3. SUPER-HEATER AND SYNCHRONIZING MECHANISM.



FIG. 4. GENERATOR.

speed of the engine and generator, which is direct connected, may be retarded in connecting in the other unit after a 'shut-down' of one of them. This retarding device is shown in Fig. 3, being an attachment on the governor, which is within the fly-wheel as shown. The retarder is operated by a hand wheel, shown in the illustration, which acts upon the governor and in

flexible coupling with the generator. The coupling consists of two annular castings, one within the other, which allows an inch of play between them. These two rings are laced together by two strips of leather belting. In this manner, all of the vibration in the engine is taken up in the coupling and none is transmitted to the generator.



FIG. 5. SWITCH-BOARD.

turn upon the valve-rod and piston valves of the cylinders, which type of valve is used in this engine. The valve-rod has a pointer attachment which slides with the rod over a graduated scale, which has been calibrated to indicate, by measuring the travel of the pointer, the approximate horse-power which is being developed in the cylinder.

Metallic packing is used throughout the engine, and bearings are of the finest bearing alloys. The bearings are fitted with oil cups, and only the best grades of lubricating oil can be used. A careful watch must be kept on the bearings, as they are always at a temperature which will scarcely permit being touched with the hand, and a very temporary suspension in lubrication results in the burning out of a bearing, with its attendant 'shut-down' and delays. Since beginning operations there have been two bearings burned out at this plant, but with a familiarity with the engine and careful supervision, little difficulty is to be expected from this quarter. Five barrels of lubricating oil is used per month on the bearings, guides, etc.; and three barrels of cylinder oil is used per month in the cylinders of the two units. The cylinders are lubricated by means of an oil pump which is driven from the piston rod.

Over-All Dimensions

The over-all dimensions of this particular locomobile boiler and engine unit are 24 by 14 ft. 6 in. base and 10 ft. high. The engine goes under the house name of Type V.K.13, and was made by the R. Wolf Maschinenfabrik at Magdeburg, Buckau, Germany.

The engine is direct connected through a Zedel Voith

cycles, 46 amp., 440 volts, and 680 r.p.m.

The electrical equipment also includes four transformers, three being in use, with one extra. These transformers are General Electric apparatus, rated as Type A, Form B, 60 cycles, 219 kva. The current is thus stepped up from 480 to 33,000 volts for transmission to the Buckhorn mines and mill, 35 miles distant. The switchboard, shown in Fig. 5, is of gray marble fitted with a curve drawing watt-meter, watt-hour meter, curve drawing volt-meter, voltage regulator, together with volt and ampere meters, switches, and other equipment. There has also been installed an aluminum lightning arrester for the protection of the plant. The engine-room is also fitted with an overhead hand-operated traveling crane, for facilitating the movement of large spares and parts. The centrifugal pumps for the circulation of water through the cooling towers, seen on either side of the power-plant building, were made by the Krogh Manufacturing Co. These pumps are direct connected with small 3-hp. General Electric motors.

As a small and compact power-plant, the locomobile type at this property presents many attractive features: the fuel consumption is low, as are the attendance charges, only two men, an engineer and fireman, being required per shift of 8 hours. While exact figures are not available at this time, it may be said that efficiency of the plant compares most favorably with the regulation boiler and steam-engine combination. The super-heating and high temperatures which result from the arrangement of engine and boiler have been the cause of some mechanical difficulties, of which, however, up to the present, nothing of a serious nature has developed.

Reduction of Radium Ores

By GEORGE D. VAN ARSDALL

The work on the extraction of radium started several years ago, due to the personal and philanthropic interest Dr. Douglas felt in the subject. At that time little general information was available. The object of the experiments was to devise, if possible, a method of making radium at a lower cost than the market price at that time. Naturally, since the amount of high-grade carnotite was limited, the first experiments were on concentrating low-grade material. I was uncertain at the start whether, in a mechanical concentrating scheme, the radium would follow the mineral or not. The tests showed, however, that a concentration of the radium as well as of the other mineral constituents took place.

The method adopted was the obvious one that has been used by others, namely, to crush the ore sufficiently to free the carnotite from the sandstone grains and then to separate the resulting slime by agitation and decantation from the sand. The ore first treated was from Colorado, and contained about 1.25% U₃O₈; our tests showed a concentration of about 5 into 1, with an extraction of about 80% of the radium. The early tests were made by photographic methods alone, so that the above percentage is only approximate, but I believe is nearly correct.

Use of an Acid Solvent

Extraction experiments were then started. There were a number of possible methods of treating the ore, but extraction with an acid solvent seemed simplest. Since radium is very similar to barium, any chemical method suited to the extraction of barium would be expected to remove radium also. Fairly good results were obtained in small laboratory tests by the use of hydrochloric acid as a solvent. In all the ores tested there were appreciable amounts of barium, although the amount was quite variable. I found that the barium was soluble in the acid used, and that the washed tailings apparently carried little radium. Tests on a scale of about 100 lb. per day were then arranged for, and the results from this work being encouraging, plans were then made and apparatus secured for a larger plant.

Tests up to this point had given extractions of 80 to 90% of the radium content of the ore, checked by samples tested by Professor Boltwood of Yale, so that it was safe to go ahead. The large-scale work was disappointing, however, since the final amount of radium secured was only about 30% of the estimated content of the ore. This larger work was not done under my personal supervision, and there were some unexplained losses of radium, so that I feel that, properly conducted, this method is capable of yielding, say,

80% of the radium content of an ordinary carnotite. Further tests will be made and the question definitely settled.

The work was much complicated by the necessity of making a special grade of uranium and vanadium product, and I am inclined to think that, except under special conditions and when there is a ready market for these products at a good price, it will pay better to treat the ores simply for their radium content.

Cost of Radium

From a carload of ore there was obtained between 50 and 60 mg. of radium, which was barely 30% of the amount present; deducting the cost of plant equipment, which should not be charged as a production cost, and also deducting the cost of experimenting on the uranium product, which, of course, would not be repeated in future work, the actual cost of the radium made, including everything else and crediting the returns from the sale of uranium and vanadium, was \$78 per milligram of pure radium bromide. Naturally, if the extractions had been as high as expected—about 80%—the cost would have been correspondingly lower. I believe that radium can be made by this method in the East, from 1 to 1½% carnotite ores, under proper conditions, at a cost not to exceed \$30 per milligram of pure bromide, and probably somewhat less. This, of course, assumes approximately the present price of carnotite ore. I have since confirmed my earlier tests, and it is possible that something may still be done with the method, although the large-scale test was not a commercial success, due to the unexplained losses.

One must, of course, recognize that where sulphates are present in an ore, or in the water or acid used, the solubility of the radium is diminished, but in any case the radium will be either in solution or left with the sands as insoluble sulphate. If the latter, the separation of any considerable amount is a comparatively simple matter. Credit should be given to A. H. Phillips as one of the earliest investigators of carnotite in this country, whose methods, substantially, I adopted.

Quite recently I have found an interesting new method of precipitating uranium and vanadium, and while much remains to be done to prove its value, I believe that results will come from its use. The extraction of radium itself is comparatively a simple matter, and most of the complication in the treatment of carnotite ores comes from the great difficulty in separating and preparing uranium and vanadium in forms sufficiently pure to be readily salable. It seems probable to me that the eventual method by which radium will certainly some day be produced at a cost that will make its use generally possible, will have to be a much simpler method than any heretofore described.

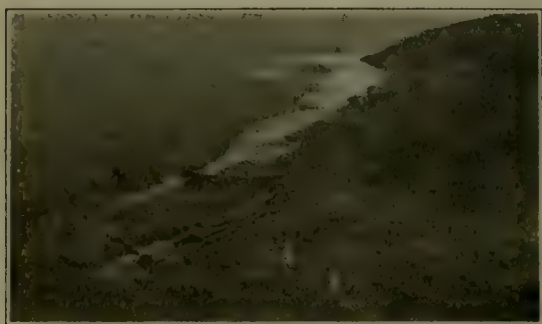
**Bulletin* of the Mining and Metallurgical Society of America.

The Chilean Nitrate Industry—II

By LESTER W. STRAUSS

The present system of treatment, as in vogue since 1876, was introduced by J. T. Humberstone, resident manager for the Agua Santa Nitrate & Railway Co. He adopted the Shank process which had been previously used only in the soda industry. Mr. Humberstone, known in the province of Tarapaca as the 'Father of the nitrate industry', ingeniously modified the Shank system to suit local purposes. In the early days of the industry the boiling tanks were placed over an open fire; in 1856 heating was done by blowing steam into the liquor covering the caliche. This innovation gave higher recoveries at less costs.

The leaching of caliche is based on the fact that so-



CALETA ALTA, A NITRATE PORT.

dium nitrate is decidedly more soluble in hot than in cold water, also that, in cooling, the hot saturated solutions (which have been produced in the presence of a large excess of common salt) first precipitate sodium chloride, and (on the further reduction of temperature) the salt is re-dissolved, yielding almost pure nitrate of soda. Sulphates, which occur in less percentage, react similarly but because the amount present is less, they do not seriously contaminate the soda. The application of the principle is described in detail below but it is worthy of note at this point that the refined nitrate is crystallized out of hot solutions by cooling, and the cold mother liquor (saturated) is sent back to be mixed with material ready for leaching in the boiling tanks, thus running no nitrate solution to waste. Early in the process considerable salt, from the caliche, goes into solution but later is re-precipitated, as the temperature rises and continues, in the presence of an excess of undissolved nitrate in the caliche. A portion of this nitrate is dissolved, the salt remaining with the earthy matter sometimes occurring as white crystalline masses or replacing the nitrate in the caliche and forming a crustation over same. The hot solutions leave the tanks—at a temperature between 80° and 90° C.—and pass through to settling tanks where mud separates out, as also considerable salt due to the drop in temperature to between 60° and 65° C. (the settling takes about

two hours). The solution of saturated nitrate then passing to the crystallizing tanks, locally called *baleros*.

Solution of Nitrate

The following table, by M. A. Prieto, shows approximately the solution of nitrate and chloride of sodium from an excess of both salts, in 100 c.c. of water, at varying temperatures:

Temp., ° C.	Nitrate, grams.	Salt, grams.	Density, ° Twaddell.
10	49.50	27.0	72.0
20	57.00	26.0	75.5
30	65.80	24.0	78.5
40	75.50	22.5	82.5
50	86.50	20.5	87.0
60	98.00	18.9	91.5
60 to 65			90 to 95*
70	110.40	17.5	96.0
80	123.80	17.0	100.5
90	139.00	16.2	103.5
100	157.50	16.0	107.5
110	184.00	15.4	108.5
120	220.00	15.0	110.5

*Temperature and density corresponding to the hot solution stated below.

The number of degrees Twaddell multiplied by 5 plus 1000 equals the specific gravity, water being 1000.

Every charge of caliche is given four boilings, with solutions each successively weaker than the previous one admitted, and one fresh-water wash. Thus each mother liquor goes through four boilings with material successively higher in nitrate, finally reaching the desired density varying from 90° to 95° Twaddell; the density desired depends on the quality of the caliche leached and the quality of the salitre or nitrate, 95% (minimum) NaNO_3 , to be made. High density means cleaner nitrate but with increasing costs due to the raising of more steam; the economical limit of the density raising determines this point. The calculation of the water to be used in leaching is an important economic consideration; too much water means that an excess of fuel must be consumed—too little water leaves part of the caliche undissolved. The average specific gravity of the hot saturated liquor, or *caldito*, for the settling tank, is 1.50, while the mother liquor, leaving the crystallizing tank, is 1.41 (82° Twaddell).

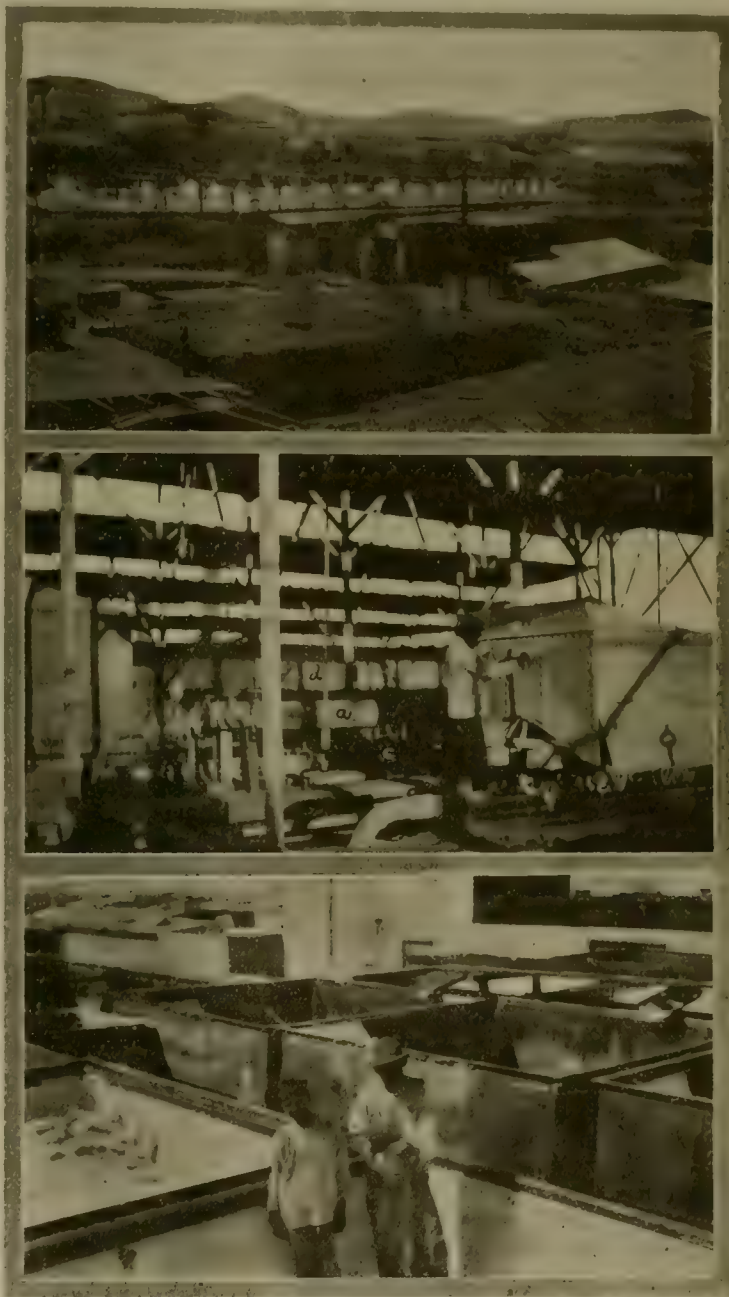
For a clear conception of the process it will be assumed that tank No. 5 has been charged with caliche and steam has been turned on. Mother liquor, already through three boilings, is admitted at the top and boiling proceeds until the density limit, the economical point, is reached. The contents of the tank are allowed to settle a few minutes, after the steam has been shut off: the solution (*caldito* or saturated liquor) is then drawn off from below the false bottom and goes to the settling tanks. The perforated false bottom serves not only as a space for settling out the fine mud

or slime but as an equalizer for the circulation of solution through the caliche. The fine mud is sometimes treated separately for its nitrate contents. Tank No. 6, in which second stage liquor is boiling with twice boiled caliche, is then ready to have its siphon to tank No. 5—opened, the liquor discharging over the top of No. 5. Meanwhile, the other two siphons of the series are opened up and a solution of weaker density enters the top of the tank while the higher one leaves through the bottom. Tank No. 8 is being filled with mother liquor pumped back from the crystallizing tanks, and warm wash water, as quickly as the solution is leaving for tank No. 7. When the liquor in No. 5 reaches the minimum economic density, due to solution from No. 6, the circulation of solutions is stopped and boiling again started. Due to the four different densities the solutions will not be at the same level in the four tanks, so that pumping is frequently necessary to help the siphons. When boiling has continued for some time, the liquor in tank No. 5, now thrice boiled, is passed to tank No. 1, the caliche in this being ready for its first boil. Tank No. 8 has now been washed with cold water to cool down the leached caliche and to remove whatever nitrate remains in the mass, which is shoveled out through the two discharge gates; this residue (*ripio*) still carries between 7 and 10% NaNO_3 . At a later day this low-grade residue, or tailing, may be re-treated when the high-grade caliche and costra have been mined and the export tax reduced. The cold wash water is collected in a sump to be used, at the next transfer of solutions, in tank No. 7.

Time Required for Leaching

The total time taken for a charged tank, from the first operations until the final discard of the residue, is usually 27 hours. The saturated liquor goes to settling tanks, as already mentioned. The sediment, in these tanks, is said to carry up to 40% NaNO_3 ; this is sometimes washed, but more frequently discarded. The crystallizing tanks of sheet iron are 18 ft. square, with an inclined bottom so that the depth is 27 in. at one end and 33 in. on the opposite. A tank holds about 600 cu. ft. of solution or approximately 30 tons. A tank is never filled to the brim. From five to ten days are allowed for the cooling and crystallizing of the nitrate, which forms in friable crystalline cakes—

about 8 in. thick—on the bottom and sides of the tank. At the expiration of this time the mother liquor is drawn off and pumped back to a boiling tank in which



VIEWS OF A NITRATE OFICINA.

the material has had its third boil. The crystallized nitrate is shoveled into cars, and run on a trestle to be dumped on the drying floor, later—when dry—to be shoveled into 100-kg. sacks (220.46 lb.). The nitrate, now refined, is referred to as salitre in the trade and contains between 95 and 96% NaNO_3 . The remaining percentage (4 to 5%) consists of chlorides, sulphates,

and moisture. Nitrate under 95% NaNO_3 content is penalized according to the amount below this figure. While apparently a simple process the average recovery of nitrate from caliche is only slightly above 60% and from costra the recovery is lower. There are no losses due to evaporation, and only a small amount in handling solutions, but the heaviest losses are those resulting from the unleached caliche, that has been crusted over by salt, and to a lesser degree the nitrate in the sediment below the crinolin and in the settling tanks.

The following analyses give an idea of the constituents of the various solutions, also salitre:

	Solution to settling tanks.		Solution to crystallizing tanks.		Sol'n 'mother liquor' to boiling tanks.		Salitre, %	
	Degrees Twaddell:		Degrees Twaddell:		Degrees Twaddell:			
	90	100	92	102	82	86		
	grams per litre							
Total nitrates as nitrate of soda.....	680	900	700	920	460	537	94.9	96.2
" chlorides "	260	150	190	140	160	150	2.0	0.9
Perchlorate of potash	15	2	...	...	15	2	...	...
Iodate of soda	6	4	...	...	6	4	...	...
Total sulphates	70	52	...	...	70	52	0.6	0.4
Insolubles .....	...	...	...	...	...	...	0.2	0.1
Moisture	419	392	...	...	699	685	2.3	2.5
Total	1450	1500	...	...	1410	1430	100.0	100.0

In the Agua Santa plant, from which source the above analyses have been obtained, there are 32 boiling tanks, 6 settling tanks, and 192 crystallizing tanks. 900 tons (metric) of caliche can be treated in 20 tanks per day, yielding an average production of 1300 quintals of salitre per day (40,000 quintals per month).

Method of Analysis

The method of analyzing caliche is rapid after experience in the work has been had. Five grams of finely pulverized sample is boiled in 100 c.c. of water, filtered, and the filtrate made up to 100 c.c. Of this 20 c.c. is taken, to which 10 c.c. of sulphuric acid (50° Baumé) is added, and the solution heated in a porcelain evaporating dish to between 70° and 80°C., this temperature is maintained, the solution being stirred with a thermometer, and titration made with a 12% ferrous sulphate solution, acidulated with sulphuric acid. A dark brown coloration is produced which disappears on stirring but leaves a sage green tint to the solution, that deepens as titration proceeds. Effervescence is noticed as the titration approaches completion; the end point is reached when further addition of ferrous sulphate ceases to produce the brown coloration. Practice is necessary to note the end point; the method is correct to within 2%, which is near enough for practical purposes. In a few of the modern plants the method is checked periodically with more exact determinations. In the finished product for export, the nitrate content is estimated by difference; export salitre must contain 95% NaNO_3 and the so-called refined, which is really only selected, 96% NaNO_3 and less than 1% NaCl (and a minimum perchlorate of potash). The 'nitrate -by-difference'

method has been found to yield high results (almost 3%) in NaNO_3 . The 'Devarda' method, with modifications, gives more satisfactory results; this involves the direct analysis for NaNO_3 .

Operations in Agua Santa begin at 4 a. m. and continue to 4 p. m. No work is done at night, but the treatment plant operates on Sundays. The steam plant consists of nine boilers—Lancashire type—of which 5 or 6 are in use all the time, for heating the solutions, the caliche, and making distilled water for local consumption and the locomotives. No drinking water is close at hand as that used for the solutions is too saline.

The source of this water is from the pampas near an old river course, which at intervals of seven to eight years becomes a roaring torrent due to cloud bursts near its head. Ordinarily the course is dry, so that wells, 40 to 80 ft. deep, must be sunk to reach the underground water. The pipe-line to the treatment plant or *maquina* may be over 6 miles long; electric pumps are used. The feed water to the boilers is pre-heated by the waste steam from the coils; condensed water, from the heating coils, after leaving the boiling tanks passes through a steam trap. At some plants water is piped (occasionally, as in Antofagasta, over 100 miles) from sources in the Andes.

Output of Individual Plants

The output of individual plants varies from 200 to 8000 tons of salitre per month. The largest oficina or plant is the Alianza in Tarapaca, which produced over 1,680,000 quintals in 1912, with a greater output still possible. There were 9 plants which yielded over 1,000,000 quintals each, in 1911, as compared with 11 in 1912. The smallest output recorded was 11,000 quintals (1912). Prior to March 1909, there was a restriction of output regulated by the Nitrate Combination; restriction has been again effected by the producers.

With the larger producing companies steel structures, as well as modern mechanical appliances, prevail; a side view of a treatment plant resembles a multiplane flying machine. The buildings are not housed-in, only terraced roofing of split bamboo cane being used as a protection against the glare and heat of the sun. The average cost of a nitrate treatment plant, exclusive of the cost of the ground and associated expenditures pertinent to operations, also the promotion expenses,

etc., is approximately £1 (\$4.80) per quintal of salitre capacity per month; including necessary accessory equipment such as light, tools, railway cars, carts, mules, etc., the cost is about £1 10s. (\$7.20). The total capital invested in the industry, inclusive of equipment (also eight railways) might be £30,000,000 or \$144,000,000.

The fuel used in the industry is principally coal, brought from England or Australia in ships or steamers, which return with nitrate, within recent years the use of petroleum has met with much favor. The California crude oil and residuum, the specific gravity varying from 14 to 16° Baumé (0.960 to 0.972 specific gravity), is brought in large tank steamers to Pisagua, Junin, Iquique, Tocopilla, Antofagasta, and Taltal and pumped, through submerged piping, to huge tanks on shore; it is then distributed, in tank cars, to the various plants. The cost placed at the boilers is about \$15 per ton of 2240 lb. Coal would cost from \$12 to \$14 at the same point, per ton. The Peruvian crude oil, specific gravity 0.860, or deprived of its benzene specific gravity 0.881, is landed, at all the above mentioned ports in small quantities for use in Diesel engines which are coming into general use for generating power. The Agua Santa Co., which was the first to use petroleum (in 1903), importing through the port of Caleta Buena Peruvian oil for its own use, and that of the plants served by the railroad (Agua Santa). This Company now employs it for all purposes as fuel for its several plants. The present cost is slightly higher than the California residuum. At Caleta Buena the oil is pumped to the shore tanks through a floating hose, and again pumped to the railroad station on top of the cliff, 2440 ft. vertically, through 7000 ft. of steel piping; a double line, each being 3 in. diameter. Powerful electric pumps, made in the United States, work very smoothly against the 1200-lb. pressure. In all 60,000 tons of oil is handled at Caleta Buena per year and the consumption is increasing.

Power Plant at Agua Santa

The power plant at Agua Santa, which (inclusive of the boiler consumption) consumes about 450 tons of oil per month, consists of three sets (one in reserve) of three-cylinder Diesel engines, each of 120 hp. Each engine is belt-connected with a 100-kw. Westinghouse dynamo, which furnishes the necessary power for the treatment plant, or máquina, and electric lights about the entire plant. The crushers, there are six of the Blake type, have 24 by 17-in. openings and are driven by two 40-hp. motors; the six pairs of rolls, 36 in. diameter, are driven by two 20-hp. motors. Electric winches are used to haul the caliche to the boiling tank and the leached material, or rípio to the waste dump. Electric power costs 1d. (2c.) per horse-power hour (\$14.40 per horse-power hour per month). The installation of Diesel engines and the electric equipment, replacing a poorly equipped steam plant, have resulted in a reduction of 93% of the former power costs. Coal, delivered on board at Caleta Buena, costs

29s. (\$6.96) per 2240 lb. The following figures, in pence per quintal (46 kg. or 101.4 lb.) of salitre, may be taken as representative on the basis of 27,000 tons of material in treatment per month (30 days) resulting in an output of 40,000 quintals of salitre for a Tarapaca plant (average figures for 1912), and 22% caliche treated resulting in 100,000 quintals of salitre being produced, per month, in the Antofagasta plant. Costs have gone up considerably, at least 6d. per quintal, in 1913 due to increased cost of labor and lower recovery.

	Tarapaca. (pence)	Taltal. (pence)
Mining or quarrying caliche.....	10.50	7.632
Transport in carts to loading station.....	5.10	6.363
Transport on railroad to máquina.....	2.25	
Crushing material and filling boiler tanks...	1.42	.....
Water (cost of bringing same to the works)...	1.17	1.156
Leaching (of this, fuel is 5.04d.).....	11.41	.....
Treatment .....	.....	12.622
Administration house expenses.....	1.31	.....
Power (Diesel engines).....	.....	1.114
General charges including administration....	3.00	0.841
<hr/>		
Per quintal on cancha (drying-floor).....	36.16	29.728
Sacks, sacking, and loading on cars.....	2.62	3.300
Railroad freight to Caleta Buena and loading into lighters	5.50	.....
Railroad freight (150 km.), etc.....	.....	6.600
Lighterage in Caleta Buena bay.....	0.72	.....
Lighterage Taltal .....	.....	0.700
Port charges (including propaganda).....	.....	3.000
Commissions abroad, etc.....	1.32	.....
Export duty	28.00	28.000
<hr/>		
Total	74.30	71.348
Less store profits	1.60	1.001
<hr/>		
Total, including propaganda contribution..	72.70	70.347

Ocean freight is 1s. 3d. per quintal; previously it was under one shilling.

It is evident from the above that the export tax is a heavy charge. In view of the high-grade deposits having become history, a rational reduction of this tax would mean the possibility of increased activities in the treatment of low-grade caliche and costra. (In 1903 the average grade of caliche treated was 26% NaNO_3 ; in 1912 it was 18%—this refers to the entire industry.) More economical methods might be evolved and larger tonnages treated, with resultant lower costs, but it is questionable as to how the market would absorb the increased output. A lower cost would tend to eliminate the entry of the artificially made (Norwegian) nitrate, and by reason of a lower selling price consumption on a larger scale might be induced where present prices are prohibitive. The prevailing number of oficinas cannot produce salitre f.o.b. at less than 7s. (\$1.68) per quintal (60d. is probably a minimum figure) so that a low price abroad would reduce production, notwithstanding that the largest oficinas have been planned to effect low costs, and possibly demoralize the Norwegian nitrate making. This latter industry, it is stated, will soon be in the position to develop 500,000 hp., hydro-electrically, and produce 6,600,000 quin-

tals of calcium and sodium nitrates per annum. In 1912, 1,304,400 quintals—an apparently low output—was produced. The total proposed would be less than one-eighth of the Chilean production for 1912. Its effect on the Chilean product would not be serious in view of the latter's yearly increases. The Norwegian nitrate cannot be shipped great distances. The local demand exceeds the supply hence there is no necessity for long transportation, and must be produced close to the point of demand as it is more hygroscopic than the Chilean nitrate and readily becomes a pasty mass. It cannot be handled in sacks and is packed in wooden barrels wrapped in strong paper.*

The following figures of comparison between salitre and the two most important artificially made fertilizers are of interest:

	Ratio of cost Nitrogen, per unit %, of nitrogen.	
Ammonium sulphate	20.5	1.07
Salitre (Chilean nitrate)	15.5	1.00
Norwegian (calcium nitrate)	13.0	1.15

The Southern Chemical Co., at Nitrolee, South Carolina, may produce calcium nitrate, using the Paulin process, at the rate of 50,000 quintals per annum.

Agua Santa Railroad

The Agua Santa railroad serves 16 oficinas besides the six of the Company, not including the one just completed, the Irene. The locomotives, which are of the Baldwin type, haul a train usually made up of 20 cars, each carrying on an average of 5.5 tons (metric), or 55 bags, of salitre. The line has an almost continuous down grade from Agua Santa to Caleta Alta: the ride in the coach, at the end of a train, with the frequent sharp curves to negotiate, is a memorable one producing all the inward distress of seasickness. Alongside of the track is a 3-in. pipe carrying distilled water for the locomotives. About 865,000 gallons of distilled water and 500 tons of coal are consumed monthly by the locomotives. At Caleta Alta are well equipped machine and repair shops, roundhouse, etc., also storage tanks for petroleum. Telegraph and telephone lines supplement the equipment. A sufficiently large rolling stock is always kept on hand. The locomotives are 21 tons and are run in a series of five or six trains at intervals of from 500 to 1000 ft. The loaded nitrate cars are switched to the head of an incline upon arrival at Caleta Alta, and hooked singly to a one-inch cable, which is controlled by a specially designed drum and brake in the head house. The wear on the cable is severe, although passing over rollers: its average life is 300 days. The vertical descent is 2440 ft. to the

pier at Caleta Buena, the track varying from 22 to 32° pitch. There are three inclines, each double tracked (30-in. gage), divided into three divisions of about 800 ft. vertical lift each, and from 1440 ft. to 2340 ft. long on the incline. A down trip, including hooking and unhooking at the two intermediate stations also at the head and foot of the incline, takes approximately five minutes: the actual descending time is less than half of this. In an average day's run (of 11 working hours) 120 loaded cars are handled: a record run of 250 cars has been made. The cost of handling is 1s. (24c.) per ton. The up cars are loaded with supplies.

The sacks are sampled in the yard, which is a shed of considerable extent so as to permit the proper sorting out of the various companies' products, by a government official, who also keeps track of the shipments made. A narrow scoop, similar to a cheese tester, is inserted in every bag and the resulting sample reduced and divided into three bottles which are duly sealed. Each company receives its respective sample, one is kept by the official, and the third is held for umpire. Nitrate under 95% NaNO_3 is penalized according to the lack of NaNO_3 : 1% of the price being deducted if under 95% and over 94%, 3% additional if under 94% and over 93%, and so on with increasing penalty: nitrate above 95% NaNO_3 is contracted for to contain more than 96% nitrate, 'double refined', and less than 1% salt impurities. This quality generally brings 3d. to 4d. more per quintal than the 95% grade, but the penalty for non-fulfilment is much higher than for the 95% material. The sacks are loaded into launches, by means of chutes, and taken alongside of the receiving ship—usually a sailing vessel—at a cost of 0.72d. (or 1.44c.) per quintal. The loading capacity at Caleta Buena is about 2000 tons per day, when three or four steamers or sailing ships are loading at one time.

Freight Rates

Frequently the incoming boats bring coal from England or Australia, so that low freight rates prevail and competition is keen for the outgoing nitrate freight, which is 27s. (\$6.48) per ton, and was formerly 20s. (\$4.80). In 1912, 642,800 tons of coal and 206,362 tons of oil were consumed in the entire industry. Chilean coal is much lower in calorific quality than the foreign coal and none is used in the nitrate industry. Notwithstanding that more than a million tons is produced annually, it is necessary to import over one and a half million tons to supply the consumption of the railroads, steamers, and industries. Petroleum is brought from northern Peru in tank steamers, which discharge to the 6000-ton shore tanks through a 6-in. pipe-line, with flexible joints, that is supported by floats. The specific gravity of the oil varies from 0.861 to 0.884. A ton of 2240 lb. is usually figured as 305 gal., but this depends on the specific gravity. About 5000 tons of petroleum is received per month at Caleta Buena at a contract price on board, which is variable, but 40s. (\$9.60) per ton might be

*This statement appears contradictory. Later information not obtained from the quarterly reports of the Nitrate Propaganda Association is as follows: "Norwegian nitrate carries an excess of lime and is not deliquescent or only slightly so. It is packed into tins for transport. As a fertilizer it has the advantage of leaving lime in the soil, which is an advantage in clayey soils."

an average. The cost of unloading is 5 centavos Chilean (1 cent U. S.) per quintal. From the tanks the oil is pumped to Caleta Alta, as already explained, at a cost of 2 pesos Chilean (40c.) per ton, delivered in the upper tanks (2c. per 101.4 lb.). A distilling and ice plant forms part of the Company's equipment in the port. Water is sold at two centavos Chilean (less than half a cent U. S.) per gallon for local use and Caleta Alta, and alongside of ships at 6 centavos Chilean (slightly over 1c. U. S.) per gallon.

A Large Tank Excavation

An engineering feat of some importance has recently been completed at Mortlake, Sydney, New South Wales, for which it is claimed that in some respects it is unique, namely, the excavation from solid rock of a huge gasometer tank for the Australian Gas Light Co. The gasometer when completed is to have a capacity of 12,000,000 cu. ft. of gas, but its completion is not anticipated for a couple more years. The water-tank is 945 ft. in outside circumference, 50 ft. deep, and 9 ft. wide; it is said to be the third largest in the world, and the only one excavated in rock, according to the *Australian Mining Standard*. The quantity of rock (sandstone) to be removed was 12,000 cu. yd., and the entire work has been carried out without the use of explosives, that being a necessary condition imposed by the proximity of two gasometers in actual use. The work has been in hand less than six months, the monthly average being about 2000 cu. yd. Besides the rock, and before the rock-cutting could be commenced, ploughs and scoops were employed to remove 35,000 cu. yd. of earth, and the recent heavy rains added to the contractors' task the necessity of pumping out a million and a quarter gallons of flood water. The rock-cutting was done by a Siskol type channeling machine. A channel a few inches wide is cut round the piece of rock to be taken out. Holes of about a foot in depth are drilled along its length, into which two knife-like blades of steel are inserted. Between these 'feathers', as the plates of steel are called, a plug, or wedge, is placed. A man passes along the line of holes and taps each plug with a hammer, and comes back on his tracks, tapping all the while, when the mass of rock suddenly breaks along its entire length. The stone is then cut crossway into blocks, some of which weigh four tons, and the traveling crane, running on rails around the excavation, drops a large iron claw into the tank and carries off the rock, piece by piece, to the dump.

Tunnel-Driving in India

An irrigation canal to water a maximum of 448,895 acres of land has recently been completed in the Punjab district of northwest India, at a cost of \$6,390,000. It has a length of 150 miles, of which 11,235 ft. was a tunnel through the Malakand hills. The aqueduct traverses wild and rocky country, and 167 gulches, from 20 to 100 ft. deep, are crossed. The tunnel is

the second longest in India, has a cross-section of 13½ by 18 ft., and has a capacity of 2420 cu. ft. of water per second. The grade is 1 in 215. Work was started in March 1910 with a Temple-Ingersoll electric air rock-drill. Ten of these were then used at each end of the tunnel, but after a long trial were discarded in favor of a compressed-air plant. Rock cut was a tough and hard muscovite granite, which quickly blunted the best steel. Three shafts were sunk for ventilation, unwatering, discharge of rock, and opening more faces to work at. An average of 400 drills per day were sharpened. In each heading 16 holes were drilled, also 14 in the sides and bottom. These were from 5½ to 7 ft. deep, and it took from 10 to 16 hours to drill a round of 30 holes. Blasting and removing rock occupied from 5 to 8 hours. An advance of 4 to 6 ft. was made each blast. Nobel's blasting gelatine and Monobel were used. The cost was 24c. per cubic foot of rock removed. According to *The Times*, the originator of the scheme was Sir John Benton.

Progress at the Broken Hill Proprietary Co.'s Steel Plant

At the end of April 1914 the state of construction at this Company's iron and steel plant at Newcastle, New South Wales, was as follows: Pile-driving is well in hand. Concrete foundations for the blooming mill, blooming-mill engine, blooming-mill tables, and the 66 coke-ovens are completed. The open-hearth building and ore bridges' foundations are in progress. Dredging the waterfront and reclamation of swampy land is proceeding. Large coal-bins, with conveyor belt attachments, are complete and ready for work. The blast-furnace construction has reached the last ring. At stoves No. 3 and 4 the dome is bolted on and is being riveted. Stoves No. 1 and 2 are up to their full height and ready to receive the dome. At the coke-ovens, the foundations having been completed, one of the permanent tracks has been put in, and the erection of the base of the ovens is in hand. The 15 gas-producers have been riveted together, and a large amount of similar work on accessories of the blast-furnace plant carried out. Three generating sets in the powerhouse and the lighting unit have been erected. One of these generator sets is now running regularly, supplying the power required for construction work. Two steamers are to arrive with machinery weighing 11,000 tons in all.

In March, at Broken Hill, there was mined 25,414 tons of ore. The concentrating plants treated 23,400 tons of crude ore, and 19,591 tons of tailing was re-ground, together producing a total of 4570 tons of lead concentrate and 5320 tons of slime. In the zinc separation (flotation) plant, 6450 tons of zinc concentrate was produced, assaying 46.56% zinc, 6.82% lead, and 12.91 oz. silver per ton. The sulphuric acid plant made 502 tons of strong acid.

Discussion

Readers of the MINING AND SCIENTIFIC PRESS are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment. Insertion of any contribution is determined by its probable interest to the readers of this journal.

The Rand Banket

The Editor:

Sir—I must apologize for delay in accepting the invitation to join in the discussion on the valuable paper in which Mr. Horwood re-advances that protean hypothesis—the infiltration of gold into the Rand Banket.

Mr. Horwood's memoir opens with an important contribution to the pseudomorphic nature of the pyrite in the banket. I naturally welcome his full treatment of this subject, as I advanced this conclusion in February 1907 and then figured two pebbles, which, from their *deikantzer* form, I interpreted as pseudomorphs after wind-worn pebbles; after consideration of the various original materials available, I concluded that they were pseudomorphs after ironstone, and that opinion still seems to me the most probable for the cases I had under consideration. I also held that many of the seams crowded with pyrite were pseudomorphic after black iron-sand. The evidence for that seemed clear from the many sections of these layers which I had the opportunity of examining in different Rand mines. Their arrangement agrees exactly with that of the black iron-sand in modern placers.

Mr. Horwood (Fig. 25 and 26, p. 770) extends the pseudomorphic origin to much more of the pyrite, and perhaps goes somewhat too far; for Messrs. Hatch and Corstorphine have a strong case for their view that many of the pyritic nodules are concretionary. Like most concretions, the nodules probably represent the segregation of material already present in the deposit. The analogy drawn by Mr. Horwood between these pyritic and flint nodules tells against his view of the introduction of the pyrite by infiltration from outside. Flints are formed by the segregation of the silicious spicules and grains scattered through the chalk, and not by the infiltration of silica from without. The vertical joints in the chalk which are filled with flint show, it may be noted, that when material has traveled even a short distance in solution the old drainage channels are easily recognized; and yet they are not seen in the Rand.

The pseudomorphic nature of the pyrite pebbles does not seem to help the infiltration theory. On the contrary, it removes one of the difficulties in the placer theory as stated by G. F. Becker. The fact that some of the pyrite pebbles are pseudomorphic no more proves that their materials came from outside than the presence of flint nodules in chalk proves their silica was introduced by infiltration.

Mr. Horwood advances the infiltration theory in a somewhat new and more definite form; for he claims

that the gold was introduced "during or after" the deposition of the dolomites (p. 1010) which lie at the base of the Transvaal System of Molengraaff or Potchefstroom, System of Hatch and Corstorphine. His conclusion seems contradicted by the fact that lumps of auriferous banket occur in the Black Reef conglomerates; and unless that well known fact be disproved, it follows that the gold was present in the banket before the deposition of the Black Reef, and consequently long before the formation of the dolomites.

Mr. Horwood's paper contains many interesting and new facts; but many of them increase the difficulties of the infiltration theory. He rejects, for example, the attempt to explain the restriction of the gold to certain narrow seams by the precipitating effects of carbon in them; Mr. Horwood regards the carbon as injected and not as an original constituent. Its quantity certainly appears too small to have had the effect that has been assigned to it; and if it were due to intrusion from some outside area, it would be expected to occur in the fine-grained beds for the same reason that oil pools are found in the 'oil sands' and not in the adjacent conglomerates. Mr. Horwood therefore rejects the most plausible attempt to remove the difficulty of the concentration of the gold in the layers of conglomerate.

He has graphically described the main facts in the Rand goldfield and shown how different it is from any lode-mining field. For its gold occurs in a series of ancient shingle beds extending for 60 miles in length; these beds are made up mainly of pebbles of vein quartz; the conglomerates and their associated sands and shales were deposited during the denudation of a country composed of schists which had been invaded by granites; the intrusion of the granites had formed abundant quartz veins, fragments of which form the conglomerates; the quartz pebbles are associated with the materials which are the natural residues from such quartz veins, including gold and platinum, diamonds, small quantities of copper, lead, and zinc ores; the banket also includes grains of iridosmine and chromite, which Prof. R. B. Young, though an advocate of the infiltration theory, claims as detrital in origin (and Mr. Horwood's answer to Professor Young's arguments on this point does not seem convincing); the most conspicuous silicate is chloritoid, a mineral species which is usually developed by pressure and is not characteristic of lode formations; all the materials of the banket are such as might be expected in shore deposits due to the denudation of the country along which these beds were formed. All these features, as well as the distribution of the gold, its concentration in the beds of coarse-grained, well rounded conglomerate that show the influence of long continued scour by water, and the poverty in gold where the pebbles are angular and the beds show no such traces of long continued water wear are consistent with the detrital origin of the beds and their constituents.

It is difficult to get an absolute test between the infiltration and placer theories. Thus in my paper I

referred to the question whether the gold occurred in shoots or patches. The distinction between these is difficult of definition. I referred to the question at some length because the claim had been made, in support of the infiltration theory, that true gold shoots occurred on the Rand. I examined the best known of these occurrences and showed that it was not a shoot of gold in a widespread sheet of material, like a shoot in a quartz lode, but a simple band of conglomerate in an old channel, and the ore was bounded on each side by quartzite.

A true ore-shoot must have four characteristics: (1) the orebody must be continuous and elongated in form; (2) its boundaries must be fairly well defined, though the passage from ore to barren lode may be gradual; (3) these boundaries are not the margin of the lode, but are due to some change in a continuous lode—for a pipe vein is not a shoot; (4) the distribution of the ore was determined by mechanical concentration and not chemical precipitation. Judged by the third characteristic, the oft-quoted ore-shoot at the Van Ryn has no title to that claim.

Mr. Horwood's interesting illustration of the distribution of the rich and poor material in his figures 25 and 26 (p. 770) correspond, it may be remarked, better with the patchy distribution of gold in a placer deposit than with shoots in a lode.

Mr. Horwood summarizes his list of arguments in favor of the infiltration theory as follows (p. 1005): (1) The great depth to which the profitable ore extends; (2) the dryness of the mines in depth; (3) the abundant water-ways by which mineralizers "could have ascended"; (4) the crystalline character of the gold; (5) the occasional association of the gold with vein quartz (6) the close association of the gold and pyrite; (7) the occasional presence of calcite, tourmaline, galena, blende, copper pyrite, pyrrhotite, iridosmine, and other metals of the platinum group; (8) the pseudomorphic origin of the pyrite pebbles and their shape and association with rich ore; (9) the distribution of the gold.

1. The first of these points is one of those in which Mr. Horwood's paper strengthens my doubts of the infiltration theory. He shows, from the evidence up to date, that a steady reduction in the grade of the ore with increasing depth has not yet been proved.

There is no doubt a fall in the grade milled, but that does not prove any fall in the actual grade of material in the mine; for owing to the remarkable success of the Rand mining engineers in lessening working costs, lower grade material is now being mined which was formerly left underground. The connection of the fall in grade with the increase in the tonnage milled may be illustrated by the diagram, Fig. 1. Mining, moreover, of course started where the richest ore occurs at the surface; and these mines would naturally become poorer as they approach the margin of these richer areas. Mr. Horwood's summary of the evidence shows that the Rand as a whole displays no such average decrease of actual grade in depth as

there is in all great goldfields. On the infiltration theory, we should expect such a fall, for the deposition of the gold would be more concentrated near the surface where the physical and chemical conditions altered more rapidly.

2. The second point, the dryness of the mines in

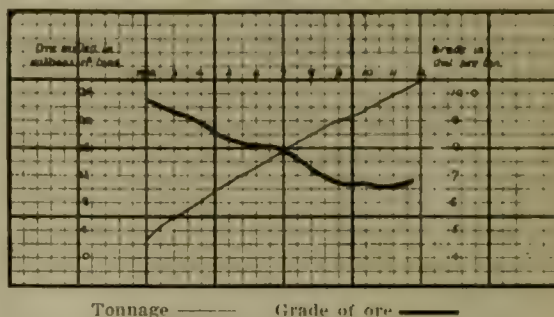


FIG. 1. DIAGRAM SHOWING THE FALL IN GRADE ACCOMPANYING THE INCREASE IN QUANTITY MILLED SINCE THE RESUMPTION OF MINING IN 1902.

depth, would apply equally well to some coal mines, which might be represented as lodes due to bituminous infiltrations. In fact, all the arguments for the infiltration theory could be used to explain coal seams as due to bituminous infiltration.

3. Mr. Horwood tells us that there are abundant channels up which the mineralizing waters "might have come"; but we are still without actual evidence of channels up which such waters did come. Mr. Horwood quotes instances in which the dikes have had an apparent influence on the blanket, and, as he says, I quoted various instances of the same sort. But I regarded those as coincidences; for assay plans from many parts of the Rand showed that in a very much larger number of cases the dikes were not associated with any change in the distribution of the gold. Kessler and others, after very careful consideration of this question, had come to the conclusion that, in spite of occasional exceptions, the overwhelming balance of evidence shows that the dikes have had no influence on the richness of the adjacent ore.

If the gold had been introduced by infiltration, very many actual channels ought to have been discovered. But there is no evidence that any one of them has ever been found, except in the case of the small secondary veins which were formed after the blanket.

One of the most important features of Mr. Horwood's paper is his series of valuable photographs showing the microscopic structure of the blanket. They show that the blanket, in its microscopic characteristics, is quite unlike any known lode. Lodes formed by infiltration, unless deposited in a fissure, usually show a gradual passage from the country rock through a silicified stage, into sheets of vein quartz; but in the blanket many of the richest samples have been no more altered than barren samples. As the matrix of the blanket is composed mainly of grains of silica, it would have been readily altered into ve-

quartz. The matrix of even the richest Rand ore is, however, often practically unaltered. I have studied microscopically the quartz veins from four continents, and I know of no lode of rich gold ore in which the matrix has not been greatly altered, although it may, under suitable illumination, show traces of its original structure.

4 and 5. The fourth argument—the crystalline character of the gold—is part of the placer theory, according to which the gold has been redissolved and redeposited during the cementing of the blanket. The occasional gold quartz veins have no bearing on the main question, as they are secondary products of the same period. They are only of historic interest.

6. The close association of gold and pyrite is not constant: some rich ore is poor in pyrite and some poor ore very rich in it.

7. The seventh feature, the presence of the materials enumerated, is fully consistent with the placer theory, for most of them must have been present as detritus in the pebble beds, and the rest (the diamonds, platinum, and iridosmine) are more easily thus explained.

8. The eighth, the pseudomorphic origin of the pyrite pebbles, was originally advanced to remove a difficulty from the placer theory.

9. The distribution of the gold, its limitation in paying quantities to the beds of water-worn blanket, and its absence from the beds of equally permeable 'bastard' reef above and below the rich seams, are facts also consistent with its detrital origin.

Mr. Horwood's arguments for the infiltration theory appear to be not only consistent with the placer theory, but to tell in its favor.

The great quantity of gold in the blanket is no doubt unique, but it is also unique for a lode field, and the clastic theory most readily explains this feature. The formation of a goldfield is a process of concentration of a once diffused material. The placer theory adds an extra process by which gold, after a first concentration in the reefs of the metamorphic zone beside the Rand, was further concentrated during the denudation of the country.

The placer theory gives a simple, reasonable, and natural explanation of the origin of the gold, for it attributes its source to the vast quartz-lode series that existed on the Rand before the formation of the blanket; the infiltration theory, on the other hand, introduces the gold from a hypothetical and improbable source, along solution channels of which we still have no evidence, and, according to Mr. Horwood's version, at a date long after the blanket had received its gold.

J. W. GREGORY.

Glasgow, Scotland, May 5.

The Editor:

Sir—The articles by Mr. Horwood and the resulting discussion have brought out much that is of interest to students of ore deposits. The thesis that the

gold in the Rand blanket is of later origin and was introduced as an after-effect of eruptive activity in the region, has been placed in much stronger position than ever before. That the argument made by Mr. Horwood is not wholly convincing to such competent students of the deposits as E. T. Mellor and J. W. Gregory, heartens those of us farther away who still find unanswered questions. It may be freely conceded that the pyrite 'pebbles' are due, at least in large part, to replacement; Mr. Horwood's painstaking researches having brought out convincing proof. It is less certain that this replacement took place long, geologically speaking, after deposition of the sediments, or that the iron, sulphur, or even the gold, was introduced later. The amount of iron involved, though no figures are given, would not seem greater than is commonly found in conglomerates and sandstones derived from pre-Cambrian schists and gneisses. Neither would the necessary sulphur seem to form an exceptional draft upon the powers of sedimentary processes, account being taken of rearrangement of material in the beds; and as to the gold, the great supplies have always come from placers. In certain Cambrian gold-bearing conglomerates in the Black Hills of South Dakota studied by J. D. Irving,¹ the same problem is involved. There, as on the Rand, gold and pyrite are generally distributed through the beds worked, and there are local enrichments. Mr. Irving found that much of the gold was detrital and held that the original sediments contained iron. The formation of the pyrite, according to him, represented action subsequent to deposition and was accompanied by enrichment of certain areas in the conglomerate. Original sedimentary process might, it is true, be appealed to in explanation of such enriched parts of the conglomerate. Take for example the gravels now being dredged at various points along the Sierra foothills in California. In these, gold occurs distributed as on the Rand; that are definite thin beds of gravel, corresponding to the 'reefs' in a thick series of sand and gravel, contain the workable gold: the profitable beds are miles in extent, and within each workable area there are rich and lean portions, often in fact definitely marked pay-streaks. The California placer deposits are not so rich as the Rand blankets, and they are not so thoroughly cemented, but at least they are analogous to the possible original fossil placers that have been assumed by others to have been what F. L. Ransome would call the 'prot-orebodies' of the Rand.

The California placers occur at the embouchure upon the plains of rivers traversing auriferous areas. Essentially they are delta deposits. In this connection it may be noted that Mr. Irving found the Cambrian conglomerates already mentioned to be littoral sediments. Examination of fluvial placers, the usual type, shows that long, narrow, and usually crooked pay-streaks are the rule. The map of no river placer of which I know resembles the most interesting stope

¹U. S. Geol. Survey, Prof. Paper 26, p. 98 *et seq.*

maps of the Rand which Mr. Horwood has given us.

T. A. Rickard has pointed out the differences between the Rand blankets and the beach gravels at Nome, and if T. M. Gibson's map² of the Third Beach line be compared with the Rand stope maps, it will be seen that there is practically no resemblance in form. Indeed, the Nome pay-streak is characteristically long and narrow, as is one formed by river action; it differs in being straight rather than crooked. It is to be remembered, however, that the Nome gravels contain gold concentrated and reconcentrated by active waves on a long gently sloping beach line with shallow water. These conditions would seem most favorable to bringing the gold into the narrowest possible streak along the shore. The California placers, on the contrary, were formed where there is little evidence of wave action. They are alluvial cones formed in quiet water, or even possibly in flood times above normal water level, just as material is being spread over their tops now. The point is that there are types of placer deposits that show just such distribution of gold as on the Rand, and further, that at least one fossil placer of this type is known. That there has been redistribution of the gold in the placers, proceeding furthest on the Rand and least in the very modern California deposits, is quite in accord with the ordinary history of rocks, and does not require, though it may be facilitated by, unusual geological agencies such as the intrusion of eruptive rocks.

Assume, on the other hand, that the gold was, as Mr. Horwood contends, introduced later as an incident of igneous activity, where is any analogous deposit? The nearest correlative that I have seen is, again, in the Black Hills, where there are certain 'silicious' deposits also studied by Mr. Irving. These are sandstones mineralized by solutions entering along transverse fissures and cracks. A brief visit to these mines, reinforced by a study of his admirable cross-sections and plans,³ shows that the result is not at all the same as on the Rand. The gold is localized and is much more definitely related to the fissures through which the solution entered than the Rand stope maps indicate. Briefly, pay-streaks were formed rather than mineralized beds. In the Black Hills the two methods of origin are contrasted, the examples being in beds of possibly the same approximate age as on the Rand, and other conditions including later intrusion of igneous rocks being the same. Mr. Irving has presented only one stope map of 'conglomerate' workings, and I am not personally familiar with these deposits, but so far as evidence at hand goes, the argument from analogy would seem to favor considering the Rand a re-worked placer. Argument from form, it must be confessed, is put one possible mode of approach and does not give a final answer. It may, however, justify an attitude of suspended judgment, even in the face of such evidence as Mr. Horwood has presented.

There is one other point in this connection that warrants a word. Mr. Horwood accounts for the segregation of the gold in certain 'reefs' in the midst of the great sandstones series, by the action of shales or slates in checking the flow of the gold-bearing solutions. This is a common phenomenon, and the argument is sound, but Mr. Horwood finds the gold above the shales where it would accumulate if it were detrital or rearranged detrital gold, and not below, where Mr. Irving found his gold in the Black Hills and where deep-seated solutions would be checked. Among American geologists at least, one of the common tests for determining whether ascending or descending solutions have been active is whether the accumulation is below or above the barrier bed. Is this criterion valueless? It is difficult to see how a special and local efflux of water from dikes could produce the results shown. It would be easy to conceive of these results as flowing from a normal general circulation of underground water acting in the main on material already in the rocks and reinforced locally both as to energy and material by the intrusion of igneous rocks.

Mr. Horwood's evidence relating the gold to the dikes is apparently convincing to those who are in a receptive attitude, or who see all gold deposits in close relations to some igneous rock however small. To others it is as intangible as is much of such evidence. Possibly this is a limitation of the readers in question; possibly not. Time will tell.

I would not close without expressing my high appreciation of the work Mr. Horwood has done. For so busy a man in the midst of other and exacting duties to find time, energy, and enthusiasm for so much research, is inspiring to all his fellow-workers. If some of us fail to find his conclusions entirely convincing, we must needs stand open to the imputation of over-conservatism.

II. FOSTER BAIN.

San Francisco, June 10.

[As Mr. Horwood can devote but little more attention to this subject for the present, this will, except for his general reply now in preparation, close the discussion. The whole matter will shortly be brought together in book form.—EDITOR.]

Magnesite produced by the Anglo-Greek Magnesite Co., Société Hellenique des Mines, and the Hellenic Magnesite Co., operating in Greece, amounts to approximately 110,000 tons of raw, 32,000 tons of calcined, and 4000 tons of dead-burned product per year. California produces about 11,000 tons of raw ore per year. Imports of magnesite into the United States in the year ended June 30, 1913, were 172,595 tons, valued at \$1,727,848.

High-grade chrysotile (fibrous asbestos) was opened about 30 miles northeast of Globe, Arizona, in 1913. Raw asbestos produced in the United States in that year was 1100 short tons.

²*Mining and Scientific Press*, April 25, 1914.

³*Op. cit.*, plate XI; Types of Ore Deposits, Fig. 14, Fig. 15.

Concentrates

Most of these are in reply to questions received by mail. Our readers are invited to ask questions and give information dealing with the practice of mining, milling, and smelting.

A pair of 8-ton rock skips can be changed for two 4-cock cages to carry 80 miners each, or *vice versa*, at the Crown mines, on the Rand, in 15 minutes.

Steam-shovel pits often fill with water from storms and other causes, and if no pumps or syphons are available, the shovel feed pump may be used to empty the pit.

Explosives are made in three factories in South Africa, the total manufactured in 1912 being 22,891 tons. Detonators imported numbered 49,415,000, and coils of fuse, 9,943,000.

Men employed in mines, mills, and reduction works of Queensland in 1913 totaled 15,842, against 16,632 in 1912. The death rate in all mines and works was 1.38 per 1000 employed, compared with 1.92 in 1912.

Concentrate treatment at the cyanide plant operated by the companies on Douglas island, Alaska, cost \$3.05 per ton treated, the total from five stamp-mills being 32,546 tons in 1913. The recovery was 97.3 per cent.

Artificial rubber may probably be made from coke-oven gases, according to the president of the Iron and Steel Institute, London. These gases contain the hydrocarbons, the derivatives of which were found in india rubber.

The Foundry at the Alaska Treadwell mine in 1913 produced 1,207,187 lb. iron and 11,802 lb. brass castings. Included in this is nearly all of the mill parts used in constructing the new mill of the Alaska Juneau Gold Mining Company.

Horse-power required for Root's blowers capable of supplying 100,000 cu. ft. of air per minute in a mine, at a pressure of 12 oz. plus the power required to overcome friction in pipes, is 600 to 650 hp., as determined by the length of pipes. An installation of ventilating system for a mine employing 2000 miners would cost under \$48,000, according to G. H. Blenkinsop of the Rand.

A tube-mill is to be installed in the Antelope mill, Rhodesia, to replace 12 grinding pans, which, according to the manager, A. J. Fraser, would not do the work expected of them. In spite of all efforts to increase the duty of the pans, little success was met with. This is a peculiar result. The ore is crushed in two No. 8 Krupp ball-mills, roasted in four Edwards' furnaces, ground in 12 pans, agitated, and filtered in Dehne presses.

The Lonely Reef mill in Rhodesia now consists of twenty 1250-lb. stamps, two 5 by 14, and one 5.5 by 16-ft. tube-mills, four 20-ft. Dorr thickeners, four 8 by 32-ft. Pachuca tanks, and three 50-chamber, 40-in. square Dehne filter-presses. Ore treated in 1913 totaled 58,903 tons, yielding 16,641 oz. gold and 747 oz. silver by amalgamation, and 35,370 oz. gold and 1550 oz. silver by cyanidation.

An interesting tin mineral was found in Butte during the past year and it was first discovered in the Colusa vein, one of the early locations of the district. It has been called colusite, according to C. W. Goodale. A part analysis of one specimen is as follows: Cu, 46.1%; Fe, 1.8%; S, 28.4%; As, 6.5%; Sb, 2.5%; Sn, 6.6%; Te, 3.1%; Au, 7.55 oz.; and Ag, 15.80 oz. per ton; total, 95.0%. The appearance of the mineral in a polished section under the microscope leads to the conclusion that it is complex, perhaps a mixture of stannite, tetrahedrite, a telluride of gold, and other minerals. Ten specimens have been analyzed, including several from the Mountain View mine, and variations in compositions are found, so that further study may show that it is not entitled to a name for a new mineral.

The appearance of high-grade cyanide bullion, after acid treatment and direct smelting of the precipitate, is often impaired by the presence of small quantities of matte which adhere tenaciously to the surface of the gold. With a lower-grade bullion, the matte, if any, generally comes away cleanly on sudden cooling, leaving a bright surface of metal. In other instances, and where the by-product is troublesome, the best method of procedure is as follows: After the fluxed precipitate has been smelted, and the molten mass poured into a pot, only enough time should be allowed for the gold to thoroughly set. The slag-pot is then tilted and the liquid slag poured off. The pot is then inverted, away from the slag, and the button of bullion tipped out. The adhering matte, in a pasty condition, is then cut and scraped off. The matte has a much lower melting point than the bullion, and sufficient time will elapse to allow for the removal of nearly all the matte before it sets. After the gold buttons have been remelted and the metal poured into an ingot mold, and if there is still sufficient matte to cause trouble, then the appearance of the bullion may often be considerably improved by adopting the following method of procedure: The ingot should be tipped from the mold while the bullion is still red-hot, the slag having been pulled away from the surface of the metal with a bent iron rod, when part cooling has allowed the slag to become sufficiently viscous. The surface of the ingot is then rapidly scrubbed with a coarse wire scratch brush. This will remove the remaining slag and matte. The ingot is then placed, while still hot, in a bath of diluted commercial nitric acid. When all action has ceased, the ingot is removed, washed in water, moistened with soda liquor, and scrubbed bright.

Special Correspondence

NEW YORK

UNITED STATES SMELTING COMPANY'S BONDS.—INTERNATIONAL NICKEL, BUFFALO MINES, AND CALUMET & HECLA REPORTS FOR 1913.—PANAMA CANAL AND COPPER PRODUCTION.

The excellent reception which the \$4,000,000 of United States Smelting, Refining & Mining Co. 5% bonds received shows an encouraging tone in the money market. The notes were offered at 98½, and mature June 1, 1918. These notes are the only debt which the Company possesses, though it has a contingent liability in \$10,000,000 of the collateral trust notes of the Utah company, which it has guaranteed.

The International Nickel Co. has also made its report for the year ended March 31. The total income amounted to \$6,566,786. The profit balance available for dividends amounted to \$4,792,665. The copper output of the Company was a high record, but the decline in the price of metal prevented the Company from making a record for earnings. The sum of \$1,391,290 was charged off to the property account, against which \$1,324,309 was written off for replacing mineral exhaustion and depreciation. Excess of current assets over liabilities amounted to \$7,384,561.

The Buffalo Mines Co. has also made its report showing a total income of \$982,040 and operating expenses of \$471,835. Dividends during the year amounted to \$660,000, leaving a deficit of \$273,010. Although the tonnage milled was greater than last year, the average silver content of the ore was 7.14 oz. less. This, taken in conjunction with the lower price of silver, made a marked decrease in earnings. The ore reserves from development contained 1,352,900 oz. of silver in ore containing 25 oz. per ton; 707,725 oz. in ore of the same grade is already broken in the stopes. There was 200,000 tons of sand from the mill, containing over 1,000,000 oz. of silver caught by retaining dams. The mill recovery was 76.14%, and the total recovery by milling and cyanidation was 81.5 per cent.

The Calumet & Hecla Mining Co. has made its report for the year ended December 31, 1913, and has resumed reporting the output of its subsidiaries. From its own properties, the Calumet & Hecla produced 45,016,890 lb. of copper during 1913. The average yield was 22.11 lb. of copper per ton, produced at a cost of 14.25c. per pound. The increase, as compared with 9.86c. per pound for the preceding year, is of course due to the difficulties created by the strike. The balance sheet shows a surplus of \$6,553,964. Dividends received from the subsidiary companies were as follows: Isle Royale, \$32,300; Ahmeek, \$539,264; Osceola, \$343,875. The output of the Calumet & Hecla properties is now practically back to normal, since the yield for May was 9,299,567 lb. as compared with 10,765,426 lb. in May of last year. It was generally supposed that the long strike and the consequent cutting down of the supply of Lake copper would have the result of causing consumers to use electrolytic copper instead, and since this is just as good for many purposes, it was expected that Lake copper would show a tendency to lose the premium which it has for so many years commanded as compared with electrolytic. This does not seem to have been the case, however, and Lake copper still seems to be in good demand.

The opening of the Panama canal is apparently to have considerable effect on the copper-smelting situation, and possibly on output. Not long ago the fact was mentioned that the Tacoma smelter was handling a constantly increasing tonnage due to the fact that freight rates from the west coast of South America to Tacoma were better than to the eastern seaboard, and as a result it was not profitable to

ship here. The opening of the Panama canal is likely to change that situation, however, and indeed make it possible to send copper-bearing material from the west coast of the United States to the East through the canal. The report has recently been given out that one of the Western companies has made a contract for the delivery of copper matte from the western coast to the copper refinery at Laurel Hill, Long Island, for \$12.50 per ton, as compared with a former freight rate of \$36 per ton. The production of copper on the eastern coast of the United States will be correspondingly stimulated, and some interesting changes in the general copper-bearing situation may develop.

DEADWOOD, SOUTH DAKOTA

ORO HONDO OPERATIONS.—RATTLESNAKE JACK MILL EQUIPMENT. EXPERIMENTS AT GOLDEN REWARD MILL.—WASP NO. 2.—HEIDELBERG COMPANY.

Considerable more repair work was necessary at the Oro Hondo mine than was anticipated at the commencement of work by representatives of J. T. Milliken, of Colorado, but everything has now been put in shape and sinking began. Extra power was found necessary, and to furnish it two boilers of 100 hp. each have been installed. This makes a total boiler capacity of 400 hp. The mine does not require much pumping, so that this equipment should furnish sufficient steam for carrying forward the sinking of the shaft, which it is proposed to continue from the present level, 1050 ft., to the 2500-ft. level. Joseph Carr is manager.

At the Rattlesnake Jack mill, in the Galena district, a complete equipment of Trent cyaniding machinery is being installed. The plant has 10 stamps, with which it is proposed to crush the ore to 6 mesh, and with a Hardinge conical mill slining everything the capacity will be close to 100 tons per day. Classification will be done in a Dorr classifier. The Trent machinery includes a 16 by 24-ft. agitating vat, a similar sized thickener tank, and two 14 by 24-ft. replacing tanks. Precipitation will be by the Merrill method, and a press of 200-ton capacity is being installed. Work on the plant is being expedited, and it is hoped to have it crushing ore by August 1.

Exhaustive experiments are to be conducted at the Golden Reward mill, in Deadwood, on roasted ore from the Company's properties in the Bald Mountain district, and to facilitate the work a 60-ton tube-mill and three additional tanks, an Akins classifier, and other apparatus are being installed. Part of the ore carries a high percentage of pyrite, and sulphates are formed during roasting which have caused some difficulties, and it is proposed to solve the problem on a working scale.

A Keystone No. 3 traction drill has been received by the Wasp No. 2 company, and considerable prospecting will be started. Recently a skip track was laid to an old cut in the porphyry, and a portion of the mill supply is now of that material, which is said to be giving high returns. The clean-up on June 1 was the largest in several months.

Incorporation of the Heidelberg property, which was promoted as a prospecting syndicate last summer by the Deadwood Business Club, is now proposed in order to furnish funds to complete the development of what is undoubtedly a meritorious prospect. It is proposed to form a company of 500,000 shares having a par value of 25c. each, of which one-half will be placed in the treasury and one-half divided among the owners. The half the owners will receive will be divided equally between the original owners, John Treber and A. T. Roos, and the 50 local people who subscribed to the development fund. Under the plan, then, Treber and Roos will receive 125,000 shares, and each subscriber to the fund will receive 2500 shares. It has been decided to offer to the public 100,000 shares at 10c. per share.

DULUTH, MINNESOTA

DULL TIMES IN THE IRON REGION AND LOWER WAGES PAID.—LINCOLN, CORSICA, AND VIRGINIA MINES.—OLIVER COMPANY'S OPERATIONS.—FIRST-AID WORK.

Conditions are very dull on the Mesabi Range at present. Few mines are working to capacity, and many properties that have a poor grade of ore, or high operating costs, are closed down entirely. This has resulted in throwing a large number of men out of employment, and in one instance nearly led to a riot, which was quelled without any serious consequences. A general cut in wages, amounting to about 5%, was made, surface labor being reduced from \$2.50 to \$2.25 per day. Underground men have been reduced less, and contract prices will be lessened in proportion. As a consequence of the slackness in the mining business, the various municipalities where there are a large number of idle men are planning extensive improvements. A concrete road will be constructed between the villages of Hibbing and Buhl, and a large amount of paving will be put in this season in Eveleth, Mountain Iron, Buhl, Chisholm, Nashauk, and other towns.

The Lincoln mine, which was drowned out last month, has been drained, and a ditch has been constructed to provide a channel for the large amount of drainage that passes near the property. The fact that the mine is in a depression makes it a difficult matter to control the heavy flow of water which comes in the spring, and occasionally during a heavy rain. This mine is also erecting a new steel head-frame.

The shafthouse at the Corsica mine, at Elba, which was destroyed by fire last month, will be replaced with a steel one, for which plans are under way. The fire is supposed to have been of incendiary origin, and gained considerable headway before discovered, burning from the top down. Timber in the shaft to a depth of about 70 ft. was also destroyed, and it is expected that this timber will be replaced with steel sets. A new timber shaft is being sunk at this property, and a "rock drift" is being driven from the workings to connect with it. Owing to the hoisting plant being out of commission, the rock from this work is trammed and dumped in an abandoned shaft. This mine is operated by the Pickands-Mather Co., which is also dismantling the Virginia mine. The work of removing the crushing plant is now in progress. This was installed for the purpose of reducing large pieces of hard ore, broken in the pit, to size suitable for the furnace.

The Oliver Iron Mining Co. has removed two of the steel head-frames from the Gilbert mine, and is now removing the third. This is one of the properties embraced in the Higgins Estate lands. The Company has a large number of drills at work on these lands, and it is understood that they are being purchased outright by the Oliver company, payment being based on the results of the drilling. The fact of the head-frames being removed from the Gilbert mine would indicate the abandonment of operations at the property for a term of years, or that it will be operated entirely as an open-pit mine. The Minnewas mine of the Oliver company has recently completed a concrete stack for its boiler-house, and the work of plant construction is being carried on vigorously. The main activities of the Company seem to be concentrated at present on the lands leased from the Hill interests, which leases will be given up at the end of this year.

Mine-rescue car No. 8 recently finished a tour of the Range, giving instruction in first aid to the injured and training in oxygen breathing apparatus at Eveleth, Virginia, Hibbing, and Chisholm. At the end of the trip a meet was held in the ball park at Virginia, and a public demonstration given in first-aid rescue work. About 30 teams took part, and a large crowd was present, evincing great interest in the work. During this trip of the car to the Range, about 300 men re-

ceived training in first-aid work, and about 75 in mine-rescue work. The campaign of education for safety is being greatly aided by this government car, and it is felt that the number of preventable accidents is on the decrease. The various companies are taking active interest in general welfare work. Prizes have been offered for the foremen with the least number of accidents on their shift, and prizes are also offered for the best garden, the best lawn, and the best and cleanest premises, with the result that many places that were formerly filthy are now orderly and sanitary.

Many contemplated improvements are being held in abeyance until business improves. Economy is the watchword, and all work is being done with as small a crew as it is possible to use.



MAP OF IRON RANGES OF MINNESOTA.

The Rowe open-pit mine on the Cuyuna Range has entered the shipping list. The top overburden has been removed by hydraulicking and the balance by steam-shovel. The Company has built 19 cottages for its employees, and the streets of the township have been graded. Each cottage has a cement cellar, sewer, water, and a bathroom. These are rented to the employees for \$15 per month. There are about 10 smaller houses, not modern, which are rented at \$6 per month. Shipments have begun from the Cuyuna mill, Laes, Armour No. 2, and Kennedy mines. Drilling activity continues in spite of general slack business at various iron properties.

BUTTE, MONTANA

IMPROVEMENTS AT THE ANACONDA SMELTER.—CLAIM MAPS.—HECLA AGAIN PRODUCING.—BUTTE & SUPERIOR MILL RESULTS.—LITIGATION.—BUTTE & LONDON.—LABOR UNION TROUBLES.

Improvements of various kinds are under way at the Anaconda smelter. The plant for grinding coal to dust for use in the reverberatory furnaces is nearly completed and should be ready for use by July 1. The new slime concentrator, with a capacity of 300 tons per day, is working satisfactorily, and is making a concentrate containing 7 to 8% copper. The big leaching plant should be ready for use within a year. The first unit of 2000 tons will be ready then, but further units will be added just as soon as the initial unit is working smoothly, until the plant is finally increased to a capacity of possibly 10,000 tons per day. The old tailing dumps will be treated, and also the tailing as it now comes from the mills. Reports from the Company for purposes of taxation show a net income for the twelve months ended June 1 of but \$8,613,564. This compares with \$11,446,901 last year, and with \$11,323,498 for the calendar year 1913, as re-

ported to the shareholders, that is, the earnings for this period were about \$2 per share as against \$3 paid.

Some recent changes and advances in the staff of the Anaconda Copper Mining Co. are of interest. The managing director, C. F. Kelly, is confining his attention entirely to executive affairs, turning over the legal department to L. O. Evans, who now becomes chief counsel. The title of the general superintendent, John Gilhe, is changed to manager of mines, which has been his actual position for years. In like manner, B. H. Dunshee becomes assistant manager of mines. A new general superintendent has been created in the person of W. B. Daly. The assistant superintendents are as before, namely, Thomas Mitchell and Jack O'Neill.

North Butte also feels the effect of the lower metal market, the income for the twelve months ended May 31 being reported at \$1,294,000, as against \$1,613,046 and \$1,437,777 for the calendar year 1913. This amount, however, is still well in excess of the dividend rate, being equivalent to about \$3 per share as against \$2 paid.

Mining engineers who have been indulging in the rather common practice of copying claims from published maps should take warning that claim maps are generally copyrighted, and that copying them without permission for sale in mine reports is against the law. In a recent case at Butte an engineering firm was awarded damages from defendants who had copied portions of a map without permission.

The famous old Hecla mine, above Glendale, is again in the producing list. Under the able management of the Longmaid family of Helena and their associates, the mine is being resuscitated. A 20-stamp mill and concentrator have been equipped for the property and concentrate is shipped to the East Helena smelter.

The millmen of the Butte & Superior Copper Co. deserve considerable credit for their success with the hard, silicious zinc ores of the Black Rock mine. With the aid of flotation the recovery has now been brought up to 93%, and the concentrate is averaging 54% zinc. Before flotation was used it was difficult to get the concentrate up to 50%, which meant unsatisfactory smelting rates and higher shipment costs. The finding of the Butte & Superior zinc mine was a remarkable thing, but more or less of an accident, as the zinc ores were not predicted. But the remarkable metallurgical successes with the ore are not accidental and are the result of hard-headed, clever experimenting.

Butte is having something of the old-time activity in mine litigation these days. Mine 'experts,' 'practical miners,' 'old-time' prospectors, and ubiquitous lawyers are collected about the courthouse in full force just now. The Anaconda Copper Mining Co. and the Pilot-Butte Mining Co. are disputing over the ownership of certain rich orebodies. The suit is being tried before the district court.

The Rainbow Lode Development Co. is unwatering the shaft of the Butte & London Copper Development Co., preparatory to further exploring the property. The task of unwatering the mine to the 1200-ft. level is no small one, as the natural flow of water is heavy in that section. Bailing tanks and electric pumps are being installed, with a total capacity of 2400 gal. per minute. One of the pumps to be used in unwatering the mine was left on the 800-ft. level when the mine was closed down several years ago. The pump was found in good condition after its long submergence, and will soon be ready for service again.

As mentioned in the 'General Mining News' section of this issue, disaffection is rife in the miners' union at Butte. To all the trouble and damage done on June 13 the city and county authorities offered no serious resistance, making the plea that the miners had a right to do what they wished with their own property. As usual, the mining companies have to be the 'goats' for this internal strife, and the mines will be working but part time until the men settle their differences.

JOPLIN, MISSOURI

H. L. & S. MINE CHANGES OWNERSHIP.—UNUSUAL LEAD DISCOVERY.—NEW MILL PRACTICE.—ZINC AND LEAD ORE PRICES

The H. L. & S. mine, operated by Schuck, Larkin, Hill, and Norton at Lawton, Kansas, has been sold for \$60,000 to Walter S. Watson and Charles Pointz, of Joplin, and L. Kirk of Maysville, Kentucky. The property occupies a lease of the Eastern Lead & Zinc Co.'s land, and was the second mine opened in the Lawton district, which has been productive for only about three years. Edward Goettel, who will manage the H. L. & S., intends to increase the capacity of the mill from 100 to 150 tons; and mining, which has been done to a depth of 120 ft., will be lowered to 160 ft., and a high stope will be taken up.

On the eastern portion of the Eastern Lead & Zinc Co.'s land, at Lawton, Kansas, a new shaft has opened lead ore at from 40 to 50 ft., and driving will be started. The ore will be trammed to the mill, 1000 ft. to the west, which is already being supplied with ore from two shafts. The fact that Lawton has been almost exclusively a producer of zinc ore causes the lead discovery to be of unusual interest. Not only is the lead ore known to exist in the immediate vicinity of the shaft, on all four sides of which the ore is exposed, but it is shown in several drill holes nearby. The 'dirt' is of exceptional richness, yielding 30% galena. It occurs in a hard blue flint, and no timbering will be required, as the ore stratum is overlain by hard limestone. The galena is high grade, running better than 80% metallic lead.

Within the past week or two some important developments have been made on the Robinson & Coleman land, in the Neosho river bottoms, two miles northwest of Miami, Oklahoma. This is a virgin district, several miles from the mines of the main Miami camp, is of high grade, some of it running as high as 61% metallic zinc. Galena also is plentiful. A concentrating plant of 150-ton capacity was erected by McConnell & Barnes on this land before they sunk their shaft into ore. So many drill-holes have been put down into the rich ore that they felt confident of opening it in quantities sufficiently extensive to warrant the operation of a mill. While their mill was under course of construction they were sinking their shaft, and this has now broken through into good ore.

The J. B. Jameson Mining Co., which is interested in mining in the Joplin district, has begun the construction of a 150-ton concentrating plant in Taney county, miles from the nearest developed area. The new property lies near the little town of Melville, and while lead ore was occasionally found by farmers in digging wells, no effort was ever made to mine on an extensive scale until the present Company took over their present property. A former company had sunk a shaft only a short distance; this was extended deeper by the Jameson company, and what appears to be an extensive fissure vein of about 6% zincblende was cut. This is now opened by several drifts, and the ore is shown in a number of different headings.

At the B. & H. mill, operated by the Granby Mining & Smelting Co., on its land at Chiltwood in the northwest part of Joplin, an experiment in separation of slime from the ore is being tried. A dewatering screen of 1¼-mm. mesh is used to separate the slime from the coarse ore before the ore reaches the rougher jig. All dewatering devices in the district at this time are used after the chats have passed through the rougher and the cleaner jigs. The operators of the plant believe the innovation will materially increase the efficiency of the jigs and will remove the bulk of sludge ore before it passes to the cells. They claim the process will eliminate the necessity of using such a heavy flow of water over the jigs as heretofore.

Zincblende prices are lower throughout this district than

for the corresponding week of 1913. The best grades sell for \$43 on an assay basis of \$40 per ton for lots running 60% metallic zinc. The basis offerings range down to \$37. Calamine sells for \$23, basis of 40% metallic zinc, and lead ore at \$46, 80% metallic lead. For the corresponding week of 1913, blende brought \$43, basis; calamine, \$21; and lead ore, \$52.50 per ton.

HOUGHTON, MICHIGAN

ENERGY DISPLAYED AT THE COPPER MINES.—CALUMET & HECLA, ISLE ROYALE, WHITE PINE, WINONA, MASS, VICTORIA, AH-MEEK, WOLVERINE, AND KEWEENAW MINES.

With the termination of the strike, and the resumption of old conditions, the mining companies are again devoting their energies to the economical production of copper, and the campaign for lowering the cost per ton of 'rock.' Calumet & Hecla officials are giving considerable attention to placing their numerous subsidiary companies in the best possible condition, and are achieving great success. The Isle Royale continues to warrant its name of a real mine, won after 50 years of uphill struggling, and developments in its extensive territory to the west, near the old No. 1 shaft, look still more promising. Many Houghton people are pleased at Isle Royale's improvement, and it is thought that its future is bright. Another Calumet & Hecla subsidiary, of which the future is liable to be surprising, is the White Pine, alone in the Porcupine Mountain district. This mine is on a new type of formation from all other Michigan copper mines; its copper, fine and flaky, occurs in shale or sandstone known as the Nonesuch formation. The mill, on which construction has been started, will be different from other Lake Superior



COPPER SMELTER OF THE COPPER RANGE CONSOLIDATED, PORTAGE LAKE, NEAR HOUGHTON, MICHIGAN.

mills, as elaborate experiments on White Pine ore have shown that the flaky copper is difficult to save, being more friable and less tough than the general run of native copper. Some hitherto unprofitable mines on the south end of the copper range are showing encouraging improvement, especially the Winona, which has the advantage of an excellent and up-to-date equipment, and which may possibly be on a paying basis soon, after 16 years of assessments. The Mass company perseveres, and is finding more copper and perfecting its organization; its management being good. The Victoria, where the famous Taylor compressor furnishes air for running the mine and mill at practically no cost, is making a few discoveries of copper occasionally. This mine is almost as obscurely situated as the White Pine. On the north end of the copper range, the Ahmeek is getting its fine equipment and rich stopes into order again after the strike. Old Wolverine, which was such a steady 'gold mine' for so long, is extending its life a little by finding copper in the foot-wall of old workings. Still farther along in the Ashbed country, the Keweenaw Copper Co. continues to test out T. F. Cole's faith in his boyhood district, by extensive diamond-drilling, and is said to be making favorable progress.

PORCUPINE, ONTARIO

DOME YIELD AND FUTURE POLICY.—HOLLINGER PROFITS.—DOME LAKE AND DOME EXTENSION MINES.—MCINTYRE YIELDS.

During April the Dome mill treated 14,770 tons and produced bullion valued at \$97,455. Official figures for the May production have not yet been published, but it is understood that the amount treated will be slightly over 15,000 tons, while the grade will be somewhat lower, averaging about \$5 per ton. According to the statements given in the annual report, this latter grade is about what should be expected from future operations. At the annual meeting held in Toronto on May 26, the president stated that the question of dividends, together with the policy of future enlargements and the method of financing the same, would receive the most serious consideration by the directors as soon as they were possessed of sufficient information to justify action being taken. Despite the many rumors to the effect that a dividend would shortly be paid, it is altogether probable that such disbursement will not take place for some time to come.

During the past month or so, Hollinger stock has been slightly depressed, due, it is believed, to the fact that the Anglo-French Syndicate has been liquidating some of its holdings. About a year ago, this Company purchased 20,000 Hollinger shares, but its recent report would indicate that a large portion of this has been sold. The stock has been much stronger recently, partly on account of statements to the effect that the dividend would shortly be increased from 3 to 5% every four weeks. It is well known that the Hollinger company will not consider an increase in the dividend rate until such time as it has accumulated \$1,000,000 cash. It is hardly likely, however, that the rate will be increased from 39% per year to 65% per year. The last annual report showed ore reserves having an estimated value of \$13.70, and it is understood that while development on the property is extremely satisfactory, and has been successful in opening large bodies of ore, the grade is lower than was estimated in the annual report. The increased production will no doubt offset the inevitable drop in grade, but any material increase in the dividend rate is hardly to be expected for some time to come. In addition to this expected drop in the grade, the large tonnages being developed will shortly justify further extensions to the plant, and this will probably be provided for out of current profits.

At a special meeting of the shareholders of the Dome Lake company, a by-law was passed authorizing the sale of 100,000 shares of treasury stock at 50c. per share. This stock will be offered to the shareholders, but as the market price is below 50c., the greater portion of it will probably be taken by the Temiskaming & Hudson Bay company, which already has control. The proceeds from this sale will be used for the erection of a cyanide plant, and to enable the Company to carry on a more extensive scheme of underground development. The recent report of the manager covering the last five months, states that several veins have been cut in the underground workings, but the gold content is low. He considers, however, that the possibilities of the discovery of further bodies of commercial ore are extremely promising and is optimistic as to future development.

A meeting of the shareholders of the Dome Extension Mining Co. has been called for June 19 to consider a by-law authorizing the sale of 199,993 shares of treasury stock at 10c. per share. This property adjoins the Dome mine, and it is calculated that the extension of the Dome orebody runs into the Dome Extension ground. A considerable amount of work has already been done on another orebody, and has succeeded in opening a considerable tonnage of ore, the grade of which is, however, too low to permit of economical operation at the present time. It is not unlikely that this ore will be profitable some time in the future.

General Mining News

ALASKA

CORDOVA

Since January 1, the Mother Lode mine has shipped 325 tons of ore to the Tacoma smelter, yielding 561,484 lb. copper, and 8915 oz. silver, worth \$69,429 net.

NOME

The steamer *Cordova* is inside the ice-pack, and her passengers were landed. The *Victoria*, *Senator*, *Elihu Thomson*, and *Bear* were waiting on June 13 in the ice, eight miles from Nome, for a chance to make a landing. About 1000 passengers were on the *Victoria* and *Senator*.

VALDEZ

On July 1, an automobile mail and stage will be started from either Valdez or Chitina to Fairbanks. The government is to send most of the interior mail overland this summer, instead of by the Yukon river route. Fourteen feet of ore is being mined in the Granite property. A run of 13 days with a Lane mill yielded \$6000 gold. W. R. Millard is superintendent. Three miners who spent the past winter in the Nelchina district arrived in Valdez on June 4. Sluicing was in progress on eight claims, and 'pay' has been found on five different creeks. An output of \$250,000 is expected this season. A contrary report by C. Artal, who reached Seward after being at Nelchina, states that the camp is dead and most of the creeks are poor.

ARIZONA

COCHISE COUNTY

(Special Correspondence.)—A 2-jig concentrating plant, with a capacity of 30 tons per day, has been completed here by the Hermitage Mining & Milling Company.

Hermitage, June 11.

MABICOPA COUNTY

(Special Correspondence.)—Ranchmen in from the vicinity of Mesa, 16 miles from Phoenix, report a gold discovery made 25 miles northeast of Mesa and 5 miles west of the McDowell range. A large tonnage of \$16 ore is showing on the surface. The vein, which is in granite, also contains bismuth. About 20 years ago, O. D. Merrill staked a claim in the same district, and after these many years has returned. A number of claims have been staked.

Phoenix, June 11.

MOHAVE COUNTY

More rich ore is said to have been opened in the Tom Reed mine. The first week in June the Gold Road yielded gold worth \$15,500. A 60-ton smelter is to be erected at the Swastika mine, near McCracken, to treat lead-gold-silver ore. W. H. Smith is in charge. At a depth of 100 ft. in the Arabian mines, in the Union Pass district, a large body of silver ore has been cut. This property is under option to the Mines Company of America. The Frisco mine, nearby, contains gold, while the Sheeptail and Catherine contain silver.

YAVAPAI COUNTY

At the mine of the Aztec Mines Co., near the Cash, Storm Cloud, and Senator properties, the latter being operated by Phelps, Dodge & Co., in the 110-ft. adit a good grade of copper-gold-silver ore has been opened. On the Peacock claim, a shaft is 125 ft. deep, and a cross-cut has passed through 14 ft. of ore. Other promising developments have been made. The Arkansas & Arizona mine at Jerome is to sink its main shaft from 1400 to 2000 ft. A large orebody was opened at 1200 ft. A line is to be constructed from the shaft to connect with the railroad from the Clarkdale smelter to the

main tunnel of the United Verde mine, thus giving direct transport without rehandling. W. A. Clark, who expects the new smelter at Clarkdale to be ready by September 1, is erecting a model town there for his employees. He intends to run the place entirely on company account.

CALIFORNIA

BUTTE COUNTY

Two dredges of the Oroville Company recovered gold worth \$3634 during the week ended May 7.

ELDORADO COUNTY

New equipment at the Tondstool mine, in the Diamond district, has been tested. A good deal of ore is blocked out.

NEVADA COUNTY

A large flow of water was opened in the Delhi mine at Columbia Hill, and the mine is flooded. Extra pumps will be installed. The recent clean-up at the Golden Centre mill, Grass Valley, more than paid expenses. Rich ore is still being extracted from the Pennsylvania mine, and 20 stamps



MAP OF NEVADA COUNTY, CALIFORNIA.

are working full time. On May 11 the Grass Valley Miner's Union held its annual picnic, all mines and mills being shut down.

PLUMAS COUNTY

The Walker copper mine, in Grizzly valley, was recently examined by J. F. Cowan, of Salt Lake City. Some rich ore is showing, and the property is to be fully equipped.

SIERRA COUNTY

Another winze is being sunk in the Tightner mine at Alleghany. It is in 2000 ft. from the portal of the main adit and is 800 ft. below the apex of the vein, also 1300 ft. below the summit of the hill. This winze or shaft will prospect ground between the old Johnson shoot and the Red Star claim. There is fair activity near Gibsonville, now that the snow has disappeared. Twenty-eight men are working at the Miner's Home, a placer mine on Howland flat. Work at the North Fork mine, near Forest City, resulted in the Uncle Sam vein being picked up again.

COLORADO

BOULDER COUNTY

The mill of the Southern Illinois Mining Co. has made a satisfactory run. A flotation process, devised by Henry E. Woods, of Denver, is doing good work in recovering tellurides, which occur in this district. Curtis Brown is manager for the Company.

LAKE COUNTY (LEADVILLE)

Mining is to be started again by claim owners in the Birdseye, French Gulch, and Alicante districts. Ore opened in the past contains gold and silver. From the Tenderfoot, in South Evans gulch, a good tonnage of gold-silver-lead ore

is being extracted. Work in this and Big Evans gulch is quite active. The Walker adit is being driven into the Mosquito range; Little Ellen is producing gold ore; the St. Louis adit is being driven, and ore has been cut; the Ollie Reed is opening well; a large output is coming from the Dean shaft of the Forrest Rose; while lessees in other properties are busy on development and ore extraction. Rich gold ore has been opened in No. 5 adit of the Mt. Champion in Lackawanna gulch; a lower adit is to be driven. Eleven cars of lead and silver ore were shipped from the Hill Top mine last week to the Salida smelter. The bins are now full of ore.

MESA COUNTY

The Unaweep copper district, 12 to 15 miles west of White-water on the D. & R. G. railway, is described by B. S. Butler in *Bulletin* 580-B of the U. S. Geological Survey. The area was examined in September 1913. The ore occurs in fissures that cut both igneous and sedimentary rocks, and the pre-vailing vein minerals are calcite, quartz, and a little fluorite, together with pyrite and chalcopyrite. Most of the ore contains a high percentage of primary sulphide, even in shallow workings. Considerable prospecting has been done, but most of the claims were idle at the time of this visit. The McKinley is opened to 600 ft. In the Nancy, a shoot was followed to 50 ft., and produced 21 cars of 16% ore. The Chance and Bell claims have also been developed.

MINERAL COUNTY

(Special Correspondence.)—A short visit to Creede shows that there is not much excitement there. The Del Monte, Amethyst, and Commodore mines are each shipping about 1000 tons of crude ore per month. The two concentrating mills, the Amethyst and the Humphreys, are both shut down, and probably will not start up until the price of lead goes up. (The fact that they are shut down will doubtless bring joy to the hearts of the fishermen.) The people there are hoping for a resumption of the tariff on lead. The fluor-spar mine at Wagon Wheel Gap has a good deal of high-grade material developed, but no market. The tariff is also blamed for this.

Creede, June 10.

SUMMIT COUNTY

No. 1 dredge of the Tonopah Placers Co., at Breckenridge, has been busy digging mud and sand out of an old pit, filled for several years. Some rich gravel is nearby, and the boat will have to cross a railway, so a new track will be built around the boat; then it will cut through and restore the original track. Leadville men are reopening the Gold Dust mine at Breckenridge.

THE SAN JUAN

The Camp Bird company, of Ouray, report for the quarter ended March 31 shows the following results:

Ore treated, tons	6,695
Bullion sold	\$106,932
Concentrate sold	\$6,413
Total revenue	\$193,345
Profit	98,287

Mine development amounted to 855 ft., and 81,160 cu. ft. of stoping. Ore broken in stopes, at the end of the term, totaled 16,164 tons. While small shoots of ore were opened, on No. 6 and 8 levels, nothing of importance was disclosed.

Shipments of concentrate and crude ore from the Silver-ton district during May were as follows: Concentrate: Iowa Tiger, 12 cars; Gold King, 42; and Sunnyside, 21; a total of 75 cars. Crude ore: Arastra Leasing Co., 1; Gold Tunnel, 4; Slattery (Silver Lake), 7; Aspen, 3; Mayflower Leasing Co., 3; Primrose Leasing Co., 6; and Anti Periodic, 1; a total of 25 cars. The Tomboy, at Telluride, produced bullion worth \$40,000 and concentrate worth \$38,500 from 12,000 tons of ore in May. Net profits were \$31,200. At the Missoula copper

mine of the Snowstorm company, 55 men are employed. An ore-shoot 700 ft. long is said to have been opened. Ore is to be shipped from the Castle Rock, which contains copper and silver. About three miles above the Snowstorm mine are the Tucker Mining & Milling Co.'s silver and gold claims. A 900-ft. adit has been driven to cut the vein at a depth of 250 to 400 feet.

IDAHO

ELMORE COUNTY

Seventy-four miles from Boise, the Boise King Placer Mining Co. is operating on the middle fork of the Boise river. The Company has 740 acres of ground, the gravel averaging about 30 ft. depth, containing good gold content. An Evans elevator of 6000-yd. daily capacity is in operation. There is also a Ruble elevator and three giants, and nearly 20,000 yd. of material is moved per 24 hours. The Elmore Placer Mining Co. has a dredge at Featherville. There are other sluicing concerns in the district.

SHOSHONE COUNTY

Ore and concentrate shipments from Coeur d'Alene mines in May were as follows:

Mines.	Tons.	Mines.	Tons.
Hercules	7,000	Success	1,385
Bunker Hill & Sullivan	5,500	Gold Hunter	1,020
Morning (23 days)	4,500	Ontario	750
Green Hill-Cleveland ...	3,300	Marsh	500
Stewart	3,500	Snowstorm ...	1,015
Interstate-Callahan	2,800	National Copper	300
Hecla	2,000	Crown Point	100
Last Chance	2,000	Caledonia	200
Tamarack & Custer....	1,700	Yankee Boy	50
Sierra Nevada	1,200		
		Total	38,820

The Washington Water Power Co. has contracted through its agent, M. C. Osborn, with the Western, Snowshoe, Ray Jefferson, and Treasurer Vault companies to supply power for 50, 75, 75, and 75-hp. motors and air-compressors respectively. The Stewart mine is being examined by an engineer who was accompanied by N. J. Miller, of New York City, who represents the Stewart Mining Company Stockholders' Protective Association. A fight for control of the property will be held at the next annual meeting. On the east drift of the Sunset, at 400 ft., 16 ft. of galena with some lead and zinc ore has been opened. This is a W. A. Clark property. Sinking is to be resumed at the Success. At what is known as the 1000-ft. level, or 300 ft. below the main adit, 35 ft. of 30% zinc ore is showing. The magnetic separator in the mill is doing good work on the zinc concentrate. A Callow flotation plant is to be installed.

MICHIGAN

HOUGHTON COUNTY

At the Mohawk, 750 men are employed, which is more than at any time in its history. The stamp-mill at Gay is working full time. Good copper 'rock' is being opened on the lower levels at No. 2 shaft. At the Winona, 450 men are employed, which is 200 more than before the strike.

MONTANA

SILVERBOW COUNTY

The Butte & London mine was dewatered to 800 ft. last week. At this point is a large station with an expensive pump, which has been there since the mine shut down, five years ago. It was then painted, greased, and packed, and was found to be in splendid condition after its long immersion in water. It will be changed from steam to electric power, and used again. During May the Butte & Superior mill treated 33,510 tons of ore, yielding 10,010 tons of concentrate assaying 53.59%

zinc. The recovery was 88.38%, and total zinc produced 10,729.398 pounds.

On June 13 the Butte Miners' Union held its thirty-fourth anniversary, which resulted in serious riots. Over 2000 men refused to recognize the union, and under leadership of I. W. W. members, attacked the parade being held, also did considerable damage in the union hall. A new union will probably be formed. The trouble had its origin over the dissatisfaction of the miners with heavy special assessments levied against them, by the officers of the Western Federation of Miners and the local officials as benefits for the Michigan copper mine strikers. Some of the miners were said to be paying as high as \$8 to \$10 per month in assessments. Although the strike there has been called off, the assessments continued. The climax came on June 12, when the men employed at the Speculator mine of the North Butte company refused to exhibit their union cards to the six walking delegates of the union sent there to inspect them. The union officials informed the mine management that the men would not be allowed to go to work. The men marched down from Butte hill and that night called out the night shift. Men from the Butte & Superior mines also joined the movement. Work has since been resumed at the mines.

MISSOURI

JASPER COUNTY

Lessees on the St. Paul Mining Co.'s land at Spring City are opening good lead and calamine at 150 ft., while east of the Hash mine the Black Hawk is showing lead and calamine at 15 ft. Hand jigs are used to clean the ore. After being idle for nine months, the 150-ton mill at Klondyke is to be restarted. Zincblende was cut at 115 ft. in the New England mine nearby. Eighteen per cent ore is being milled from the old Marlon B. mine.

NEVADA

ESMERALDA COUNTY

The annual meeting of the Jumbo Extension Mining Co. will be held at Phoenix, Arizona, on July 13. Net ore returns for the past five months were \$118,000, and net profits \$60,000. The Velvet claim, recently purchased, is showing twice as much ore as the purchase price. A side-line agreement, instead of the apex agreement, has been made with the Goldfield Consolidated company. The estimated net return for May was \$24,000. Development in the Florence continues to be satisfactory. Driving is under way at 810 ft. in the Oro mine.

MINERAL COUNTY

Another option which expired on June 15, was given the Goldfield Consolidated on the Aurora Consolidated property, according to W. Lester Mangum, the general manager of the latter. The price was \$927,000. Albert Burch, of the Goldfield mine, has been at Aurora in connection with the business. The new mill at Aurora, constructed by Kirk & Leavell, of Salt Lake City, is nearly completed.

NYE COUNTY

Ore production of Tonopah mines last week was 11,455 tons, valued at \$295,395. May yields were as follows: Belmont, 15,561 tons, yielding 343,740 oz. bullion, with a profit of \$152,411; Jim Butler, 3955 tons, with a profit of \$42,924; Tonopah Mining, 12,111 tons, yielding 218,525 oz. silver and 103 tons of concentrate worth \$35,155, the profit being \$99,695.

WASHOE COUNTY

A new gold discovery is reported about 10 miles from Reno.

WHITE PINE COUNTY

Accidents at the Nevada Consolidated properties in May were as follows: Veteran mine, five trivial disabling injuries; Copper Flat, 11 disablements; concentrating plant, 800 men employed, one man off for four shifts; smelter, 600 to 700 employed, three small injuries; the total accidents being

20 involving a loss to the men of 90 days in all, which is a good record.

NEW MEXICO

The production of coal in New Mexico in 1913 was 3,708,806 short tons, with a value at the mines of \$5,401,260, according to E. W. Parker, of the U. S. Geological Survey, who compiled the figures in cooperation with the State Geological Survey. In 1913, as in 1912, New Mexico beat all previous records in the production of coal. The output in 1912 was 3,536,824 tons, valued at \$5,036,824. The average price in 1913 was \$1.33 per ton. Colfax county produced 2,749,765 short tons out of the total of 3,708,806 tons for the state. The number of men employed in the coal mines increased from 3928 in 1912 to 4329 in 1913. The average production per man decreased from 900 tons in 1912 to 857 tons in 1913. This decrease was not due to any falling off in efficiency, but was one of the minor effects of an appalling disaster which occurred at mine No. 2 of the Stag Cañon Fuel Co., at Dawson, in October 1913. This accident, one of the most disastrous of the year in coal mining, and the worst in the history of the state, caused the death of 261 persons. It occurred in one of the mines of a Company which had spared no expense, and had taken every precaution human intelligence could suggest to reduce the hazard of coal-mining operations. The other fatalities reported to the U. S. Bureau of Mines outside of the explosion at Dawson were 11, making a total of 272. Only one instance of labor trouble was reported in 1913, and in this eight men were on strike for 130 days.

OREGON

JACKSON COUNTY

The Northern California-Southern Oregon Mining Congress will meet at Ashland on July 9 and 10. L. J. Luce, of Etna Mills, Siskiyou county, California, will preside. Following is the official program: First day, reception at Commercial Club rooms; address of welcome by the mayor, Mr. Johnson; response, F. J. Newman, of Medford, S. J. Taylor, of Yreka; president's address, L. J. Luce; S. B. Edwards, of Grants Pass, 'Placer Mining in Southern Oregon;' H. N. Lawrie, of Portland, 'Mining Industries of the State;' and R. A. Watson, corporation commissioner, 'Blue Sky Law, Relation to Mining Industry.' On the second day the following papers are to be read: A. L. Lamb, of Ashland, 'Mining in Jackson County;' J. Mangum, 'Mining in Josephine County;' Henry M. Parks, 'Mineral Resources of Oregon;' address by F. McN. Hamilton, state mineralogist of California; C. B. Watson, of Ashland, 'Clay and Kaolin and Their Possibilities;' Iron and Copper, Their Relation to Commercial Industries;' E. P. Hopson, 'Irrigation and Reclamation;' and an address by C. L. Probsted, 'Mineral Resources of Siskiyou County.'

UTAH

SALT LAKE COUNTY

At the western foot of the Wasatch range, between the mouths of Little and Big Cottonwood creeks, and 15 miles southeast of Salt Lake City, the Wasatch-Utah Mining Co. has a large low-grade property, the ore of which can be treated at a net profit of \$1 per ton. A 5-stamp mill has been used to test the ore, and with cyaniding a good recovery can be made. A mill of 500-ton daily capacity is proposed. The ore is soft, and mining costs will be low. A. W. Nieman, of Salt Lake City, is president.

SUMMIT COUNTY

Remodeling of the old Grasselli zinc mill at Park City is well under way, and it should be ready for work by July 15. The capacity is to be 50 tons per day, most of which will come from the American Flag mine. During May the Thompson-Quincy mine produced 35 mine-cars of first class and 70 cars of mill ore.

WASHINGTON

'The Mining Advance into the Inland Empire,' being a comparative study of the beginnings of the mining industry in Idaho and Montana, eastern Washington, and Oregon, and the southern interior of British Columbia, and of institutions and laws based upon that industry, is the subject of a thesis submitted for the degree of doctor of philosophy at the University of Wisconsin, by William J. Trimble. The publication is *Bulletin* 638, history series, containing 254 pages, and is sold for 40 cents per copy. It includes an introduction on the region and the movement, history from 1855 to 1870 in each state, economic and social aspects of the mining advance, together with a discourse on the law and government.

CANADA

BRITISH COLUMBIA

The Consolidated Mining & Smelting Co. has installed a pulmotor and other up-to-date rescue apparatus in its mines at Rossland. Classes will shortly be arranged for instructing the miners in the use of the machine and apparatus. Large numbers are taking the first-aid classes organized by Dudley Michell, representing the Department of Mines.

The Le Roi No. 2 company will probably acquire the Giant-California claims.

ONTARIO

During May the Nipissing refinery shipped 523,320 fine ounces of silver. Prospecting by hydraulicking is in progress near shaft 86. The cross-cut at 900 ft. depth is expected to soon cut the main vein, the distance being estimated at 255 ft. Other development was satisfactory.

The McIntyre mill treated 4480 tons of \$11.10 ore in May, yielding \$47,180. A station is being cut at 500 ft. at No. 4 shaft. Vein No. 6 was cut in the Tough-Oakes last week. It is 14 in. wide and of high grade, being parallel to No. 3 vein. A 100-ton mill is proposed next fall.

The recent statement of the McIntyre company for the year ended December 31, 1913, shows that for the twelve months the average value of the ore milled was \$5.18, while the cost was \$6.60. This report is very discouraging, but since that time better and more economical mining methods and more favorable underground development has placed the Company in a better position. From January 1 to March 31, 1914, the mill treated 11,190 tons averaging \$9.83, while during March over 4000 tons was milled, the average of which was \$12.68. In April the mill treated 4200 tons averaging \$10.70, and shipped bullion to the value of \$36,100. The capacity of the mill is being increased to 300 tons per day. The recovery of this Company from its former unfortunate position is an encouraging feature.

YUKON

With the exception of No. 1, at the mouth of Bonanza creek, and No. 6 on Gold Run, the Yukon Gold Co.'s dredges were at work on May 22. No. 3 and 8 started on May 12, No. 5 and 9 on May 13, and No. 2 and 4 on May 14. No. 1 and 6 were expected to start early in June. Of those operating, one is on Eldorado, one on upper Bonanza, one on 41 Hunker, and three on lower Bonanza. The hydraulic plants are also busy, the Fox gulch giants starting on May 8, and at Lovett gulch on the following day. The Twelve-mile power-plant started on May 9, this power being used on the dredges.

Canadian Klondyke dredges recovered 3192 oz. gold during the week ended May 23.

An adit has been driven 506 ft. into a hill on Hale creek, a few miles below Dawson, by A. T. Heydon, who expects soon to cut a buried gravel channel. He thinks a great deal of good gravel will be found.

Shipments of copper ore are being made from the Atlas company's Pueblo mine, at Whitehorse, to Tacoma. There

are 160 miners and 40 others employed on the property. Ore is coming from the 200 and 400-ft. levels. The Eureka Creek district is active, and a number of gravel dumps are being



STRIPPING OPERATIONS OF THE YUKON GOLD CO., CLAIM 88 BELOW BONANZA, SHOWING CREEK IN CENTRE AND CROSS-DITCHES IN 'MUCK.'

washed. The business portion of the town of Atlin was reported to have been destroyed during the first week in May.

CHILE

The Braden mill during May treated 70,477 tons of ore. The grade of this ore was 2.11%, and the recovery 75.36%. The production of blister copper for the month was 2,480,000 lb. While more than 200,000 lb. below that of April, it is the second largest monthly production from the mine. Development in progress disclosed some good ore. One of the cross-cuts on the No. 1 Teniente level advanced in ore, bringing the average for the 292 ft., so far driven, to 3.44%. In a raise above this level, which advanced 150 ft., the total distance of 630 ft. averages 3.32% copper. The extraction obtained of 75.36% for the month showed a marked improvement over that of April, when the recovery was 69.9%. The tonnage reported for May was all handled in the new mill, as the old mill was closed, the equipment now having been moved to the new plant. In April the tonnage handled in the new mill was 77,000, and in the old mill 5700, a total of 82,700 tons. The concentrator at Braden now has a capacity of about 3500 tons per day, or around 100,000 tons per month. The enlargement, however, of this plant is under way and its capacity will be increased to about 4500 tons.

COLOMBIA

The Pato dredge recovered gold worth \$10,350 from 54,250 cu. yd. during the fortnight ended May 19.

KOREA

A gold refinery is to be established at Pyongyang by Fusano Hisahara, a Japanese capitalist. With their present crude methods of refining gold, Japanese and Korean miners waste a considerable quantity of the metal. At the Hidachi mine a similar plant is working satisfactorily.

PHILIPPINE ISLANDS

A new 5-ft. dredge of the Malaguit Dredging Co. started work in the Paracale district in April. J. A. Bruce is in charge. The governor-general of the territory, Burton Harrison, recently gave a 'straight talk' to the business community of Manila, which has considerably cleared the air and promoted a distinctly better feeling in business circles, according to *The Far Eastern Review*.

Personal

W. W. MEIN is in San Francisco.

SIDNEY JENNINGS has gone to Europe.

H. W. MACFARREN has gone to Plumas county.

C. R. WIDLEY is at the Barstow property at Orray.

W. H. STORMS is studying the Mt. Lassen eruption.

WILLIS T. BURNS was in New York City last week.

J. W. RICHARDS has gone to Norway for the summer.

R. M. RAYMOND is staying in New York City for a time.

H. V. WINCHELL is expected in New York City at the end of this week.

C. W. PURINGTON has left St. Petersburg for the Lena district of Siberia.

H. G. S. NOBLE has been elected president of the New York Stock Exchange.

JINTARO KOJIMA, of the Furukawa Copper Co., is visiting Western copper mines.

J. F. KEMP is at Lake George, New York, and will go to Cuba later in the summer.

FREDERICK CLOSE passed through San Francisco last week, returning from Juneau to London.

HENNES JENNINGS is in New York City and expects to come to California later in the summer.

G. M. TRENT, manager of the L. C. Trent Engineering Co., of Los Angeles, is in San Francisco.

F. L. LOWELL, of the State Mining Bureau, is examining mines in Mariposa county, California.

W. F. DEANER has resigned as manager for the Original Amador company, at Amador City, California.

W. DEL. BENEDICT has returned to New York after an absence of ten weeks in California and Washington.

WILLIAM MOTHEWELL, of Australia, is at Humboldt, Arizona, with the Consolidated Arizona Smelting Company.

MORTON WEBBER has been examining a low-grade gold property in the vicinity of Pioche, Nevada, for New York interests.

G. D. LOUDERBACK will sail for China on June 28 to take charge of a geological survey party for the Standard Oil Company.

HENRY JONES, a well known manufacturer of Tasmania, and largely interested in tin properties in the Malay Peninsula, is in San Francisco.

J. B. TYRRELL, Canadian representative of the Anglo-French Exploration Co. of London, is investigating the mining conditions of British Columbia.

GEORGE E. FARISH has just returned to New York from the San Juan district in Colorado, where he has been engaged in examination work since February.

N. DICKERMAN, general manager for the Pato Mines (Colombia), Ltd., has arrived in New York City from London and will be in San Francisco the last of June.

N. W. SWEETSER has been promoted from engineer at the Phoenix, B. C., mines of the Granby Con. M. S. & P. Co. to superintendent of the Hadley, Alaska, mines of the same Company.

R. S. RAINSFORD has resigned as general manager for the Argonaut Mining Co. at Jackson, California. He will be succeeded by N. KELSEY, who has been assistant superintendent of the mine.

CHARLES A. DINSMORE, of the *El Paso Mining Journal*, disappeared May 19. Any information as to his whereabouts will be welcomed by Mrs. Dinsmore, whose address is: % First State Bank, Artesia, New Mexico.

PERCY A. SEIBERT, manager for the Andes Tin Co., Bolivia, is on holiday in Paris, where his address is 53 bis Rue de Villiers, Neuilly-sur Seine. In his absence from La Paz, JOSEPH A. INSLEE is in charge of the affairs of the Company.

Society Meetings

JUNE

American Institute of Electrical Engineers 22 or 26
 American Society for Testing Materials 22-27
 American Society of Mechanical Engineers end of June
 Franklin Institute, Philadelphia end of June
 Society for the Promotion of Engineering Education 29 to July 2

JULY

Northern California and Southern Oregon Mining Congress, Ashland, Oregon 9-10

AUGUST

American Institute of Mining Engineers, Salt Lake City 10-14
 Canadian Mining Institute, Rocky Mountain branch, Banff.
 Lake Superior Mining Institute, Marquette, Michigan 17

SEPTEMBER

American Chemical Society, Montreal 15-18
 American Institute of Electrical Engineers not fixed
 Colorado Scientific Society, Denver 3

OCTOBER

American Institute of Electrical Engineers 9
 American Iron and Steel Institute 23-24
 Colorado Scientific Society, Denver 3

NOVEMBER

American Institute of Electrical Engineers 13
 Colorado Scientific Society, Denver 7

DECEMBER

American Institute of Electrical Engineers 11
 American Museum of Safety 11-20
 American Society of Mechanical Engineers 7-8

D. C. JACKLING left about June 15 for Alaska on an inspection trip of the Alaska Gold Mines Co. property, which he expects will take a great deal of his attention this summer. Mr. Jackling will be accompanied on the trip by a number of friends and business associates, among whom are L. S. CATES, general manager for the Ray Consolidated Copper Co.; HOWARD FRITCH, general manager for the Kansas City Structural Steel Co.; GEORGE WOOLSEY, of Tripp & Co., bankers, of New York; M. B. McKELVIE, junior partner of Hayden, Stone & Co., of Boston; J. FRANK JUDGE, of Salt Lake City; N. B. POLL, editor of the *Boston News Bureau*, of Boston; H. S. ALEXANDER, president of the Alaska-Pacific Navigation Co.; GEORGE O. BRADLEY, chief mechanical engineer for the Utah Copper Co.; J. G. JANNEY, manager of the mills of the Alaska Gold Mines Co. and the Utah Copper Co.; and CHARLES W. STIMPSON, of the Stimpson Equipment Co. of Salt Lake City. The party will return to Seattle about July 3.

The U. S. CIVIL SERVICE COMMISSION announces an open competitive examination for assistant mining engineer on July 13, 1914, for men only. From the register of eligibles resulting from this examination, certification will be made to fill vacancies in this position in the Bureau of Mines, for service in the field, in relation to coal mining or metal mining, at salaries ranging from \$1800 to \$2400 per year.

MICHIGAN COLLEGE OF MINES, at Houghton, started its practice work in metallurgy and ore dressing on June 9. Ore to be treated this year is five tons from the Dome mine at Porcupine, Ontario. A week will be spent watching the operation of six mills in the district; also two weeks in the plant of the Michigan Smelting Company.

THE AUSTRALASIAN INSTITUTE OF MINING ENGINEERS held its 1914 meeting at Melbourne, Victoria, on May 21 to 30. A three days' trip was made to the gold mines of Walhalla and the government coal mines at Wonthaggi.

The Metal Markets

LOCAL METAL PRICES

June 18.

Antimony	9	— 9½c
Electrolytic copper	15	— 15½c
Pig Lead	4.15	— 5.10
Quicksilver (flask)		\$38.50
Tin	39	— 40½c
Spelter	6½	— 6¼c
Zinc dust, 100 kg. zinc-lined cases, 7½ to 8c. per pound.		

EASTERN METAL MARKET

(By wire from New York.)

NEW YORK, June 18.—All metal markets are dull and weak. Copper and spelter are a trifle lower than last week, and lead is the same price. It is feared that labor troubles at Butte may result as in Michigan last year. News from Mexico affected American Smelting & Refining shares. Tin is firm at 30.20 to 30.50c. spot; and antimony is dull at 7.25 to 7.37½c. The St. Louis lead and spelter markets are exceedingly dull at 3.80 to 3.82½c. and 4.92½c. respectively. In London copper is firm at 61 16s.3d.; lead, 119 17s.6d.; spelter, 121 5s.; tin 1137 10s. to 1139; and bar silver quiet at 25.94d. per ounce.

SILVER

Below are given the average New York quotations in cents per ounce, of fine silver.

Date.	Average week ending
June 11.....	56.87
" 12.....	56.25
" 13.....	56.75
" 14 Sunday.....	56.50
" 15.....	56.50
" 16.....	56.50
" 17.....	56.50
Monthly averages.	
1913.	1914.
Jan.	63.01
Feb.	61.25
Mar.	57.87
Apr.	59.26
May	60.21
June	59.03
July	57.58
Aug.	57.53
Sept.	58.01
Oct.	58.52
Nov.	58.21
Dec.	57.73

The daily recorded last week proved to be short lived, according to Samuel Montague & Co., writing on June 1. So little animation was felt that prices shed fractions each day, until yesterday 25½d. was fixed for cash and 25¼d. for two months delivery. It is considerably over two years since such low prices have been touched, not since January 17, 1912, when 25.7d. and 25¼d. were fixed for the respective deliveries. The fact is the more remarkable, as business frequently has been on an extremely small scale. The only apparent cause for the low level of prices now ruling is an exceptional reluctance of buyers to support the market. It will be observed that the shipment from San Francisco to China, which was £120,000, is unusually large. Sales aggregating to so considerable a sum as comprised in this shipment contributed to make that quarter rather inactive so far as the London market was concerned. It is possible that the imminence of the monsoon deters the Indian Bazaars from purchasing until it can be reasonably anticipated that favorable climatic conditions are assured. Today buying orders were received from China, and as sellers were disposed to hold off, a sharp rise took place of 0.2d. in the price for both deliveries. An Indian currency return, cabled on June 1, shows an increase in the note issue of 110 lacs, and in the holding of silver rupees of 140 lacs. The holding of gold in India has decreased by 30 lacs (1 lac = \$32,000). The stock in Bombay has decreased from £470,000 to £405,000. The off-take is unchanged at 100 bars per day. The holdings in Shanghai by banks and others consist of £5,770,000 in sycee or currency, a decrease of £70,000. The holding of bars is about the same, namely, £35,000. (Sycee is a shoe-shaped bar weighing from 50 to 60 ounces.)

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending	June 4.....
May 21.....	39.00
" 28.....	39.00
Monthly averages.	
1913.	1914.
Jan.	39.37
Feb.	41.00
Mar.	40.20
Apr.	41.00
May	40.25
June	41.00
July	41.00
Aug.	40.50
Sept.	39.70
Oct.	39.37
Nov.	39.40
Dec.	40.00

COPPER

Quotations on copper as published in this column represent average wholesale transactions on the New York market and refer to electrolytic copper. Lake copper commands normally 1-5 to 1-4c. per lb. more. Prices are in cents per pound.

Date.	Average week ending
June 11.....	13.65
" 12.....	13.65
" 13.....	13.65
" 14 Sunday.....	13.65
" 15.....	13.65
" 16.....	13.65
" 17.....	13.65
Monthly averages.	
1913.	1914.
Jan.	14.54
Feb.	14.93
Mar.	14.72
Apr.	15.22
May	15.42
June	14.71
July	14.21
Aug.	15.42
Sept.	16.23
Oct.	16.31
Nov.	15.08
Dec.	14.25

Copper production of the Wallaroo and Moonta mines, South Australia, to the end of 1913 was as follows: ore mines, 10,200,000 tons; average copper content, 3%; fine copper yield, 283,882 tons; dividends, \$10,704,000.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.	Average week ending
June 11.....	3.90
" 12.....	3.90
" 13.....	3.90
" 14 Sunday.....	3.90
" 15.....	3.90
" 16.....	3.90
" 17.....	3.90
Monthly averages.	
1913.	1914.
Jan.	4.28
Feb.	4.33
Mar.	4.32
Apr.	4.36
May	4.34
June	4.33
July	4.11
Aug.	4.02
Sept.	3.94
Oct.	3.86
Nov.	3.90
Dec.	4.02

Metal production of the Broken Hill Proprietary Co., New South Wales, during the four weeks ended May 7 was as follows: Silver from Company ore, 127,966 oz., and from custom ore, 187,842 oz.; lead from Company ore, 1748 tons, and from custom ore, 4505 tons; antimonial lead, 27 tons; zinc concentrate, 5550 tons, containing 71,023 oz. silver, 354 tons lead, and 2591 tons of zinc. The output was low on account of holidays.

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date.	Average week ending
June 11.....	4.85
" 12.....	4.85
" 13.....	4.85
" 14 Sunday.....	4.85
" 15.....	4.85
" 16.....	4.85
" 17.....	4.85
Monthly averages.	
1913.	1914.
Jan.	6.88
Feb.	6.13
Mar.	5.94
Apr.	5.52
May	5.23
June	5.00
July	5.14
Aug.	5.22
Sept.	5.12
Oct.	4.98
Nov.	4.91
Dec.	5.00

TIN

New York prices control in the American market for tin, since the metal is almost entirely imported. San Francisco quotations average about 5c. per lb. higher. Below are given average monthly New York quotations, in cents per pound:

Monthly averages.	1913.	1914.
Jan.	50.45	37.85
Feb.	49.07	39.76
Mar.	46.95	38.10
Apr.	49.00	36.10
May	49.10	33.29
June	45.10	
July	40.70	
Aug.	41.75	
Sept.	42.45	
Oct.	40.61	
Nov.	39.77	
Dec.	37.57	

The Stock Markets

SAN FRANCISCO STOCKS AND BONDS

(San Francisco Stock and Bond Exchange)

June 17.

BONDS

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Associated Oil Co.	—	38	Natomas Consol. Bds.	—	20
Natomas Con.	28½	30	Pac. Port. Cement Bds.	100	—
Unlisted.			Santa Cruz Cement Bds.	85	—
General Petroleum Bds.	30	—	Union Oil	86½	87½

STOCKS

Listed.	Bid	Ask	Listed.	Bid	Ask
Amalgamated Oil	79	—	West Coast. pfd.	—	112½
Associated Oil	38½	—	Unlisted.		
Du Pont. pfd.	80	84	General Petroleum	4	4½
Giant.	—	81	Noble Electric Steel	50c	—
Pac. Ost. Borax. com.	—	57½	Pac. Port. Cement	60	94
Sterling O. & D.	—	14	Riverside Cement	—	63
Union Oil	89	—	Santa Cruz Cement	40	—
			Stand. Port. Cement	—	24

NEVADA STOCKS

(By courtesy of San Francisco Stock Exchange.)

June 18.

Atlanta	15	Montana-Tonopah	73
Belcher	30	Nevada Hills	34
Belmont	6.87	North Star	30
Con. Virginia	15	Ophir	16
Florence	45	Pittsburg Silver Peak	28
Goldfield Con	1.40	Round Mountain	39
Goldfield Oro.	10	Sierra Nevada	11
Hallifax	65	Tonopah Extension	2.60
Jim Butler	1.00	Tonopah Merger	47
Jumbo Extension	22	Tonopah of Nevada	6.75
MacNamara	02	Union	06
Mexican	40	Victor	40
Midway	24	West End	79
Mizpah Extension	26	Yellow Jacket	35

CALIFORNIA STOCKS

(Latest Quotations.)

	Bid.	Ask.		Bid.	Ask.
Argonaut	\$3.00	—	Kennedy	\$7.50	—
Brunswick Con.	1.40	—	Mountain King	0.45	—
Bunker Hill	1.90	—	South Eureka	1.25	—
Central Eureka	0.11	0.12			

COPPER SHARES—BOSTON

(By courtesy of J. C. Wilson, Mills Building.)

June 18.

	Bid	Ask		Bid	Ask
Allouez	\$40	40½	Mohawk	\$44	46
Ariz. Commercial	4½	4½	Nevada Con.	19½	14½
Butte & Superior	37½	37½	North Butte	25½	25½
Calumet & Arizona	64½	65	Old Dominion	48	48½
Calumet & Hecla	410	415	Osceola	76	78
Copper Range	36½	37	Quincy	66	58
Daly West	1½	2	Shannon	6	5½
East Butte	10½	10½	Superior & Boston	14	2½
Franklin	4½	4½	Tamarack	35	36
Granby	81	81½	U. S. Smelting. com.	34½	35
Greene Cananea	32	32½	Utah Con.	10½	10½
Isle Royale	20	20½	Winona	24	23
Mass Copper	4½	4½	Wolverine	40½	41½

NEW YORK CURB QUOTATIONS

(By courtesy of E. F. Hutton & Co., Kohl Building.)

June 18.

	Bid.	Ask.		Bid.	Ask.
Braden Copper	7½	7¾	McKinley-Dar.	64c.	68c.
B. C. Copper	1½	1¾	Mines Co. Am.	2¾	3
Con. Cop. Mines	1¼	1½	Nipissing	6¾	6½
Davis-Daly	¾	¾	Ohio Copper	¼	¾
First National	2	2½	Stand. Oil of Cal.	322	325
Hollinger	17	17¾	Tri Bullion	¼	¼
Iron Blossom	1¼	1¾	Tuolumne	¼	½
Kerr Lake	5	5¼	United Cop. com.	¾	¾
La Rose	1¾	1½	Yukon Gold	2½	2¾
Mason Valley	2¾	3			

NEW YORK STOCK EXCHANGE

(By courtesy of J. C. Wilson, Mills Building.)

June 18.

	Bid	Ask		Bid	Ask
Amalgamated	70½	71	Alumina	22½	23½
Anacosta	30½	31	Nevada Con.	14½	14
A. S. & R. com.	62½	63	Quicksilver. com.	1	2
Calif. Pet. com.	19½	20	Ray Con.	21	21½
Chino	41	41½	Tenn. Copper	7½	41
Guggenheim Ex.	52½	53	U. S. Steel. pfd.	109½	109½
Inspiration	16½	17	U. S. Steel. com.	64½	64½
Mexican Pet. com.	50½	64½	Utah Copper	57	57

Mineral Production of Japan

The Department of Agriculture and Commerce has recently published the result of its investigations into the conditions of the mining industry of this country. The yield of the principal minerals during 1913 was valued at 146,657,813 yen, the highest output in recent years. Compared with the preceding year, these figures are an increase by 10%, that is, 16,416,478 yen. Eliminating silver, which had a decrease of 170,000 yen as compared with the preceding year, all other principal minerals have increased, the gain being heaviest in coal. Details are as follows:

	Yen.*
Gold	7,281,411
Silver	5,798,975
Copper	41,738,339
Iron	3,418,224
Coal	70,956,121
Kerosene oil	12,498,506
Sulphur	1,556,826
Other miscellaneous minerals	3,499,412

Total 146,657,814

*One yen = about 50 cents U. S. coinage.

MONEY IN CIRCULATION in the United States on June 1, as estimated by the Treasury Department, totaled \$3,480,074,312, made up as follows: gold coin, \$615,431,580; gold certificates, \$1,105,753,619; standard silver dollars, \$70,680,082; silver certificates, \$466,402,217; subsidiary silver, \$159,629,313; treasury notes, 1890, \$2,450,805; United States notes, \$339,992,091; and national bank notes, \$719,734,605. The circulation per capita was \$35.19.

THE U. S. ASSAY OFFICE at New York transacted the following business in May: gold bars paid on deposit, \$259,597; gold bars exchanged for gold coin (domestic), \$2,519,325; exports to Canada, \$32,425; and exports to Europe, \$5,941,797. Transactions for the current year total \$36,465,254, against \$34,283,992 for the whole of 1913.

PHOSPHATE ROCK reserves of the United States are estimated as 10,519,875,000 tons, of which 10,000,000,000 tons is in Utah, Idaho, Wyoming, and Montana; 374,300,000 tons in Florida; 115,075,000 tons in Tennessee; 10,000,000 tons in South Carolina; 20,000,000 tons in Arkansas; and 500,000 tons in Kentucky.

PIG-IRON PRODUCTION of the United States in May totaled 2,092,686 tons, an average of 67,506 tons per day. This was 8000 tons per day less than in April. There were 197 furnaces active on June 1.

GOLD AND SILVER EXPORTS from New York to June 6 amounted to \$37,278,299 and \$17,912,660 respectively, against \$59,792,290 and \$23,151,073 for the same time last year.

UNDERGROUND ELECTRIC RAILWAYS of London carried approximately 1,100,000,000 passengers during the past financial year. Gross earnings were \$31,932,300.

Company Reports

NORTH LAKE MINING COMPANY

This Michigan copper company has not yet reached the producing stage. Shaft-sinking was in progress in 1913, and had reached a depth of 345 ft. when the strike caused a shut-down. A cross-cut is being driven on the 300-ft. level and has advanced 112 ft. The balance sheet of the Company for December, 31, 1913, shows cash assets of \$22,783 and total assets of \$904,649. During 1913, \$30,000 was expended on development work.

CONSOLIDATED COPPERMINES COMPANY

The Consolidated Coppermines Co. has issued a report covering the period from May 20, 1913, to April 30, 1914. The report shows that the Company, which was incorporated May 20, 1913, owns 1151 acres in the Ely district besides 2565 acres of ranch land and valuable water rights. Ore reserves are as follows:

	Giroux mine.	Old Coppermines.
Fully developed, tons	14,199,180	.....
Copper content, per cent.....	1.219	.....
Partly developed, tons	6,456,872	968,184
Copper content, per cent	1.041	1.01

For the purpose of proving tonnages and grade of the ore, several drills were put to work. The holes so far put down have shown a close check on previous work. Seven holes were also drilled west of the Old Glory territory, with the result that the concentrating ore there was shown to be a continuation of the so-called Morris deposit. Heretofore it was supposed that these were distinct orebodies. In addition to the churn-drilling on the Giroux, underground mining was conducted at the Coppermines property, and the result of both drilling and underground work was satisfactory. No work was done on the Ely Central, Butte & Ely, or the Chairman properties. In the Morris Hill portion of the Giroux, six drill-holes have been put down below the 165-ft. level, the deepest level in the mine, with the result that a large additional tonnage of high-grade concentrating ore has been developed and partly developed. In calculating tonnages, no allowance has been made for the direct-smelting ores known to exist in the Old Glory, Taylor, Giroux, and Alpha shafts. The drilling which was carried on is said to have blocked out an additional tonnage of several million tons of ore under 1% copper, which can be mined by steam-shovel at a low mining cost, and most of which could be leached or otherwise treated at a profit. These ores will be handled in connection with the mining of the higher grade concentrating ores. During the period from June 1 to April 30, 170,298 tons was mined and shipped from the Giroux, producing 3,041,678 lb. of copper. The profit after expenditure was \$5814. In addition there was charged to drilling, general expense, and miscellaneous, the sum of \$178,944. The general manager, Mr. Gray, advises the erection of a small experimental plant in the old Giroux concentrator to determine the best treatment for the ores. Total receipts of the Company were \$247,352. Expenses were \$226,152, leaving a balance of \$21,200.

DOMINE MINES, LIMITED

The report of this Porcupine, Ontario, company covers the year ended March 31, 1914, and is complete in every detail. Development totaled 6802 ft., including shaft-sinking, and cost \$1.11 per ton milled. Ore reserves above the 100-ft. level are estimated at 512,600 tons averaging \$4.81 per ton. In addition to this tonnage of fully developed ore, work in the vicinity of No. 2 shaft has shown an additional tonnage,

which is partly developed, amounting to 2,000,000 tons and averaging \$3.50 per ton. Mining now extends along the strike of the orebody for 1250 ft. Practically all work during the year was done at No. 2 shaft in opening the No. 3, 4, and 5 levels, particularly No. 3, where a large orebody, equivalent to a horizontal area of 100,000 sq. ft., was proved. This was defined by 859 ft. of drifts and 969 ft. of cross-cutting, the sampling value being \$3.49 per ton. Only a limited amount of development was done on No. 4 and 5 levels, but further areas of ore have been exposed. On No. 4, 539 ft. of driving showed an area of 29,480 sq. ft., averaging \$4.03 per ton; and on No. 5, 644 ft. of work disclosed 37,000 sq. ft. of ore which sampled \$4.94 per ton. A much greater amount of work, however, will be necessary on No. 4 and 5 levels before it will be safe to estimate the probable size or value of the orebody. In the vicinity of No. 4 shaft, six diamond-drill holes were put down within an area of 15,000 sq. ft., and results indicate a considerable tonnage of profitable ore which will be developed from the 100-ft. level.

Records for the year show that an average of 4.203 tons of ore was produced per man per shift for all underground employees, and 1.73 tons per man per shift for all employees on the property. The stoping record shows that 43.7 tons was broken per machine shift with the large piston drills, and 61.01 tons per machine shift for the pluggers working in the open pits.

The mill ran 93.52% of the possible running time and treated an average of 398 tons of ore per day, making a



DOMINE MILL, PORCUPINE, ONTARIO.

recovery of 94.5%. The average stamp-duty was 10.6 tons per 24 hours. Of the total value recovered, 60.7% was by amalgamation, and 39.3% by cyanidation. The total ore treated was 145,305 tons, yielding \$1,204,598, equal to \$8.29 per ton. The total expenditure on operating development, plant, etc., was \$919,512. Costs were as follows: Mining, 68c.; hoisting, 7c.; crushing and conveying to mill, 25c.; stamping, tube-milling, and amalgamation, 86c.; thickening, cyaniding, and precipitating, 50c.; refining, 8c.; and general, 64c.; a total of \$3.08 per ton. This cost was \$1.49 lower than the previous year. The consulting engineer, W. W. Mein, states that working costs will be further reduced, and that when the enlarged plant is in operation they should be less than \$2.50 per ton. The mill's capacity is being increased to 28,000 tons per month, and this construction cost \$303,999. Cash on hand at the end of the term was \$168,749, and the surplus was \$486,520.

The Company possesses a large deposit of low-grade ore which should be worked by a policy of non-selective mining, and which gives assurance of a profitable life on the basis of the new treatment capacity, according to Mr. Mein. The advisability of further increasing the capacity of the mill will depend upon the results of further development from the lower levels of No. 2 shaft, and upon the establishment of low operating costs.

Production Statistics

THE FOLLOWING DATA, COVERING THE YEAR 1913, IS FROM THE UNITED STATES GEOLOGICAL SURVEY.

SLATE

Slate production of the United States amounted to 1,113,944 squares of roofing material averaging \$4 per square; 6,312,911 sq. ft. of mill stock, averaging 19.5c. per sq. ft.; and other products worth \$480,576, the total value being \$6,175,476. The other products include 6,174,526 school slates, and 3,504,162 sq. ft. of blackboard material. Pennsylvania and Vermont were the chief producing states. Practically no slate is imported, while exports amounted to \$226,413.

COAL MINING IN ALABAMA

The production of coal in Alabama in 1913 was 17,678,522 short tons, valued at the mines at \$23,083,724, according to figures compiled by E. W. Parker, in co-operation with the Alabama Geological Survey. The increase in coal production in Alabama in 1913 compared with 1912 was 1,577,922 short tons in quantity and \$2,254,472 in value. The number of men employed in 1913 was 24,552, against 22,613 in 1912. The total time lost by strikes in 1913 was 27,041 days, 1048 men being idle for an average of 26 days. There were 124 men killed in the coal-mining operations of Alabama in 1913.

APPALACHIAN OIL PRODUCTION

During 1913 this oilfield, embracing New York, Pennsylvania, West Virginia, southeastern Ohio, and Kentucky, showed a slight decline, 1.72%, in the production of petroleum, falling from 26,338,516 in 1912 to 25,885,640 bbl. in 1913, a decrease of 452,876 bbl. The value, amounting to \$63,619,677 in 1913, was, on the contrary, increased by 48.58%, about the same proportional increase as was shown in 1912 over the previous year. The largest amount, 2,307,422 bbl. was produced in April; the smallest amount, 1,963,460 bbl., in February. The average price per barrel increased from \$1.63 to \$2.46.

Production by states was as follows:

State.	1912. Barrels.	1913. Barrels.
New York	874,128	902,211
Pennsylvania	7,837,948	7,927,137
West Virginia	12,128,962	11,567,299
Southeastern Ohio	5,913,110	4,964,425
Kentucky	484,368	524,568
Total	26,338,516	25,885,640

ANTHRACITE PRODUCTION

The production of anthracite again broke the record in 1913, exceeding the highest previous output by nearly 1,000,000 tons, according to figures compiled by E. W. Parker, coal statistician of the Survey. Including the coal recovered from old culm banks, and a small quantity dredged from Susquehanna river, the production of anthracite for the year was 81,718,680 long tons, valued at \$195,181,127, compared with 75,322,855 tons, valued at \$177,622,626 for 1912. The previous highest record was 80,771,488 long tons, in 1910. Anthracite miners and operators are now working under an agreement extending over a period of four years from April 1, 1912; there were consequently no serious interruptions to mining operations by labor troubles in 1913, and industrial peace is assured in the anthracite region until 1916. Another record in addition to that of tonnage was established in the anthracite region in 1913. The average working time for men, 257 days, exceeded anything in the history of the industry, the nearest approach being in 1911, when an average of 246 working days was recorded. In 1912 the average was 231 working days. The average number of men employed in

1913 was 175,745. Reports to the U. S. Bureau of Mines show that there were 618 fatal accidents in the anthracite mines in 1913 compared with 584 fatalities in 1912.

POTASH IMPORTS

The importation of potash salts for consumption into the United States during 1913 amounted to 600,000,000 lb., valued at \$10,800,000, according to W. C. Phalen. This importation is only a part, however, of the potash salts entering the country, as shown by the figures of the Department of Commerce. To it should be added the importation of kainite and manure salts, including double manure salts. The imports of these classes of material amounted to nearly 700,000 tons, valued at \$4,500,000, making a total of more than \$15,000,000 as the value of imported potash salts of all classes. The imports for consumption of materials entering largely into the fertilizer industry, plus the value of the domestic phosphate rock, reached the total value of \$52,999,469. The statistics in detail, together with others showing the condition of the German potash industry are given in the Geological Survey's report on potash just issued as a chapter of the volume 'Mineral Resources of the United States, 1913.'

The activities of the U. S. Geological Survey in the investigation of potash salts during 1913 were more restricted than in previous years. In the field, drilling was carried on in two areas, Columbus marsh and Black Rock desert, Nevada; but it was of short duration, owing to the inaccessibility of the area for an unusually long period of the year on account of heavy rains, which made it impossible to transport apparatus to the drill sites. A general plan involving the stratigraphic study of the so-called 'Red Bed' salines of certain of the southwestern states, including New Mexico, Arizona, and Utah, was begun by N. H. Darton.

COAL MINING IN OHIO IN 1913

All previous records in the coal production of Ohio were exceeded in 1913 both in quantity and value, notwithstanding that coal-mining operations like all other industries of the state were seriously interfered with by an enormous flood in March and April of that year, according to E. W. Parker. Mines were flooded and the transportation companies were practically out of business throughout a good part of the state for more than a month, so that the possible production was cut down probably 5,000,000 tons. In spite of this interruption the production increased from the previous maximum output of 34,528,727 short tons in 1912, to 36,200,627 tons in 1913, a gain of 1,671,900 tons. The increased value was \$2,864,695, from \$37,083,363 to \$39,948,058, and the average value per ton showed an advance of 3c., from \$1.07 in 1912 to \$1.10 in 1913. The average number of working days made by the employees was 206 days in 1913, against 201 days in 1912, and the average production by each man employed was 790 tons for the year compared with 758 tons in 1912. This gain in individual production was due in large part to the larger production of machine-mined coal, in the proportion of which to the total tonnage, Ohio stands well at the head among the coal-producing states. In 1913 32,642,848 tons, or 90.2% of Ohio's total production, was mined by machines. The increase in machine-mined tonnage was 2,604,017, or 932,117 tons more than the total increase. At the present time Ohio enjoys the excellent record of having less than 4% of the total output reported as shot off the solid, or powder-mined. Electrically-driven chain-breast machines far outnumber all other types of machines in the Ohio mines, as out of a total of 1681 machines in use in 1913, 1421, or nearly 85%, were chain-breast. Short-wall machines are growing in popularity, as indicated by an increase in their number from 106 in 1912 to 187 in 1913. The number of long-wall machines increased from 2 to 17, and the number of pick machines decreased from 77 to 56. Reports to the U. S. Bureau of Mines show that the coal-mining fatalities in 1913 numbered 165 against 132 the previous year.

Monthly Copper Production

AHMEEK COPPER MINING CO., Kearsarge, Michigan. \$1,250,000 in \$25 shares; 24,796 shares owned by Calumet & Hecla; 1800-ton mill at Hubbell; concentrate smelted by Calumet & Hecla smelter. Total in 1913, 9,100,000 pounds.

Month.	Pounds.
May	1,178,595

ALLOUEZ MINING CO., Allouez, Michigan. \$2,500,000 in \$25 shares; controlled by the Calumet & Hecla, which owns 43,000 shares and \$250,000 in notes of the Company; ore is milled by the Lake Milling, Smelting & Refining Co., in which the Allouez owns half. Total in 1913, 4,091,129 pounds.

Month.	Pounds.
May	559,740

ANACONDA COPPER MINING CO., Butte, Montana. \$108,312,500 in \$25 shares; controlled through Amalgamated Copper Co., which owns 3,185,210 shares by Thos. F. Cole, J. D. Ryan, and Standard Oil interests; 10,000-ton concentrator and smelter at Anaconda; 5000-ton concentrator and smelter at Great Falls, Mont.; also 70-ton electrolytic refining plant at Great Falls. Production figures include copper from all companies which ship custom ore to Anaconda smelters. Total in 1913, 270,301,644 lb. copper, 64,898 oz. gold, and 10,321,296 oz. silver.

Month.	Pounds.	Month.	Pounds.
February	21,300,000	April	22,900,000
March	23,800,000	May	23,500,000

ARIZONA COPPER CO., LTD., Morenci, Arizona. £703,894, of which £379,974 is in 5s. ordinary shares, £500,000 in 5% debentures; controlled by Edinburgh investors; mill at Morenci is being enlarged to 3000-ton capacity and a new 1200-ton smelter near Clifton has just been started.

Month.	Pounds.	Month.	Pounds.
February	3,063,000	April	3,570,000
March	3,286,000	May	3,092,000

BRADEN COPPER CO., La Junta, Chile. \$2,332,030 in \$10 shares and \$4,000,000 in 6% convertible bonds; entire stock held by Braden Copper Mines Co.; \$14,000,000 in \$5 shares; \$4,000,000 in 6% convertible bonds, \$3,000,000 7% bonds controlled by Guggenheim interests; two mills at La Junta; 3000-ton capacity smelter at Rancagua.

Month.	Pounds.	Month.	Pounds.
February	2,362,000	April	2,720,000
March	1,801,000	May	2,480,000

BRITISH COLUMBIA COPPER CO., LTD., Greenwood, B. C. \$2,958,545 in \$5 shares; owns 63% of the stock of the New Dominion Copper Co.; controlled by Newman Erb; 600-ton sampling plant and 2500-ton smelter.

Month.	Pounds.	Month.	Pounds.
February	572,571	March	682,867

CALUMET & ARIZONA MINING CO., Warren, Arizona. \$6,285,710 in \$10 shares; has absorbed the Superior & Pittsburg Copper Co. by stock exchange; controlled by Hoatson and other Lake Superior interests; 3000-ton smelter at Douglas. Total in 1913, 52,987,383 lb. 886,915 oz. silver, 18,989 oz. gold. Monthly returns include the Shattuck-Arizona.

Month.	Pounds.	Month.	Pounds.
February	5,948,300	April	5,450,000
March	5,870,000	May	5,480,000

CALUMET & HECLA MINING CO., Calumet, Michigan. \$2,500,000 in \$25 shares; controls the Ahmeek, Allouez, Centennial, Isle Royale, La Salle, Osceola, Tamarack, and Superior copper mining companies, as well as a number that are non-productive; controlled by Agassiz and Shaw interests; 2 mills on Lake Linden, capacity 15,000 tons; smelter Hubbell, Mich.; electrolytic refinery and smelter at Buffalo, N. Y.; figures include output of subsidiaries. Total in 1913, from Calumet & Hecla alone, 45,016,890 pounds.

Month.	Pounds.
May	9,299,507

CANANEA CONSOLIDATED COPPER CO. S. A., Cananea, Sonora, Mexico. Capital £20,000 in shares of £100; entire stock owned by Greene Consolidated Copper Co.; \$10,000,000 in \$10 shares; 945,320 shares are held by Greene Cananea Copper Co.; \$50,000,000 in \$100 shares, which is controlled by Thos. F. Cole and J. D. Ryan; 30,800 shares held by the Amalgamated Copper Co.; 2 mills and smelter at Cananea, 3000-ton capacity. Total in 1913, 37,950,574 pounds. Output does not include copper from custom ores.

Month.	Pounds.	Month.	Pounds.
February	2,282,000	April	2,944,000
March	3,510,000	May	1,781,000

CERRO DE PASCO MINING CO., Cerro de Pasco, Peru. \$10,000,000; entire stock held by Cerro de Pasco Copper Co.; \$60,000,000 in \$1 shares which is owned by Cerro de Pasco Investment Co., which is controlled by J. B. Haggin, and Morgan estate; 3000-ton smelter at La Fundicion; monthly production figures not given out; output in 1912 was 45,000,000 lb. copper.

CHINO COPPER CO., Santa Rita, New Mexico. 4,302,700 in \$5 shares; 121,200 shares are held by Guggenheim Exploration Co.; controlled by Sherwood Aldrich and C. M. MacNeill; 5000-ton mill at Hurley, N. M.; concentrate smelted at El Paso.

Month.	Pounds.	Month.	Pounds.
February	5,769,948	April	6,109,888
March	5,399,814		

CONSOLIDATED COPPERMINES CO., Ely, Nevada. \$8,000,000 in \$5 shares; \$3,500,000 in 7% convertible bonds; is a recent merger of the Groux, Butte & Ely, Chairman, and Coppermines companies, controlled by Thos. F. Cole, Wm. B. Thompson, Charles F. Rand, and Jas. Phillips, Jr.; reduction plant not yet built; production so far derived solely from Groux; ore treated at Nevada Con. smelter.

Month.	Pounds.	Month.	Pounds.
January 1914	148,411	April	471,369
March	287,980	May	442,838

COPPER QUEEN CONSOLIDATED MINING CO., Bisbee, Arizona. \$2,000,000 in \$10 shares; owns 100,000 shares of Greene Cananea; almost all its stock is held by Phelps, Dodge & Co., Inc.; \$14,995,000 in \$100 shares; 4000-ton smelting plant at Douglas, Ariz. Total in 1913, 85,389,630 pounds.

Month.	Pounds.	Month.	Pounds.
February	6,448,770	April	6,922,390
March	7,122,739	May	7,897,070

COPPER RANGE CONSOLIDATED MINING CO., Palmdale, Michigan. \$39,371,000, in \$100 shares; owns 99,659 shares of Baltic M. Co., 99,699 shares Copper Range M. Co., 99,345 shares of Tri-mountain M. Co., half interest in Champion Copper Co., 16,392 shares of Copper Range R. R. Co., and \$870,000 in Copper Range R. R. bonds; controlled by Wm. A. Paine; production is derived from the Baltic, Champion, and Tri-mountain companies, each of which mills its ore; concentrate is smelted by Michigan Smelting Co., Houghton, which is owned by mining companies. Total in 1913, 24,852,026 pounds. Reports only "mineral" containing 60 to 70% copper.

Month.	Pounds.	Month.	Pounds.
February	3,518,000	April	4,428,000
March	3,834,000	May	5,908,000

DETROIT COPPER MINING CO., Morenci, Ariz. \$1,000,000 in \$25 shares; owned by Phelps, Dodge & Co.; 1300-ton mill and 350-ton smelter. Total in 1913, 22,352,299 pounds.

Month.	Pounds.	Month.	Pounds.
February	1,814,214	April	1,790,926
March	1,973,725	May	2,105,534

EAST BUTTE COPPER MINING CO., Butte, Mont. \$1,110,000 in \$10 shares; owns 83% of the stock and all bonds of the Pittsmtont Copper Co., which holds 90% of the stock and all bonds of Pittsburgh & Montana Copper Co.; controlled by Wm. A. Paine; 350-ton mill and 1000-ton custom smelter. Total in 1913, 14,401,108 pounds.

Month.	Pounds.	Month.	Pounds.
February	1,182,063	April	1,178,080
March	1,530,717	May	1,179,762

GRANBY CONSOLIDATED MINING, SMELTING & POWER CO., LTD., Phoenix and Hidden Creek, British Columbia. \$14,998,500 in \$100 shares; \$1,197,200 in 6% convertible bonds; controlled by General Chemical Co. interests; 4400-ton smelter at Grand Forks and 2000-ton smelter at Anyox. Total in 1913, 21,511,747 pounds.

Month.	Pounds.	Month.	Pounds.
February	1,661,212	April	1,692,102
March	1,775,852		

GREAT COBAR, LIMITED, Cobar, New South Wales. £1,000,000 in 200,000 shares of £5 each; also 6% first-mortgage debentures. Operates gold, copper, and coal mines, coke works, flotation concentration plant, blast-furnaces, and a refining plant. During past fiscal year treated 361,566 tons for 13,016,640 lb. copper, 27,136 oz. gold, and 127,542 oz. silver.

Month.	Pounds.	Month.	Pounds.
February	898,240	March	896,000

HAMPDEN CLONCURRY COPPER MINES, LIMITED, Cloncurry, Queensland. £400,000 in shares of £1 each; 350,000 issued. During past fiscal year treated 24,744 tons for 5,815,040 lb. copper, 818 oz. gold, and 24,457 oz. silver.

Month.	Pounds.	Month.	Pounds.
March	1,322,800	April	1,126,720

KYSHTIM CORPORATION, LTD., Kyshtim, Perm, Russia. £1,002,800 in £1 shares, £650,000 in 6% debentures, convertible at £2 10s. 1000-ton smelting plant at Karabash, also electrolytic plant to treat all copper produced. Blister production:

Month.	Pounds.	Month.	Pounds.
Mar. 12 to April 11	1,666,500	April 12 to May 17	1,783,280

MASON VALLEY MINES CO., Yerington, Nev. \$770,000 in \$5 shares; \$1,000,000 in 6% convertible bonds; controlled by W. B. Thompson; 1000-ton smelter at Thompson, Nev., also smelts ore of Nevada-Douglas Copper Co. and custom ore; smelter production. Total in 1913, 14,694,000 pounds.

Month.	Pounds.	Month.	Pounds.
February	1,254,000	April	862,000
March	992,000	May	940,000

MIAMI COPPER CO., Miami, Ariz. 716,935 \$5 shares issued; \$22,000 in 6% bonds convertible at \$17 outstanding; controlled by General Development Co. (Lawson interests), 3000-ton mill at Miami; concentrate smelted at Cananea. Total in 1913, 33,944,795 pounds.

Month.	Pounds.	Month.	Pounds.
February	3,193,500	April	3,227,600
March	3,361,100	May	3,447,000

MOCTEZUMA COPPER CO., Nacozari, Sonora, Mexico. \$2,000,000, entire stock owned by Phelps Dodge & Co.; 2000-ton mill; concentrate smelted by Copper Queen. Total in 1913, 36,694,013 pounds.

Month.	Pounds.	Month.	Pounds.
February	2,642,543	April	2,654,976
March	2,882,881	May	2,834,616

MOHAWK MINING CO., Mohawk, Mich. \$2,500,000 in \$25 shares; controlled by Stanton interests; 3000-ton mill, Traverse bay; concentrate smelted by Michigan Smelting Co. Total in 1913, 8,616,000 pounds.

Month.	Pounds.	Month.	Pounds.
February	790,000	April	688,000
March	749,000	May	

MOUNT ELLIOTT, LIMITED., Cloncurry, Queensland. £750,000 in 150,000 shares of £5 each. During past fiscal year treated 41,633 tons for 10,373,440 lb. copper, 8757 oz. gold, and 7285 oz. silver.

Month.	Pounds.	Month.	Pounds.
February	875,840	April	806,100
March	842,240	May	732,480

MOUNT LYELL MINING & RAILWAY CO., LTD., Queenstown, Tasmania. 1,309,000 shares of £1 each. Operates an extensive copper property, two railways, blast-furnaces, converters, and three superphosphate works in Australia. During past fiscal half-year treated 165,594 tons for 7,705,600 lb. copper, 231,000 oz. silver, and 1500 oz. gold.

Month.	Pounds.	Month.	Pounds.
Feb. 18 to Mar. 18	1,243,200	Mar. 19 to Apr. 15	1,042,400

MOUNT MORGAN GOLD MINING CO., LIMITED. Operates a large gold and copper mine near Rockhampton, Queensland, a pyrite mine, iron and limestone quarries, a coal mine, concentrating plant being built, blast-furnace plant, and controls an electrolytic refinery at Port Kembla, New South Wales. During past half-year treated 152,016 tons for 9,741,960 lb. copper and 54,992 oz. gold.

Month.	Pounds.	Month.	Pounds.
Mar. 8 to April 5	1,147,040	May 3 to May 31	1,594,880

NEVADA CONSOLIDATED COPPER CO., Ely, Nevada, \$9,997,285 in \$5 shares; has absorbed the Cumberland-Ely Copper Co.; controlled by American Smelters Securities Co. through the Utah Copper Co., which owns half of the Nevada Con. stock; the Nevada company owns the Steptoe Valley Mining & Smelting Co., \$10,000,000; 16,000-ton mill and 1500-ton smelter at McGill, Nevada. Total in 1913, 64,972,829 pounds.

Month.	Pounds.	Month.	Pounds.
February	4,588,243	April	4,880,043
March	5,218,227	May	

NEVADA DOUGLAS COPPER CO., Mason, Nev. \$4,614,300 in \$5 shares, \$800,000 in 6% convertible bonds; controlled by A. J. Orem; ore smelted at Mason Valley smelter.

Month.	Pounds.	Month.	Pounds.
January 1914	409,733	February	387,287

OHIO COPPER CO., Bingham, Utah. \$7,554,350 in \$1 shares, \$1,246,000 in 6% convertible bonds; 3500-ton mill at Lark, Utah; concentrate smelted at Garfield.

Month.	Pounds.	Month.	Pounds.
February	599,394	April	629,400
March	616,129	May	

OLD DOMINION CO., Globe, Ariz. \$7,333,925 in \$25 shares. Controlled by Phelps Dodge & Co. Owns 155,353 of 162,000 \$25 shares of Old Dominion Copper Mining & Smelting Co., and all the \$2,300,000 stock of the United Globe Mines; 300-ton mill, 2400-ton smelter. Production figures include custom ore smelted. Total in 1913, 30,810,000 pounds.

Month.	Pounds.	Month.	Pounds.
February	2,066,000	April	2,779,000
March	2,997,000	May	3,303,000

OSCEOLA CONSOLIDATED MINING CO., Osceola, Mich. \$2,403,750 in \$25 shares; owned by Calumet & Hecla; 2 mills, 4000-ton capacity, at Torch Lake. Total in 1913, 11,325,010 pounds.

Month.	Pounds.
May	1,411,205

PHELPS, DODGE & CO., Inc. \$44,995,000 in \$100 shares; controlled by C. H. Dodge, James Douglas, and others; owns the Copper Queen, Moctezuma, Detroit, and Burro Mountain copper

companies, Stag Canon Fuel Co., indirectly controls Old Dominion, United Globe, and Commercial Copper Mining Co., members of the firm control the El Paso & Southwestern railway, and have large interests in the Rock Island and Great Northern railways. Production figures include all properties under its control and copper derived from custom ore, the latter ranging from 750,000 to 1,000,000 lb. per month. Total in 1913, 154,454,444 pounds.

Month.	Pounds.	Month.	Pounds.
February	11,444,123	April	12,008,825
March	12,493,651	May	13,228,353

QUINCY MINING CO., Hancock, Mich. \$2,750,000 in \$25 shares; controlled by W. R. Todd, 1500-ton mill at Mason, 340-ton smelter at Ripley. Reports only pounds of "inherent" containing 60 to 70% copper.

Month.	Pounds.	Month.	Pounds.
April	1,232,000	May	1,400,000

RAY CONSOLIDATED COPPER CO., Ray, Ariz. \$15,875,000 in \$10 shares; controlled by Sherwood Aldrich and C. M. MacNeill, 8000-ton mill at Hayden, Ariz.; concentrate smelted in A. S. & R. smelter adjoining. Total in 1913, 53,745,924 pounds.

Month.	Pounds.	Month.	Pounds.
February	5,600,000	April	6,277,693
March	6,223,617	May	

SHANNON COPPER CO., Metcalf, Ariz. \$3,000,000 in \$10 shares; controlled by N. L. Amster; 500-ton mill and 1000-ton smelter at Clifton. Total in 1913, 13,640,000 pounds.

Month.	Pounds.	Month.	Pounds.
February	994,000	April	1,012,000
March	1,082,000	May	1,056,000

SHATTUCK ARIZONA COPPER CO., Bisbee, Ariz. \$3,500,000 in \$10 shares; controlled by Duluth investors, ore smelted at Calumet & Arizona smelter. Total in 1913, 13,219,756 pounds.

Month.	Pounds.	Month.	Pounds.
February	1,134,480	April	1,336,594
March	1,136,458	May	1,353,043

SOUTH UTAH MINES & SMELTERS., Newhouse, Utah. \$4,300,000 in \$5 shares, \$1,300,000 in 6% convertible bonds; controlled by Samuel Newhouse; 1000-ton mill; concentrate smelted at Tooele, Utah. Total in 1913, 1,883,129 pounds.

Month.	Pounds.	Month.	Pounds.
February	344,200	April	255,390
March	406,381	May	

TAMARACK MINING CO., Calumet, Mich. \$1,500,000 in \$25 shares; owned by Calumet & Hecla; 2 mills, 3500-ton capacity, at Torch Lake. Total in 1913, 4,142,000 pounds.

Month.	Pounds.
May	149,835

TENNESSEE COPPER CO., Copperhill, Tenn. \$5,000,000 in \$25 shares; \$1,000,000 in first mortgage 6% gold bonds; controlled by Jas. Phillips, Jr., and associates. Total in 1913, 13,493,110 pounds.

Month.	Pounds.	Month.	Pounds.
February	1,232,812	April	1,370,800
March	1,262,184	May	1,336,950

UNITED STATES SMELTING, REFINING & MINING CO. \$24,313,700 in \$50 7% cumulative preferred shares; and \$17,553,700 common \$50 shares; copper production chiefly derived from its subsidiary, the Mammoth Copper Mining Co., Kennett, California.

Month.	Pounds.	Month.	Pounds.
February	1,629,902	April	1,850,000
March	1,814,200	May	1,750,000

UNITED VERDE COPPER CO., Jerome, Ariz. \$3,000,000 in \$10 shares; owned by W. A. Clark; 1000 to 1200-ton smelter at Clarkdale; monthly figures not given out, estimated at about 3,000,000 lb. Total in 1913, 37,750,000 pounds.

UTAH CONSOLIDATED MINES CO., Bingham, Utah. \$1,500,000 in \$5 shares; owns the Highland Boy Gold Mining Co. and 5000 shares of International Smelting & Refining Co. stock; ore smelted at Tooele. Total in 1913, 7,710,668 pounds.

UTAH COPPER CO., Bingham, Utah. \$15,826,000 in \$10 shares; owns half of Nevada Consolidated; controlled by A. S. & R. Co., Sherwood Aldrich, C. M. MacNeill, and W. B. Thompson; 2 mills, 20,000-ton capacity, at Garfield; concentrate smelted at Garfield plant of A. S. & R. Co. Total in 1913, 113,942,831 pounds.

Month.	Pounds.	Month.	Pounds.
February	9,492,898	April	13,132,463
March	12,704,200	May	

WOLVERINE COPPER MINING CO., Kearsarge, Mich. \$1,500,000 in \$25 shares; owns \$80,000 interest in Michigan Smelting Co.; controlled by J. R. Stanton; mill on Traverse bay treated 388,500 tons during last fiscal year. Total in 1913, 5,700,000 pounds.

Month.	Pounds.	Month.	Pounds.
March	628,000	May	415,000
April	590,000		

Recent Publications

ANALES DE INGENIERIA. ORGANQ DE LA SOCIEDAD COLOMBIANA DE INGENIEROS. Enrique Morales, director. P. 63. Ill. Bogata, Colombia. April 1914.

THE 'IARIRITE' IRON ORES OF BRAZIL. By E. C. Harder. Reprint from *Economic Geology*, March, 1914. P. 11. Illustrated. These ores were briefly described in this journal of January 4, July 19, and November 8, 1913. They occur at Minas Geraes, Brazil, and interests connected with the St. John del Rey Mining Co. will probably mine them at an opportune time.

U. S. Bureau of Mines publications, Washington, 1914:

FIRES IN LAKE SUPERIOR IRON MINES. By Edwin Higgins. Technical paper 59. P. 34. Illustrated.

GASES FOUND IN COAL MINES. By George A. Burrell and Frank M. Seibert. Miners' Circular 14. P. 23.

COAL-MINE FATALITIES IN THE UNITED STATES. March 1914. Compiled by Albert H. Fay. P. 12. There were 200 fatal accidents as against 202 in March of 1913.

DRILLING WELLS IN OKLAHOMA BY THE MUD-LADEN FLUID METHOD. By A. G. Heggen and J. A. Pollard. Technical paper 68, petroleum technology 15. P. 26. Ill.

MINE SIGNBOARDS. By Edwin Higgins and Edward Steidle. Technical paper 67. P. 15. Illustrated. A general discussion on these necessary adjuncts to underground and surface plant.

PROCEDURE FOR ESTABLISHING A LIST OF PERMISSIBLE PORTABLE ELECTRIC MINE LAMPS. Fees, character of tests, and conditions under which lamps will be tested. Schedule 6. P. 12.

PROBLEMS OF THE PETROLEUM INDUSTRY. Results of conferences at Pittsburgh, August 1 and September 10, 1913. By Irving C. Allen. Technical paper 72. Petroleum technology 17. P. 19.

ABSTRACTS OF CURRENT DECISIONS ON MINES AND MINING. By J. W. Thompson. Bulletin 79, law serial 2. P. 140. This is another publication which should be filed in mine libraries, as showing the litigation miners are likely to get into. This journal publishes important decisions every few weeks.

PHYSICAL AND CHEMICAL PROPERTIES OF THE PETROLEUMS OF CALIFORNIA. By Irving C. Allen, Walter A. Jacobs, A. S. Crossfield and R. R. Matthews. Technical paper 74. Petroleum technology 18. P. 38. Illustrated. Methods of sampling oil by the Bureau officials, refining, and tabulation of results are given, of value to oil men everywhere.

SAFETY AND EFFICIENCY IN MINE TUNNELING. By David W. Brunton and John A. Davis. Bulletin 57. P. 271. Ill., index. This is a valuable discussion and should be in the hands of all tunnel engineers, especially for comparative purposes. It covers American tunnels described in engineering magazines, causes of accidents (falls of roof and explosives), prevention of accidents, surface equipment for driving tunnels, power required, ventilation, drilling machines, underground haulage, drilling, blasting, costs of tunneling, history of tunneling, and rate of progress, and cost of railway tunnels. There is also a bibliography, and a well selected collection of illustrations.

MATERIALS FOR THE PALAEOLOGY OF NEW ZEALAND. By James Allan Thomson. Palaeontological Bulletin No. 1. P. 104. Maps, 6 plates, index. Geological Survey, Wellington, 1913. This publication has been prepared for officers of the Survey as a reference to New Zealand fossils; for the encouragement of palaeontological work among New Zealand geologists; and for the benefit of foreign palaeontologists. A great deal of the matter is tabulated.

Industrial Progress

AMERICAN VANADIUM Co., Pittsburgh, Pennsylvania. May issue of 'American Vanadium Facts' describes use of vanadium steel in locomotives, cranes, and automobile construction.

SWEETLAND FILTER PRESS Co., New York. Bulletin K describes the lever-operated type of the Sweetland self-dumping filter. The filter is of the pressure type and designed particularly for small plants.

THE CONNERSVILLE BLOWER Co., Connerville, Indiana, Bulletin No. 19 describes the Connerville valveless magna pump. Pumps supplied in either two or three lobe patterns to meet various requirements. Bulletin is fully illustrated.

THE MORSE BROTHERS MACHINERY & SUPPLY Co., Denver, furnish a stock list of machinery, including boilers, feed-water heaters, engines, motors, pumps, compressors, drills, hoists, crushers, stamps, power, and mill equipment.

TROPENAS CONVERTER Co., New York City, has issued a 50-page bulletin on the 'Manufacture of Steel Castings,' with a brief summary of bessemer and open-hearth methods of steel manufacture and a discussion of the Tropenas process are given. The bulletin is fully illustrated.

BUSCH-SULZER BROS. DIESEL ENGINE Co., of St. Louis, has closed an order for six 600-hp. engines for use in submarine boats being built by the Lake Torpedo Boat Co. for the United States Navy. Four of these engines will be used in two of the submarines being built by the Craig Shipbuilding Company.

AMERICAN CONCENTRATES Co., Springfield Ohio. Bulletin covers the 'New Century' disintegrating and washing screen. The screen is of the trommel type, revolving a tank of water. It is recommended by the Company for use in concrete work, sizing, and other uses. Is illustrated and contains data regarding performance.

FULTON IRON WORKS, St. Louis, Missouri, has for distribution Bulletin 'A', descriptive of the Fulton-Tosi oil-engines. The engine is of the Diesel type, built in the vertical form, and of two, three, and four cylinders. The engines are adapted to many power purposes, including electric light and power plants, water works, and the like.

SPRAGUE ELECTRIC WORKS of the General Electric Co., New York. Bulletin No. 905 contains information regarding Sprague electric hoists. The hoists described are designed to fill the gap between the hand chain block and the large traveling crane. These hoists and mono-rail cranes are adapted to many uses about industrial plants, which are mentioned in the bulletin.

COLORADO IRON WORKS Co., Denver. Catalogue 12-F, 'Some Details as to Smelting Practice and Equipments.' A book of 160 pages devoted to short descriptions of lead and copper smelting in which it is aimed to furnish sufficient information to those without previous knowledge of the process to understand the underlying principles and to render a discussion of smelting intelligible. Fully illustrated and indexed.

The Guiana-Callao Gold Mining Co., operating near Paramaribo, Dutch Guiana, South America, has given THE DENVER QUARTZ MILL & CRUSHER Co., of Denver, an order for a 50-ton Denver quartz mill for immediate shipment. The same kind of mill has been in use for the past year, and this repeat order is necessary to take care of the increased tonnage. With this additional mill, the capacity will be 100 tons per 24 hours. It is planned to still further increase the capacity of the mill to 200 tons per day.

"Science has no enemy save the ignorant."

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EDITORIAL

THE Administration seems to be under the impression that the mediators at Niagara Falls are merely members of Congress.

MOUNT LASSEN is in eruption and Californians are as proud as young married folk with a first baby. The presses are already busy on advertisements of the new scenic wonder, the "only active volcano in the States."

THE international character of the present psychological depression is well shown by the receipts of the Suez canal, which is a good index of trade. The traffic receipts of the canal showed a small but steady growth from 1910 to 1913; but a falling off of over 8 per cent last year.

SOME mines, like some men, have the gift of publicity, while others round out their existence in undisturbed obscurity. How many operators know, we wonder, that the Cordoba copper mine, in the south of Spain, has a monthly output greater than that of the Spassky; or that the Namqua mine, northwest of Cape Town, has a greater monthly output than the Wolverine.

TAXATION is always a tender subject that often evokes hard feelings. The Union of South Africa receives six-tenths of the profits of the Premier diamond mine, and the question has lately arisen as to whether the Government is entitled to levy an income tax on the remainder. As a result, the Botha ministry, which was seeking to impose the tax, has been defeated in the House of Assembly.

MINING lawyers who had followed the case were not greatly surprised that the United States Supreme Court found in favor of the Southern Pacific in the oil land suit brought by Burke. The only really new point decided was that oil is a mineral and therefore that known oil land is mineral land. That the Government alone has the right to question title, once patent has been issued, is not new, and that acceptance of classification by the Government at the time patent was issued was final, except on showing of fraud, is also old doctrine. In the cases still to be heard, and which are on suits brought by the Department of Justice, this question of fraud will be crucial. Incidentally there are technical questions of application of

the statute of limitations, but practically the point to be determined is whether Southern Pacific officials knew, and concealed their knowledge, that the lands in question were oil-bearing at the time they were claimed as non-mineral. This is a question of evidence.

CONTINUOUS operations are the aim of all good managers, and costs are usually lowered in proportion as demurrage is decreased. In this number, Mr. Huxley St. John Brooks lets his fancy play with the theoretical ideal, but practically unattainable, completely continuous gold mill. In a later number Mr. Maurice Summerhayes will give a detailed account of the good results actually obtained by the continuous process at the Porcupine Crown Mines in Ontario, where it has now been in operation long enough to make the study of results especially significant.

OIL MEN on the Pacific coast have become so used to big wells that even the Lakeview No. 2, flowing 30,000 barrels per day, has created little excitement. Elsewhere it is different, but then conditions differ too. All Japan was fluttering last month when the Nippon Oil Company brought in a 14,000-barrel well about 10 miles from Akita in the Echigo field. But then the total daily production of Japan had previously been but half that and the largest individual wells before had yielded but 300 or 400 barrels per day. American operators are interested in the new Japanese discovery because the Nippon Oil Company adopted the California rotary rig and took over a crew of drill men from this country two years ago, since when their results have been greatly improved. A big oilfield in the Orient would help all oil operators, since it would encourage more of the steamers to burn petroleum.

IN a recent editorial we mentioned the names of many of the prominent graduates of the School of Mines of Columbia University which recently celebrated its fiftieth anniversary. Through inadvertence we omitted four men who are not only among the foremost mining engineers, but also loyal supporters of their *alma mater*, Messrs. T. H. Leggett of the class of 1879; T. B. Stearns, 1881; George S. Rice, 1887; and R. M. Raymond, 1889. Many of the other graduates of the School of Mines have attained distinction in fields not directly concerned with mining, such as Messrs. Lenox Smith, '68; L. P. Gratacap, '76; Marcus Benjamin, and William Strieby, '78; N. L. Britton, Arthur Hollick, and R. E. Mayer, '79; C. A. Meissner, '80; Howard Van Sinderen, '81; F. B. Crocker, C. B. Going, and A. J. Moses, '82; D. E. Moran, W. Fellows Morgan, and C. E. Pellew, '84; I. H. Woolson, '85; E. J. Lederle, and A. M. Ryon, '86; L. McI. Luquer, '87; James Maclay, '88; E. W. Guiterman and H. P. Whitlock of the class of 1889. Other well known engineers whose names come to mind are Messrs. W. B. Potter, '69; Arthur F. Wendt, '72; J. T. Williams, '73; A. F. Schneider, '76; C. L. Constant, Ralph Nichols, and W. H. Radford, '77; R. E. Booraem, and Y. Hasegawa, '78;

G. S. Raymer, '81; C. Q. Payne, W. F. Staunton, and F. W. Traphagen, '82; J. H. Banks and W. H. Weed, '83; S. S. Fowler, Robert Mulford, Frederick Roeser, T. E. Snook, '84; H. L. Hollis, C. L. Miller, E. A. Wiltsee, and F. M. Watson, '85; H. D. Conant, A. W. Jenks, J. J. Ormsbee, and H. H. Porter, '86; E. Z. Burns, H. C. Mannheim, and F. M. Simonds, '87; J. S. Appleby, '88; and P. L. Fearn of the class of 1889. To name the men of the large classes since 1890 would make too serious inroads on our space.

Transitions in Copper Metallurgy

A decade ago it was clearly recognized by everyone that the growing use of copper for industrial purposes would make necessary a great increase in its production. It was equally evident that no great bodies of comparatively rich sulphides or native copper, such as until then had been the mainstay of the industry, were likely to be found. Universal attention was directed toward the large deposits of 'cupriferous pyrite,' as they were generally termed. Meanwhile a group of metallurgists, Messrs. L. T. Wright, W. H. Freeland, F. R. Carpenter, Robert Stiecht, Herbert Lang, and many others, had been busy developing the technique of the metallurgical operation of cheaply smelting ore consisting largely of pyrite, marcasite, or pyrrhotite. Nearly everyone regarded pyrite smelting without coke as the metallurgy *par excellence* of the immediate future.

Meanwhile an apparently small discovery had been made. 'Cupriferous pyrite' proved to be a figment of the imagination, the ores so designated being actually pyrite with chalcopyrite or it and other copper sulphides disseminated throughout them. It was further found that copper sulphides not infrequently occur disseminated through rock masses, chiefly igneous intrusives or the adjacent rocks, so as to form large bodies of low-grade ore. A second group of engineers, chief among whom was Mr. D. C. Jackling, saw the new possibilities which this opened. Cheap smelting of such material, silicious rock containing disseminated sulphides corresponding to a copper content of 25 to 50 pounds of copper per ton of ore, was out of the question, but if it could be cheaply mined and cheaply concentrated many tons into one, making a reasonable saving of the copper present, low-cost smelting would not be essential.

Thus two sharply contrasted methods of treatment are involved: on the one hand small-scale mining, the production of the ore in lump form, and the smelting of the whole mass, utilizing the heat of the sulphur present in order to economize in the use of fuel; and on the other hand large-scale mining, cheap crushing to small size, concentration (more than twenty tons being concentrated in one in some cases), roasting of the sulphide concentrate, and smelting in reverberatory furnaces. The success of the latter method hinges on the percentage of the copper present which

can be recovered by concentration. As is well known, careful large-scale experiments demonstrated that two-thirds of the copper present could be recovered by wet concentration. On the basis of a cost of 42 cents per ton for mining, 28 cents for transportation, and 41 cents for milling, and the concentration of nearly twenty tons into one, the whole operation can be conducted at a profit, even with material containing only 30 pounds of copper per ton. On this basis the relatively higher cost per ton of material smelted in the reverberatory furnace becomes of minor import in the total cost.

Several other factors contribute toward the increased and increasing favor with which reverberatory smelting is regarded. Mr. E. P. Mathewson has discussed with authority the causes which have led to this growth. Another factor, to which attention has been drawn by Mr. Lloyd, is the improvement in roasting practice. When the control of the temperature and air supply during roasting is faulty, a certain amount of ferric oxide and of ferrite of iron is produced, and additional reactions in the laboratory of the reverberatory are made necessary, thus decreasing the speed of smelting as compared with the treatment of material in which all the iron is present in the ferrous state. As a matter of practical operation, the use of liquid petroleum or powdered coal has cut down the fuel cost, and the use of boilers in the exit flues, by recovering the heat of the escaping gases and returning it to the power-plant as steam, has made a further important reduction. The reverberatory is a convenient place for disposing of the increased quantity of slag made by the converters since the addition of silicious ore to the matte charge became general practice. Above all, it handles without difficulty the finely divided concentrate which is the necessary product of the method of treatment mentioned above, and similarly disposes of the dust accumulations yielded by other departments of the plant, such as the roasters. The most recent phase of development is the use of flotation to recover the copper content of the ore. This makes even finer crushing necessary and accentuates the advantages of the reverberatory for the treatment of material in a fine state of comminution.

Blast-furnace smelting of lump ore has many advantages, which it can scarcely be necessary to mention, but is subject to the limitation that even under the most favorable conditions a considerable proportion of the ore will be of smaller size than desired. This may be sent directly to the blast-furnace, with the result that the speed of smelting is decreased, which amounts to increasing the overhead costs, and a large quantity of flue-dust is produced. This can be caught in dust-chambers, but if put back into the blast-furnace without further treatment, is merely blown out again in a sort of perpetual cycle. It may be agglomerated in brick presses, using a suitable binder, agglomerated by the use of converter slag, or sintered by one of the various processes. All the operations add to the total cost and somewhat complicate

the work of the plant. With the exception of the latest methods of sintering, they are all unsatisfactory, and the tendency of present practice all seems to be toward the extension of reverberatory smelting. In large plants coarse material is smelted in the blast-furnace while reverberatories take care of the blast-furnace flue-dust and the fine ore or concentrate. Where the amount of finely divided material is too small to justify the construction and operation of a reverberatory, the sintering of fine ore and flue-dust is an efficient way of meeting the problem. But where, as in the plant recently built at Hayden and the one now building at Globe, all the material to be smelted is finely divided, the reverberatory alone, coupled with the present very efficient roasting technique, serves to meet the situation.

Thus a decade of time bridges over three sets of problems in the metallurgy of copper. The readjustment of smelting problems which grew out of the exploitation of the disseminated copper ores has already been discussed. But, as always in human endeavor, the solving of any important problem merely leads up to the recognition of another. The financial profit resulting from the exploitation of the disseminated ores does not serve to obscure the fact that one-third of the copper content escapes recovery. In addition, large ore reserves of oxidized copper minerals are known to exist in various places, and these are not amenable to profitable treatment by any present method. The use of wet methods for the recovery of copper from its ores has been proposed ever since early times, and have been successfully practised in a few places where local conditions favor their use. Generally speaking, however, they are complicated and require a nice adjustment of mechanical equipment to chemical reactions. Except upon a large scale, they are, for general practice, an economic impossibility, but the readjustment of modern conditions seems to be tending toward a state of affairs where wet methods become feasible. The number of processes proposed is legion, but leaching with sulphuric acid is the rule in present work. The precipitation of the copper from the pregnant solution is a vital problem. It can be done by the use of metallic iron, or by electrolysis, but the difficulty is to attain a low cost. Both methods are about to be put into operation on a large scale, and in a year or two our knowledge will be more nearly complete than now. Sulphuric acid, either for leaching or for other methods of chemical attack, seems likely to remain the chief reagent; for the sulphuric content of the fume escaping from smelter stacks is everywhere a problem, and its utilization for the manufacture of sulphuric acid, some of which may be used in the treatment of oxidized or roasted sulphide ore, is likely to be one of the lines along which the copper metallurgy of tomorrow may develop. Thus along all three lines definite and notable progress is being made in the work of adding to the world's metal supply by utilizing lower and lower grade material already known and available.

Flotation Tests at Mt. Morgan

By WILLIAM MOTHERWELL •

The Mount Morgan gold mine in Queensland, Australia, which was discovered about 30 years ago, is believed to be the richest individual gold mine ever found, having produced over \$70,000,000 worth of gold to date, besides copper. In its early stage, the ore, which carried hundreds of ounces to the ton, was crushed with stamps and amalgamated, but the recovery was not especially good. Subsequently, and until seven years ago, all the ore was dry-crushed in ball-mills, roasted, and leached with chlorine solution in open brick vats and the gold precipitated on charcoal. At that time the copper content of the ore was negligible. This is one of the few large gold mines in the world that never had a cyanide plant.

About eight years ago, a large body of rather silicious cupriferous sulphide ore was found in the mine. Blast-furnaces were erected, and the less silicious ore, which contained about \$10 gold, 4% copper, and 45% silica, was, and still is, being smelted. The more silicious or so-called 'mundic' ore, carrying about \$15 gold and 1% copper, was then dry-crushed, roasted, leached with sulphuric acid, and copper precipitated on scrap iron, subsequently leached in the same vats with chlorine solution, and gold precipitated as before mentioned. About 18 months ago the gold content of this 'mundic' ore began to decrease, and the copper content to increase. For this and other reasons it was deemed advisable to cease this method of treatment, and the last of the chlorination works were shut down.

It now became necessary to find a profitable method of handling this class of ore. As iron-bearing flux has to be brought a long distance, and as the ore carries about 70% of insoluble, smelting would be too expensive. There is believed to be at least 2,500,000 tons* of this class of ore in the mine, assaying roughly \$6 gold and 2% copper. This is in addition to the so-called 'copper ore' which is being smelted. It may be explained that there is no 'carbonate zone' in this mine. All the copper is in the form of chalcopyrite. The gold is very fine.

Minerals Separation Experiments

A few years ago some experiments were made by crushing in ball-mills and concentrating on Wilfley tables, but they were not successful. Last year it was decided to make a thorough trial of the Minerals Separation process, and a small testing plant was erected in the laboratory. At the same time a full-sized experimental unit, capable of treating 300 to 400 tons per 24 hours, was erected in one of the abandoned chlorination plants. Both sets of experiments were carried out by the metallurgical staff of the Company. After they were finished, a representative of the Aus-

tralian branch of Minerals Separation, Ltd., paid a visit to the mine and conducted a few tests, which confirmed the results obtained by the mine staff.

As mentioned in the Company's annual report, these flotation experiments were successful, the extraction being higher and the costs lower than expected. The Company is now building the first unit of a plant to treat 1000 tons per 24 hours. The ore will be crushed by rock-breakers, Symons disc crushers, rolls, and tube-mills. It will then be concentrated on Wilfley tables, after which it will go through a second set of tube-mills, thence to the flotation machines. It is presumed that no royalty will be payable on the Wilfley concentrates. The concentrate will either be briquetted or sintered in a Dwight-Lloyd machine, and smelted in blast-furnaces along with the 'copper ore' and ironstone and limestone fluxes. The Company has no reverberatory furnaces.

Application of Flotation to Gold Ores

A flotation plant is being erected at the Falcon mine, Rhodesia, to treat ore containing gold and copper. With the exception of the Mt. Morgan, the Etheridge, and the Great Fitzroy mines, Queensland, I have not heard of the flotation process being used successfully to treat ore containing an appreciable amount of gold. The Elmore thick oil process was installed at the Lake View Consols gold mine, Kalgoorlie, several years ago, but was not successful, as the ore was not suitable, and unsuccessful experiments were made by Minerals Separation, Ltd., on ore from the Lancefield mine, Western Australia, which contains mispickel. The Elmore vacuum process was installed at the Cobarr gold mines, New South Wales, and at the New Ravenswood gold mines, Queensland. Both these mines contain copper in the form of sulphide, as well as gold, but the plants only ran a few weeks. I was informed that the plant at the former mine (where the ore contains about \$8 gold and 1.5% copper) gave a fair recovery of copper, but left too much gold in the tailing or left enough copper in the tailing to prevent profitable cyanidation of the gold.

To return to the Mt. Morgan mine, the laboratory apparatus had a capacity of one pound of ore at a time, and the results now being obtained in the experimental mill approximate closely those obtained in the laboratory. The object of concentration was, of course, to obtain a concentrate containing as much gold, copper, and iron, and as little silica as possible, commensurate with a good extraction of the gold, because it was found that the less silica the concentrate contained the poorer was the extraction of gold. It costs 13 cents to flux one unit of silica, and it was necessary to steer a middle course. Experiments made with

*The long ton, 2240 lb., is used throughout this article.

Sonstadt solution on ore from one part of the mine showed that clean quartz (after separation by specific gravity from all mineral) contained not less than \$1.50 gold per ton. In practice, of course, it is impossible to float all the mineral and sink all the gangue.

The agitator in the laboratory plant was at first run at 1100 r.p.m., but was afterward reduced to 800. Tests were made with pulps of different proportions, each separate pulp being agitated for the same length of time, that is, 6 minutes, and it was found that there was not much difference, in the extraction of gold and copper, between a pulp containing three parts solution to one of ore, and a pulp containing seven parts solution to one of ore. A pulp of 1 to 1 was too thick and gave poor results. In practice, the thinner the pulp the smaller the capacity of the flotation machine. Tests were also made to ascertain the effect of agitating for different lengths of time. Two tests were made in the laboratory of which I have a note: one for 10 minutes and one for 15 minutes. The ore contained \$6.50 gold and 2% copper; 12% of this sample would remain on a 60-mesh screen. The first one gave a concentrate containing \$22.70, 9.4% copper, and 18% insoluble, with an extraction of 51% of the gold and 84.5% of copper. The second gave a concentrate containing \$20.20 gold, 7.8% copper, and 27% insoluble, with an extraction of 64.5% of gold and 91.8% copper. The gold left in the tailing was probably in the gangue, as the extraction was poorer than usual. As a rule, the longer agitation and separation are continued, the more silicious the concentrate is. In practice, the length of treatment is regulated by the thickness of pulp and the number of boxes in the flotation machine. Tests made to ascertain to what degree fine crushing was necessary showed emphatically that the ore must all pass through a screen of 60 holes to the linear inch if a good extraction is to be obtained, and that the finer it was crushed, at any rate up to -120 mesh, the better the extraction was. Tests showed that when using eucalyptus oil there was no advantage in using an acid solution, but that, on the other hand, slight acidity did no harm. Much of the copper pyrite in the ore readily floats on water without any previous agitation. On treating ore containing \$25 gold direct by agitation and flotation, without amalgamating or concentrating on tables, it was proved that fine free gold can be floated by using eucalyptus oil.

Use of Essential Oils

Many oils were tested, and, generally speaking, it was found that only essential oils gave a coherent froth and good extraction, other oils like petroleum, oleic acid, and lubricating oils tending to form granules which sank. The best results were obtained from eucalyptus, closely followed by 'Essential C' and *Pinus laurus vulgaris*. Oleic acid, which was used for years at Broken Hill on zinc ore with hot solution, and gave good results when tried on this ore with neutral and acid solutions, gave an enormous froth and floated

most of the silica. A mixture containing 95% of eucalyptus and only 5% of oleic acid gave a concentrate containing 47% silica, showing the power of the oleic to float silica. Experiments were afterward made with a mixture of oils, and one combination (known as Mt. Morgan mixture) was found to give a better extraction of both gold and copper than any of the individual oils, and at less expense. When the sample was all crushed to pass 80 mesh, an extraction of 80% of the gold and 90% of the copper could be obtained every time, with a concentrate containing about 25% insoluble, which can be reduced to 10% by re-treatment. Hot solutions and a solution containing 1% of common salt were found to be detrimental to good recoveries.

Recovery by Flotation

A test on a sample, crushed to pass a screen of 120 holes per linear inch, containing \$37 gold and 4.8% copper, gave a recovery by flotation alone of 90% of the gold and 98.5% of the copper, but left \$8 gold in the tailing. The concentrate carried 44% insoluble matter, which could be reduced by re-treatment. A different oil (eucalyptus) would have given a poorer recovery and a cleaner concentrate.

Tests made on ore containing \$9 gold, 3.5% copper, and 45% insoluble, showed that after crushing to pass 60 mesh and treating by direct flotation, an extraction of 82% of the gold and 96% of the copper could be obtained, with a concentrate containing only 21% insoluble. No doubt with finer crushing even better recoveries would be had. These results leave tables and vanners far behind. It was found decidedly advantageous to re-use the solutions.

A Wilfey table was erected in the mill, some tests made, and the tailing treated by flotation in the laboratory. Sometimes these tailing samples were dried before flotation, and sometimes they were not. It was invariably found that a better extraction was obtained from those which had not been dried, as no matter how carefully the operation was conducted, some of the iron pyrite got sufficiently oxidized to resist flotation, and it carried some of the gold.

In some of the tests the crushed ore was concentrated by panning in the laboratory, and afterward subjected to flotation. In this case the water in the laboratory was used, which did not come from the same source as the water used in the mill. It was noticed that the longer the sample was allowed to remain in the water after panning, the worse the subsequent flotation was. For example, where flotation took place immediately after vanning, the residue assayed \$2.60 gold and 0.30% copper, but where tailing from panning was allowed to remain under water for 6 hours before flotation, the residue assayed \$3.10 gold and 0.67% copper. An analysis of this water was made, and this incident shows what might happen in a mill where the ore is in contact with bad water for some hours before reaching the flotation machine, such as the time it is going through rolls, Chilean

mills, tube-mills, and classifiers, over tables and through thickening devices, and perhaps through secondary tube-mills. The water in question was neutral, both before and after coming in contact with the ore.

Some tests were made both in mill and laboratory in which air was drawn into the agitation boxes through pipes fixed vertically in the corner with the top open to the air and the bottom ending in a bent pipe terminating under the impeller of the agitator. No improvement was, however, noticeable.

Grading tests were conducted on crude ore and flotation products. They showed that as regards crude ore, after crushing either in mill or laboratory, the finest grade of concentrate was the richest and the coarsest grade of tailing was richest, both in gold and copper. The fact that the finest grade of tailing was the poorest shows that this process will float the finest sulphides successfully.

Crushing Plant

In the experimental mill the ore is crushed in rock-breakers and Krupp dry-crushing ball-mills without drying. This plant was formerly used to crush oxidized ore for chlorination and, being on the spot, it was naturally utilized in preference to buying new machinery. The crushed ore drops into a bin at the bottom of which are two Challenge feeders. These deliver the ore into a launder where it is met by a stream of water which carries it direct to a six-compartment Minerals Separation machine. Each spindle is driven by a half-crossed belt, thus eliminating the noise and grease incidental to the old Broken Hill method of gearing. The machine is of the Hoover single-level type, by which one man can attend to all the flotation boxes. The concentrate was collected at first in circular wooden vats with filter-bottoms of coco matting, and later in shallow rectangular concrete tanks which formed part of the old chlorination works. The whole plant is extremely simple and requires very few men to run it. It has not been found practicable to use a screen finer than 35 mesh on the ball-mills. It is found that the gold, copper, and iron contents are greatest in the concentrate overflowing from No. 1 box and that they gradually decrease until No. 6 is reached, while the silica content increases from 10% in the concentrate from No. 1 box to about 50% in that from No. 6. About 56 hp. is required to drive the agitators at 350 revolutions per minute.

As it is intended to use Wilfley tables in the new mill to assist in recovering the iron pyrite in the ore for fluxing and other purposes, two of these machines were placed in the experimental mill and some tests made to find out what results may be expected of them. Taking an average of several tests on ore from different parts of the mine, the grading of the 'table feed' was as follows: 10% remained on 60 mesh, and 19% passed through 60 but remained on 120 mesh. It contained \$4.50 gold, 1.8% copper, 9% iron, and 76% insoluble. The concentrate assayed \$17 gold, 2.9% copper, 34% iron, and 18% insoluble; the recover-

ies were 33% of the gold, 13% of the copper, and 38% of the iron. No doubt, had the pulp been classified and the fine material passed over slime tables or vanners, better results would have been obtained, but the Company does not intend to use mechanical concentrators for the slime, preferring to rely on the flotation process, so it was not worth while experimenting with them.

During the flotation experiments with eucalyptus oils some tailing was produced which contained a fair amount of gold, and attempts were made to recover some of this by amalgamating and cyaniding. It was found that no extraction by amalgamation was possible, nor was any extraction by cyaniding possible without either roasting or finer grinding. On unroasted tailing assaying \$3 gold and 0.44% copper, after crushing to pass 120 mesh, separating the slime, and leaching the sand for 9 days, an extraction of only 60c. per ton was obtained with a consumption of 3.6 lb. of cyanide per ton. On a different tailing crushed to pass 80 mesh, which after slime was separated assayed \$2.90 gold and 0.30% copper, an extraction of \$1 was obtained in 5 days with a consumption of 2 lb. of cyanide.

Samples of slime were treated by agitation and washed by decantation, and gave slightly better extractions, but the consumption of cyanide went up to 6 or 7 lb. The strength of solution used in these tests was 0.10% KCN. It should perhaps be noted that all samples of flotation tailing had been dried before being tested by the flotation process.

Effect of Roasting

Two samples of sand from tailing were roasted and treated by percolation. The value was \$3. The roasting reduced the sulphur to 0.5%. Although the copper and iron were oxidized by roasting, the consumption of KCN was less than in treating the unroasted tailing, which was contrary to expectation. With three days treatment, the residue was reduced to \$1 per ton, and about one-third pound of copper was dissolved from each ton of tailing by the cyanide. The consumption of cyanide was 1.4 lb. per ton, so that the extraction was higher and the loss of cyanide less than in treating unroasted tailing. Speaking from memory, I think that attempts to regenerate the cyanide in solution by means of sulphuric acid and lime were not very successful. The solution contained 0.05 gram copper per litre.

These cyaniding tests were merely done for information, as it is not expected that the tailing from the new mill will be profitable for cyaniding. The subject of extracting gold from flotation tailing arose a few years ago at the Cobar gold mines, as already mentioned, but in that case the difficulty was overcome by selling the mine, which contained highly silicious ore, to a company which owned a smelter, and had, or thought it had, plenty of basic ore for flux. Unfortunately, the amount had been overestimated and the problem is still unsolved—but that is another story.

Sinking Through Sand in the Lake Superior Region

By P. B. McDONALD

The various troubles caused by quicksand overburdens at iron mines in Michigan and Minnesota sound like exaggerations to men accustomed only to hard-rock practice. In recent years iron ore deposits, which formerly seemed impossible to mine at a profit, have been worked on a large scale by the aid of expensive development work. The easily mined orebodies, and particularly outcrop bodies, were mined in early days, but present operations include diamond-drill prospecting followed by elaborate construction work and costly preparation for extracting large tonnages at low costs. The depth of the sand and glacial drift overburden is surprising, being often over 100 ft., frequent-

an exceptionally large boiler plant and powerful sinking pumps, and found that there was no use for them. The most popular method has been the drop-shaft in its several variations. According to one method, the whole timber structure is dropped as digging proceeds, in which case the heavy timber sets may be added to at the top, with perhaps additional heavy weights of iron or sand to force the structure down. If the ground penetrated before the quicksand is reached, is stiff or contains boulders, the timber structure may get stuck on one side, requiring a blast to free it. Usually the cutting-shoe at the bottom is covered with steel plate and pointed, but when it has seen a little service it may be turned back, twisted, and bent out of all recognition. Another modification of the drop-shaft method requires only a short section at the bottom which drops. If necessary, this is forced down by jackscrews, and then at every foot gained, a solid 12-in. timber is put in all around. (See Fig. 1.) The timbers may be bolted together and interior bracing in the shaft may be necessary to strengthen the structure.

Labor Requirements

The men who work at sinking should be quick and resourceful. Sometimes the timber structure will buckle or twist out of all shape before the miners can brace it. Or the sand may start to run and cave in a regular flood, filling the shaft perhaps 25 ft.; in such a case the miners should be good ladder climbers. Economy depends, of course, upon having as little sand to hoist or pump as possible; thus the work must be slow and cautious. After the shaft has filled by a flood, the water is slowly pumped out, and the sand shoveled and hoisted. If the sand rushes are not too serious, they may be encouraged frequently, rather than waiting for big ones to occur which may wreck the timbering.

Many mines on the Mesabi and in Michigan have trouble with sand in their drifts and stopes, where the ore lies under the sand, and the operators want to get all the ore they can without causing a run of sand. One mine at Negaunee, Michigan, has a sand-run every little while, which occasionally catches miners and stops operations for a day or two, if not longer. It sometimes happens that a miner is killed in this manner.

The first shaft in a low district of thick overburden will tend to drain the entire vicinity, and the water in the neighboring lakes may commence to go down. Under such conditions the mining company will probably contract for a concrete drop-shaft sunk by the caisson method. In spite of the high price of such work (generally reported to be \$500 per foot) this plan has advantages since the shaft is usually completed in a few

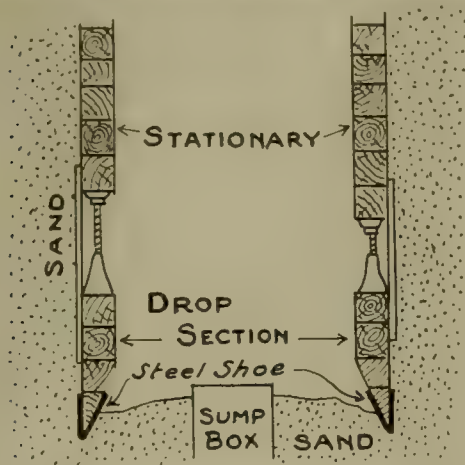


FIG. 1. SHAFT-SINKING WITH DROP SECTION.

ly over 200 ft., and occasionally 300 ft. If a company has proved by churn and diamond-drilling 2,000,000 tons of iron ore and then stopped exploration, since that quantity insures sufficient ore for a first-class plant, it is usually in a hurry to sink a shaft and see what more there is, as well as desirous to see returns from the investment. In several such instances the quicksand and water difficulties delayed progress for a year or two and caused tremendous expenditures even to get the shaft to bedrock, perhaps 150 ft. At one or two properties, foreman after foreman failed, until finally a particularly ingenious or persevering 'mine captain' succeeded.

All sorts of expedients have been tried; using hay or straw to hold the sand back, first sinking a small auxiliary shaft for pumping, and even the freezing process was tried. In some cases so much pumping was done that it seemed the whole locality would be pumped away, and a great pit grew around the timbered shaft. On the other hand, a company, anticipating trouble from quicksand and water, installed

months and is practically water-tight, sealed to bed-rock, and ready to commence sinking in rock. The Foundation Company does not pump water, but holds it back by compressed air. Thus, when the mining company begins sinking in rock, it may have trouble in the first few feet due to water, the iron ore being essentially an oxidized formation, and water gets through it easily. The most troublesome part of the caisson work is generally at bedrock, because sand and pebbles may grade into hardpan and broken 'ledge' so gradually that it may be thought bedrock has been struck when it is in reality not solid enough to warrant sealing. That is where the Foundation Company has trouble, and where the cost per foot may be several thousand dollars. The contractors sometimes lose money, as is believed to have been the case at the Morton shaft on the Mesabi where a huge sphere of concrete was rolled on the concrete drop-shaft to force it down. The caisson method is good for quicksand, but after penetrating a stratum of quicksand if a hardpan or stiff clay stratum is cut, the work goes very slowly. The 'sand-hogs' can dig only intermittently and the shaft will refuse to drop from friction on its sides.

The final pressure of air used at the Rogers shaft near Iron River was about 45 lb. per sq. in., which is not far from the limit of human endurance; each man worked two 40-minute shifts per day. Men are required to be in fair health, to have a good heart and digestion, and not to be drinking, to go into compressed air. It is not dangerous to an ordinary individual, although some people get in the air-lock and when the air is turned on, decide that their constitution is not good and ask to be let out. The feeling is similar to that of being under water, and the voice sounds similar when talk is attempted. Due to the compressed air, candles several inches in diameter are necessary and even these burn very fast. Care should be taken not to allow the clothes to catch fire, as they will burn as though soaked in oil. In entering the caisson, several minutes are taken in the air-lock where the ordinary man holds his nose and blows into his ears by puffing his cheeks out; a foreman who goes in and out a half dozen times a day may just rub his hand across his nose a couple of times. Before going in, you can test the tubes between your ears and your mouth, by holding your nose and forcing air into your ears until each one 'clicks', showing that the pressure is greater on the inside than on the outside of your ear drum. In the air-lock, as the compressed air gets into your system, the pressure on the inside of your eardrums becomes the same as on the outside; it is only at first that it is greater on the outside. That most painful affliction the 'bends' or its worse form 'paralysis', which is due to coming through the air-lock too quickly on the way out, is said to be caused by bubbles of compressed air in the blood, which should have been given time to work out by the lungs and skin when in the air-lock. 'Bends' in the arms is

common, paralysis in the legs is worse, and when attacked in the muscles of the stomach one generally asks a bystander to kindly hit him on the head with an axe. Men with the 'bends' are taken into a hospital-lock, a steel cylinder where compressed air can be turned on and then allowed to escape very slowly. The 'sand hogs' drink warm coffee before going down.

The work of 'sand-hogs' at the bottom of a shaft is merely to pick and shovel; the dirt is hoisted out in a bucket. A dozen men will work a shift in broken bed-rock or in hard pan, and scarcely any difference can be seen; perhaps a couple of buckets will be sent up. Man's strength seems greatly diminished in the high air pressure. To keep the compressed air from escaping through the sand, a layer of clay is sometimes plastered around the bottom of the steel shoe. In spite of that, bubbles will frequently be seen coming out of the ground a hundred feet from the shaft. It usually keeps an air compressor or two busy supplying the pressure for the caisson, as the air leaks out through the sand and the walls of the caisson. The air is let out of the caisson when it is necessary to let the concrete shaft drop down the distance that has been excavated, perhaps a couple of feet; otherwise the air pressure holds the shaft up. Of course, the men are out when this is done, as the water floods in and has to be blown out.

Prospecting for the precious metals has been intermittently carried on for many years in Yell county and elsewhere in Arkansas, and last March reports were received by the U. S. Geological Survey that several rich prospects had been located. G. S. Rogers, a geologist of the Survey, was immediately detailed to investigate these reports, and by taking reliable samples for assay, he determined the probable importance of the find. His report indicates that none of the prospects are of economic importance, and that while small pockets of ore may possibly be found in this region, there is little chance of developing a mine.

Small sizes of anthracite coal, such as buckwheat and smaller, now sold in competition with bituminous coal and at prices below the actual cost of production, may, in the opinion of E. W. Parker, of the U. S. Geological Survey, become more valuable as raw material for the briquette manufacturer. The output of these small sizes produced by crushing large coal to obtain the domestic grades exceeds 20,000,000 long tons annually, exclusive of 3,000,000 to 4,000,000 tons annually recovered from culm banks by washeries.

Coal imports into Argentina in 1913 totaled 4,046,278 metric tons. Imports by countries were as follows in 1912 (latest figures available): from Germany, 56,450; United Kingdom, 3,499,989; United States, 115,901; other countries, 35,616; total 3,707,956. Bituminous coal from the United States in 1913 amounted to 279,993 tons, valued at \$890,247.

The Chilean Nitrate Industry—III

By LESTER W. STRAUSS

The labor question on the nitrate fields has been a serious factor in the production of salitre. Shortage of labor means less output and higher wages, and causes less effort on the part of those employed. The men employed are Chileans, Bolivians, and Peruvians. About 54,000 peones are required in the industry. In 1912, 47,800 were employed, averaging 54 tons salitre per man per year. There is a continual movement, or migration, of the men; within the past two years practically all of the Peruvians (only found in the province of Tarapaca) have returned to their native soil—a result of misguided persecution. The Bolivians are returning to their homes lured by the increasing wages in the tin mines. The Chileans (from southern Chile), obtained in the *enganching* system (hiring through advancements made in wages), are attracted by the higher wage which prevails on the nitrate fields as compared with that at home. As the railroad construction (especially the Longitudinal railroad) is practically finished, more men should be available. The rate of wages varies from 5 pesos (\$1.10) to 7 pesos (\$1.54) per day.

The laborer is brought to the province and his fare is paid. On the field he can hire himself out wherever he chooses; no deduction is made from his wages to pay expenses and no contract is made. The expenses of his family are also paid and every inducement is made to keep him from returning southward. The *enganching* organization has a fund of 200,000 pesos (\$44,000) cash invested in advances.

Nitrate Propaganda Association

The Nitrate Propagation Association (Asociación Salitrera de Propaganda) was formed in Iquique (and later, 1896, legalized by Congress), as a separate organization from the combination of the several nitrate companies, to limit production and sustain prices. These limitation endeavors, started in 1884, were in general disastrous as prices fluctuated beyond their control. The Association keeps statistics in which are recorded the transfer of properties, names of new properties, sales and changes of oficinas, besides the figures of production, exportation, and consumption of salitre, record of the meetings held and all information for the good of the cause, especially the progress made in the consumption of the artificially made fertilizers, and advertises the benefits of its products abroad. Offices have been opened in the principal nitrate consuming countries, and considerable activity is displayed in this propaganda.

The board is composed of seven members from the Tarapaca fields, two from Tocopilla, three from Antofagasta, and two from the Taltal districts. The Association is sustained by the income resulting from the $\frac{3}{8}$ d. ($\frac{3}{4}$ c.) collected per quintal exported. This was originally $\frac{1}{8}$ d. ($\frac{1}{4}$ c.). Due to excessive production,

large stocks abroad, speculations, and the fact that a detrimental amount of perchlorate of potash (so harmful to vegetation) was found in some of the salitre, the price fell to 4s.6 $\frac{1}{2}$ d., in April 1898. This was record bottom price and caused the worst panic ever experienced in the industry. Two later attempts to sustain prices failed severely, so that at present the Nitrate Propagation Association directorate manages the combination, whose upkeep is sustained by another $\frac{1}{8}$ d. charged per quintal exported.

Production Statistics

According to the quarterly circular of the Asociación Salitrera de Propaganda, there were 158 oficinas registered in 1911, of which only 111 exported, these shipping 53,250,327 quintals. In 1912 there were 170 oficinas, but only 126 exported, these shipping 54,197,439 quintals. The exports from the various ports for 1911 and 1912 are given below in quintals.

	1911.	1912.	Oficinas 1912.	
			Total.	Producting.
Pisagua	2,917,881	2,391,282	...	...
Junin	1,806,961	1,806,961	...	...
Caleta Buena	5,693,165	5,543,030	...	...
Iquique	11,831,273	12,993,761	...	...
Total from Tarapaca.....	22,249,280	22,724,223	99	74
Tocopilla	7,440,189	6,188,023	10	10
Mejillones	7,694,606	7,539,235	29	21
Antofagasta	6,759,701	8,119,096		
Caleta Coloso	3,125,436	3,130,773	14	8
Taltal	5,981,115	6,496,099	18	13
Total from Antofagasta.....	31,001,047	31,473,223	170	126
Total exported	53,250,327	54,197,439		

Nitrate ground is not obtainable by the usual methods of denouncement. Every year certain areas are advertised for sale, by auction, at a minimum bid price of a certain number of centavos (of the gold peso of 18d. (36c.) per quintal (metric) of salitre producible, the highest bidder obtains the tract offered. The ground has been previously reported on by government engineers, who state a minimum production of a certain number of million (metric) quintals of salitre possible. With this as a basis, and taking into consideration the economic situation of the property as regards railroad facilities and more especially water supply, the price per metric quintal of salitre recoverable is arrived at. The yearly auctions are limited to properties not having a greater total output than 14,000,000 metric quintals (that is, 220.46 lb. each) of nitrate, and to be made up in lots of over 7,000,000 quintals 'output capacity'; where the ground does not permit of this minimum, less may be offered. The transfer of title is under the responsibility of the state.

Entry to the bidding must be accompanied by a deposit, to the order of the Director of the Treasury, for an amount equal to 10% of the minimum price. This deposit is presumably returned to the non-successful bidders. The deeds of sale must be signed within 30 days after the day of sale, and the balance of the sale price then paid in first-class 90 days drafts on London, failure to appear within the time specified, or if the time set is ignored, means the forfeiture of the deposit. The state does not hold itself responsible for the quantity of nitrate said to exist in the ground on the statement, and plans, of the Delegación Fiscal de Salitreras. The date of the auction is published in the newspapers of Santiago, Valparaíso, and Iquique, and abroad in London, New York, Paris, Berlin, and Hamburg. The Government donates money, from time to time, for works beneficial to the industry. For example, it gave 3,800,000 pesos of 18d. gold, or \$1,378,000, for a water line for Iquique, and grants a subsidy to the Nitrate Association (begun in 1906 with £30,000) of £40,000 yearly, which will probably be increased to £50,000 in view of the heavy expenses incurred by the Association abroad. It has been stated that the Government has received as revenue, from the export tax, more than three-fold the amount distributed as dividends to the various nitrate companies, but has contributed less than one-third of the money spent in propaganda. In 1912 the contribution per quintal exported (46 kg.) was raised from 5s. to 3d. (about £85,000 being received in 1912 from the salitre exported); but this increase (between £14,000 to £15,000) is still insufficient to permit extending the propaganda on the scale deemed advisable and necessary. The total amount contributed by the industry from 1891 to 1913 is stated as £730,727 13s.3d.; the Government has contributed £354,726 7s.4d. during the same period. It is interesting to note the comparison, for 1910, of the sum spent for propaganda by the Potash Syndicate and that for the Salitreras account:

	Value.	Propaganda.
Potash Syndicate	£ 5,000,000	£150,000
Salitreras	22,500,000	100,000

Ammonium Sulphate Competition

With respect to ammonium sulphate, the prices, based on the unit of nitrogen, are practically equal, nitrate being slightly cheaper, but the difference in the amounts of propaganda money spent is considerable. In 1911 salitre averaged £9 17s.11d. per ton and ammonium sulphate £13 15s.3d. The Nitrate Association is straining every effort to keep out competition from ammonium sulphate, its most important rival, and the other artificial nitrogen products, including the calcium nitrate made in Norway. In endeavoring to centralize the selling, and to keep prices fairly fixed, the Association is displaying a financial foresight which must bring about gratifying results.

The well arranged and amply tabulated statistics, issued tri-monthly, show practically every country on the globe a consumer of salitre. Below are given the

principal consuming countries, in order of their respective consumption of Chilean salitre for 1911 and 1912, in quintals.

	1911.	1912.
Germany	16,154,100	19,816,650
United States:		
East coast	11,147,963	8,388,000
West coast	1,116,552	1,195,811
France	7,359,975	7,703,550
Belgium	6,601,050	6,732,225
Holland	3,143,250	3,931,425
England	2,007,000	2,196,450
Italy	1,165,050	967,950
Scotland	881,550	789,525
Spain	195,075	294,525
Austro-Hungary	114,750	154,575
Denmark	74,700	104,850
Sweden	51,525	112,950
	50,093,440	52,388,486
Other countries	2,011,093	2,550,151
Chile	76,944	51,467
Total	52,181,477	54,990,104

Stock on hand (in the various foreign ports)	36,823,212	35,204,913
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American Consumption

The United States agricultural industry is said to consume over \$150,000,000 of fertilizing material annually. Voorhes has stated that its yearly consumption of nitrate might reach 2,000,000 tons (metric) (43,500,000 quintals, 46 kg.) if 10 lb. was used per acre of ground cultivatable. This appears a low estimate of the amount actually required per acre.

The highest price that nitrate sold for, on the coast, was 9s.6d. (\$2.28) per quintal; the low mark (in 1898) was 4s.6½d. (\$1.08). The average for December 1913 was 7s.11.78d. (\$1.92). The quotations refer to duty paid, immediate delivery alongside ship.

The approximate life of the nitrate fields has been estimated with wide ranges of possible existence. Several years ago, 20 to 50 years, allowing for increasing consumption, was suggested, but this is too low an estimate. Later critics (in 1907) suggested 88 years for the supply known to exist at that time, not allowing for a large area that was predicted to exist but not yet discovered. Investigations made by government engineers, of known and prospected ground, give the following quantities, in quintals or 46 kg.:

Tarapaca	725,300,000
Toco (Tocopilla)	614,925,000
Antofagasta	714,184,000
Aguas Blancas	1,083,032,000
Taltal	2,087,603,000
Chañaral and Copiapo	183,700,000

Total 5,408,744,000
Nearly 249,000,000 metric tons.

The present tonnage has also been estimated in the

	Metric tons.
Province of Tarapaca	35,000,000
Province of Antofagasta	185,000,000
Total	220,000,000

Making allowance for a yearly increase of consumption of 1,000,000 quintals (46 kg.), the above figures indicate 60 years as the probable life. It must be noted that there are several factors which would augment the life of the industry, and therefore make the present day prognostications doubtful figures. Reduction of the 28d. export tax would render available much ground that cannot be opened up under the existing duty, which is a heavy item in the selling cost; if the Centralization Committee can effect a fixed price agreement, or if higher prices prevail, ground of doubtful value might be exploited and thus additional area thrown open. Improvement of the present working methods, as regards mining and treatment, would make additional tracts, at present too low grade, available. The tonnage tied up in abandoned workings, and old tailing, or residue dumps naturally falls into the latter category. There is no doubt that any or all of the above changes can be reasonably effected and in turn result in prolonged life to the industry. These innovations will come soon. The nitrate business is in a transition stage, and the next two years will see marked changes. Considerable experimenting is being done in treatment schemes to increase extraction and lower expenses.

There is good reason to believe that the industry has not reached its maximum: it will naturally be affected by rise and fall in prices, as without a combination among the producers, it is the low-cost producing oficinas that must survive, by reason of large production, with the fluctuating selling prices.

Average Prices

Approximate half-yearly average prices for immediate delivery of salitre (alongside), duty paid, per quintal (101.4 lb.) are as follows:

	First six months:			Second six months:		
	s.	d.	\$	s.	d.	\$
1900	4	11½	1.19	5	6	1.32
1901	6	3¼	1.46	6	7¼	1.59
1902	6	7	1.58	6	5¾	1.56
1903	6	5	1.54	6	11½	1.66
1904	6	9¼	1.63	7	10	1.88
1905	7	6½	1.81	7	8	1.84
1906	7	11¼	1.91	8	10	2.12
1907	8	7	2.06	8	8	2.08
1908	7	10¼	1.89	7	6	1.80
1909	6	10¾	1.65	6	9¾	1.64
1910	6	6¾	1.58	7	1¼	1.70
1911	7	1¾	1.71	7	6¾	1.81
1912	7	6¼	1.81	8	6¼	2.04
1913	8	3¼	1.94	7	9½	1.87

The average selling price in London for 1912 was 10.014s. (\$2.40); the sea freights fluctuated from 19s. in January to 29.75s. in October; the average for the year was 26.27s. per ton (\$6.30).

The foregoing descriptions have been based on notes taken in November 1909 at Agua Santa, and the generous information given and suggestions made by J. T. Humberstone, resident manager at Agua Santa, also data supplied by A. F. Syers-Jones, resident manager

in Iquique, and C. C. Aitken, manager at Caleta Buena, of the Agua Santa Nitrate & Railway Co.; also private communications and suggestions from S. H. Loran, of Valparaiso. The tri-monthly circulars of the Nitrate Association Propaganda have been freely drawn upon for the statistical data and general information of the industry. The works of Samper and Michels (1903), later (in 1907) translated into Spanish by Gandarillos and Chigliotti, and Darapsky's 'Das Department Taltal' form excellent reference books on the subject.

The annual statistics for 1912, published by the Bureau Central de Estadistica, states that the value of the metallic and non-metallic production in the country was 372,667,774 pesos of 18d. (\$134,158,599). The value of the nitrate produced was 297,372,750 pesos of 18d. (\$107,054,190), which represented nearly 80% of the total valuation given. The Chilean peso (paper) fluctuated rapidly. In 1913 the exchange varied from (high) 10.2d. in January to (low) 9.27d. in November; the average was 9.78d. (\$0.196). It has been taken at 11d. in this paper. A pound (£1) has been taken equal to \$4.80.

Curtailement of Production

In August 1913 there was a movement on to restrict production and thus prevent a further drop in the low price (7s.6d. alongside, \$1.80, duty paid, immediate delivery). This step had been suggested so as to bring about better prices. The rate of production for the first six months has been equivalent to 60,000,000 quintals per year. A restriction of 10%, which was then decided upon, was expected to bring up the selling price the desired 6d. per quintal. In fact the price came up 5.78d. It would seem feasible, on the part of the Government, to arrange a sliding scale for the export tax (below 28d. when prices are below a certain quotation, and continuing in a decreasing proportion as prices decline) that would give the producers more margin when prices abroad make operating expenses show a loss. In 1913, from January 1, prices declined from 8s.3d. to 7s.6.67d. in July, then rising but suffering a decline in November. The average for December was 7s.7.78d. In view of the competition with the artificial fertilizers it behooves the Government to exert considerable effort to aid the propaganda, so that Chilean salitre can retain its present position in the world's products.

The following figures are of interesting comparison, the figures being in quintals.

	—January to July—		For the year
	1912.	1913.	July 1, 1912 to June 30, 1913.
Production	26,856,455	30,092,777	59,450,462
Exported	22,627,094	26,922,030	58,492,375
World's consumption.	38,432,229	38,389,687	54,947,562

	—Per quintal—	
	7s. 6¼d.	8s. 0¾d.
Average price	(£1.81)	(£1.94)

The above shows that the consumption for the trading year (July 1, 1912, to June 30, 1913, inclusive) was slightly over 3,500,000 quintals less than the export,

and 4,500,000 quintals less than the production. These figures indicate the urgent need of restricting the output.

For 1913 the figures were as below. The importance of the restriction of output is brought out by them even more emphatically.

	1913 (calendar year).	
	Quintals.	Metric tons.
Production	59,249,565	2,771,400
Exported	59,529,121	2,735,200
World's consumption	55,562,219	2,553,800

Compared with 1912, the following table is of interest, figures being in quintals:

	1912.	1913.	Increase.
Production	58,214,140	59,249,565	4,035,725
Exported	54,197,439	59,529,121	5,331,682
World's consumption	54,990,104	55,562,219	572,115

The total nitrate produced from 1899 to 1914, in round figures, might have been 45,500,000 metric tons.

Iodine to the extent of 1,010,186 lb. was produced and all exported in 1912. It is a product derived from the nitrate and is an additional source of revenue to the Government, the export tax being 1944l. 21s. per pound. Its exportation is limited by the 'Iodine Combination' so as to keep up prices, so only a small proportion of the possible output is made. Those oficinas 40 in 1912 which have caliche high in sodium iodate are the favored producers. The Domeyko oficina in the Antofagasta district has a capacity of 400,000 lb. of iodine per year. The method of manufacture consists in treating the mother liquors from the nitrate crystallizing vats or tanks, which contain iodine principally as sodium iodate, with a mixture of sodium bisulphite, and is carried out as follows: the bisulphite of soda is prepared by burning a mixture of nitrate of soda and coal 'fines,' the soda so formed is leached out, decanted, and sulphurous acid gas made by burning native sulphur in iron stoves is passed through in excess, thus forming bi-sulphite. To a given quantity of mother liquor a sufficient amount of the above mixture of bisulphite of soda is added until the temporary brassy coloration due to free iodine has disappeared, and the solution is clear, then about 20% of its volume of fresh mother liquor is added through which the iodine is precipitated; the required proportions being determined by tests made beforehand. The iodine is allowed to settle, is filtered, pressed, and the cakes so formed, containing about 75% iodine, are placed in one-ton charges in iron retorts connected with condensers, made of earthenware drain-pipes about 30 in. diameter, placed on a gentle incline. The retorts, after careful lining with clay, are gently fired until the iodine is all driven over. The apparatus is allowed to cool several days, after which the pipes are opened at night when the temperature is cooler, and the crystallized iodine, 99.6% pure, is shoveled out and packed in 100-lb. barrels, that are afterward sewed in rawhide for transportation. The cost of extraction varies from 1.2 to 1.44 per ounce, the price has been put up to 91. The analysis of a sample of mother liquor used for iodine extraction is as follows:

	Tarapaca plant. Grams per litre.
Nitrate of soda	306.61
Chloride of soda	105.45
Nitrate of potash	121.79
Perchlorate of potassium	15.99
Sulphate of magnesia	50.25
Chloride of magnesia	49.97
Iodate of soda	9.70
Sulphate of lime	3.55
Borate of soda	2.90
Boric acid	21.86
Total	694.94
Water	728.56
Weight of one litre	1419.50

Safety in Crucible Practice

*The graphite crucible is not strong even when new; it naturally weakens under the severe treatment which it must endure in service. Nevertheless, care and skill in its use makes the graphite crucible a comparatively safe vessel in which to melt and handle molten metals. The crucibles should be inspected carefully for cracks and other superficial flaws, and only those crucibles which seem to be in sound condition should be put into service. It is especially important to examine crucibles for dampness; and if the condition of the packages or of the ear in which they have been shipped indicates that they have been wet in transit, the crucibles should be put aside, either to be returned to the maker or to be specially treated. Moisture in the crucible is a great source of danger when the crucible is exposed to high temperatures, for the heat rapidly converts the moisture into steam, and the latter, unable to escape quickly, causes slight explosions in the crucible walls, which weaken or fracture them. The remedy is gradually to drive out all moisture before charging the crucible, and to prevent further absorption of moisture. When received, crucibles should be stored in a warm, dry place, preferably in an oven on the roof of a continuously operating core oven, and shut off from moist air as much as possible. The best results are obtained when the temperature in the storage oven is maintained at about 250°F., at which temperature crucibles will not absorb moisture. Waste gases from furnaces or from ovens may be advantageously used for this purpose, when these gases are moist, however, they should not come in contact with the crucibles, but should be conducted through the furnace walls. The use of damp high-sulphur coke or coal or of fuel oil containing excessive moisture should be avoided, both in the storage oven and in the melting furnace.

In April the new mill of the Shamva mine, Rhodesia, treated 39,012 tons of ore averaging \$3.79 per ton. Residue assayed 20% per ton. All working expenses were \$1.58 per ton and the profit was \$53,000.

*Safety Bulletin, National Foundry Association.

The Largest Electrically Operated Gold Dredge

By W. H. GARDNER and W. M. SHEPARD

Owing to the areas of rich gravel deposits in the world being limited, the large dredging companies have turned their attention to the problem of handling extensive low-grade gravels. Powerful dredges, with a capacity of 10,000 cu. yd. or more per day, have thus been evolved to treat this material at low operating costs. Such a boat is Yuba No. 14, constructed for the Yuba Consolidated Goldfields Co. by the Yuba Construction Co. of Marysville, California.

Dredging in the Yuba River

The Yuba river, draining a region from which the early output of California gold was largely derived, was considered as a dredging field as early as 1900,

and on the American river at Folsom, fleets of gold dredges were operating by this time, but in point of extent and value the goldfield along the Yuba river is unequalled.

In 1912, the construction of Yuba No. 14 was first projected. It was determined to build this dredge entirely of steel, the longer life and practically negligible fire risk being the determining factors. The life of a dredge is limited by the life of its hull, and the steel hull, while more expensive, increases the life of the dredge, from 10 years, with a wooden hull, to 15 years or more. Steel housing and steel gold-saving tables were provided to decrease risk of loss by fire and for other reasons. Buckets of 16-cu. ft. capacity



YUBA GOLD DREDGE NO. 14 IN OPERATION.

While good gold content was found, the ground was thought too deep to dredge, and it was several years before it was considered possible to construct dredges that could dig deep enough to handle this ground. Yuba No. 1 and No. 2, 7-cu. ft. dredges, were then constructed to dig to a depth of 65 ft. Six more dredges of improved design followed soon after. The ground was rich, one of the dredges alone once clearing more than \$400,000 profit in a single year. Later, four more dredges, having somewhat larger hulls, were built and added to the fleet. In August 1911, Yuba No. 13, a 15-cu. ft. dredge with wooden hull, started work and handled an average of 280,000 cu. yd. per month at an average operating and maintenance cost of a little over 33c. per cubic yard. On the Feather river at Oroville,

each were designed, the expected yardage being 10,000 cu. yd. per day. A long ladder was planned, to enable the dredge to dig 70 ft. below water-level, and reach the deepest bedrock. The latest improvements in electrical equipment and control were incorporated in the plans of the dredge, to help reduce the operating cost to a minimum. An increased area of gold-saving tables was provided, to secure the maximum gold recovery. While no experimental features were introduced in the design, the machinery was strengthened in many places. As a result, Yuba No. 14 stands as the largest and most modern gold dredge in the world. It was built on the Yuba river a little farther up river than the other dredges operated by the Yuba Consolidated Gold Fields Co., at a total distance of about 14 miles from Marysville.

*Abstract from the *General Electric Review*.

A brief description of the engineering and mechanical points of this dredge are as follows:

Steel Hull

Perhaps the most important and interesting feature of Yuba No. 14 is its steel hull. This is 155 ft. 6 in. long, 58 ft. wide, with an additional overhang of 5 ft. on each side to increase deck area, and is 11 ft. 6 in. deep. It is made entirely of steel, and is the first steel-hull dredge to have a deck of steel plating. Particular attention has been given to the design of the hull. It



400-HP. MOTOR OPERATING THE BUCKET LINE.

has been so constructed that all of the heavy stresses are distributed over a series of fore and aft and transverse trusses. The vertical sides of the hull form the girders which carry the concentrated loads near the edges of the main deck. The bottom of the hull is framed in such a way that the upward pressure of the water is carried to the main fore and aft trusses and to the sides, allowing the hull to be as light as possible and yet giving it at the same time ample strength to withstand the stresses incident to the operation of the dredge. Following out this same scheme, the spuds are directly in line with the fore and aft trusses.

The bow gantry, the truss from which the ladder is suspended, is of particularly heavy steel construction, and the weights of the bow and stern gantry, added to the weight of the hull, show a grand total of 1,562,546 pounds.

The housing, carrying out the general plan of the dredge, is also of steel fireproof construction. It is made up of two sheets of 22-gauge steel between which is a 1/4-in. sheet of millboard. This insures absolute fire protection, and gives a maximum insulation, keeping the dredge interior warm in winter and cool in summer. This is an important item, for warm weather in the field is particularly torrid owing to the gravel and sand bars along the river.

The digging ladder, of the plate girder type, is one of the heaviest yet designed, and to enable the dredge to dig 70 ft. below water-level has a length of 133 ft. 6 in. between tumbler centres. This girder is 10 ft. in depth. Not counting the ladder rollers or bucket line, this ladder weighs 125 tons. The bucket line is composed of 87 buckets, connected in an endless chain. The bucket bottoms are of a special nickel-chrome steel,

cast with the hoods integral. The lips and bushings are of manganese steel, and the bucket pins are of a specially heat-treated oil-tempered nickel-chrome steel. The wear on the bucket line of a deep digging dredge is very great, and hence only the highest grade steels can be used in its construction. This bucket line complete weighs nearly 203 tons, a weight of over 4600 lb. per bucket.

The ladder hoist winch is operated by the main motor through a pulley shaft on the main deck, this shaft being also belted to the main bucket drive above. The main digging motor, which is of 400-hp., is thus used to raise and lower the ladder, and to drive the bucket line.

The main drive, consisting of the upper tumbler shaft with its two 12-ft. diameter gears, the intermediate shaft which is made in two separate lengths to allow room for the long hopper, and the pulley shaft with its two differential pinions and 12-ft. diameter pulley, is rigidly supported by the steel main gantry and the upper chords of the fore and aft main trusses, this rigidity serving to hold the gears accurately in mesh and to preserve the alignment of the shafting.

The screen, a revolving cylinder of perforated high carbon steel plates, is 50 ft. 6 in. long and 9-ft. diameter, and is stiffened by heavy longitudinal steel angles extending between the supporting tread rings at each end.

Gold Saving Tables

The gold saving tables and supports are made entirely of steel, and divided into two separate banks 6 ft. apart. In each bank there are 14 transverse sluices on each side of the dredge. The three upper sluices extend through the side of the house where each one discharges into separate outboard longitudinal sluices that extend to the stern. The other 11 cross-sluices discharge into seven inboard longitudinal sluices, the discharge from which is carried about 25 ft. astern by overhanging steel tail-sluices, or delivered back of the spuds as may be required. The total table area is 7540 square feet.

The two spuds are built up of structural angles and plates, have a cast steel point, are 30 by 60 inches in section, and 60 ft. long, and weigh together 160,800 pounds.

The stacker is exceptionally long, measuring 137 ft. between pulley centres, for when digging to the maximum depth of 70 ft. the boulders have to be stacked very high. As is usual, it is of the lattice truss type.

The swing winch is an eight-drum winch, two of the drums being for spares (lines which are used for repair work and miscellaneous purposes), two for the bow swinging lines, two for the lines that raise the spuds, and two for the stern lines. This winch weighs 41 tons. The design of winches of this type has been worked out particularly well, and in spite of continuous use and hard wear, repairs on such a winch are small.

Since Yuba No. 14 will not dig with a high bank, as do some of the Natomas Consolidated dredges, no

monitor pump is carried. There are, however, three Yuba Construction pumps, one a 14-in. high-pressure horizontal centrifugal pump, used for supplying water to the screen, one a 14-in. low-pressure pump, used for supplying water to the tables, and the third, a 6-in. two-stage pump supplying water under a 125-ft. head to the dump hopper.

By a system of levers the motion of the drums on the swing winch, the speed change on the same winch, and the operation of the main drive clutch, the ladder hoist clutch, the ladder hoist brake, and the main drive brake, are all controlled from the winch room, requiring a total of 23 levers. These are in addition to the control of the main drive and swing winch motors. From the winch room the bucket line can be raised or lowered, stopped or set in motion, the spuds can be raised or lowered, and the dredge moved by either the bow swing, head, or stern lines.

The electrical equipment of Yuba No. 14 is of interest in that it represents something of a departure from the equipment heretofore considered standard for California gold dredges. This departure from former practice was made in the light of experience gained in the operation of four dredges of the largest type which were built by the Yuba Construction Co. for the Natomas Consolidated of California, and one similar dredge built for the Yuba Consolidated Gold Fields. All electrical plant was made by the General Electric Company.

Power is supplied by the Pacific Gas & Electric Co. and is a three-phase, 60-cycle, 4000-volt current. The power is brought on board the boat through 750 ft. No. 0, B. & S. gauge, 3-conductor cable, each conductor being stranded and insulated with $\frac{3}{32}$ -in. 30% Para rubber, conductors twisted together, rounded out with jute and covered with a layer of $\frac{1}{8}$ -in. varnished cambric. Over this is a layer of jute and the cable is armored with No. 10 B.W.G. armor put on with short pitch. This cable is insulated for 4500 volts working pressure. The shore cable is brought aboard the dredge on pontoons and enters a switch house on the upper deck near the stern of the dredge, where there is installed an automatic 300-ampere, 7500-volt oil switch with hand-operated remote control. The switch is mounted on pipe framework away from the panel carrying the operating lever. There are installed in this switch-house two 4400/110-volt, 200-watt potential

transformers with fuses, and two 150-ampere current transformers. The secondaries of these transformers are connected to indicating instruments mounted in the winch room. From the switch-house the current is fed through triple conductor varnished cambric cable in conduit to the primary side of the main transformers. These consist of three 200-kw. oil-cooled transformers, 4000-volt primary and 460 230-volt secondary. In addition to the main transformers, there is installed one 15-kw. 4000-volt primary 230 115-volt secondary oil-cooled transformer to supply lights. From the sec-



DREDGE IN COURSE OF CONSTRUCTION, SHOWING STEEL HULL.

ondary side of the main transformers various feeder circuits supply the different motors, triple conductor varnished cambric being used in iron conduits.

The control panel for the main drive or digging motor, and for the winch motor, is placed in the winch room, as is also the instrument panel. The instrument panel contains the following instruments, which are supplied, as mentioned above, from the instrument transformers placed in the entrance switch-house: One 5-ampere alternating current ammeter with 150-ampere scale, one 175-volt alternating current voltmeter with 8-point potential receptacle and plug, one alternating current polyphase indicating wattmeter with 1200-kw. scale. The readings of these instruments give the total input to the dredge.

The double-circuit control panel for main drive and winch motors has the following equipment: One 60-ampere alternating current ammeter (winch motor); one 5-ampere alternating current ammeter, 800-ampere

scale (main drive motor); one 200-ampere automatic oil switch with double-coil series trip (winch motor); one 600-volt 800-ampere automatic oil switch with double-coil trip (main drive motor); and two 800-ampere current transformers in main drive motor circuit.

The panels for the pump motors are placed on the lower deck, the starting compensators for the pump motors being mounted alongside the panels. These compensators are all provided with inverse time-limit relays. The pump motor panels consist of the following: Two 3-phase 2-circuit motor panels, each panel mounting two 500-volt 200-ampere level switches controlling the high-pressure, the low-pressure, the 6-in. 2-stage, and the vertical pumps.

The stacker and screen motors are controlled from independent panels located in the stern of the dredge, each panel having the following equipment: One 200-



EIGHT-DRUM SWING WINCH.

ampere automatic oil switch, with 2-coil series trip, and mounting on the front of panel for one reversible type controller. The oil switch operating level is directly above the controller.

All of the panels are natural black slate mounted on pipe supports.

The digging or main drive of the dredge is a 400-hp., 514-r.p.m., 3-phase, 60-cycle, 440-volt, slip-ring, variable-speed induction motor with three bearings, pulley, and sliding rails with a master controller and contractor panels, and is provided with resistance good for continuous operation at all speeds from 50% normal to normal.

Current-Limiting Relays

The contactor equipment is provided with current-limiting relays, which limit the maximum load that the motor can take and so protect both the motor itself and the complete digging mechanism that it drives. This is of considerable importance in keeping down the cost of repairs and preventing loss of time incident to repairs. The digging mechanism is subject at times to sudden and excessive loads and without the current limiting feature provided by the contactor control the only protection would be given by the overload oil switch. Due to the annoyance of having this switch tripping out frequently it is usually set so high as to afford little protection. The current-limiting relays

also protect the motor and digging mechanism when starting. The winchmen can throw the master controller to the full 'on' position and the motor will come up to speed at a predetermined rate, which will not impose excessive stress on any part of the mechanism.

Another motor operates the winch, raises the spuds, and swings the boat. This motor is a 35-hp., 600-r.p.m., 3-phase, 60-cycle, slip-ring, variable-speed induction motor with a controller and resistance for continuous operation at from 50% to full speed. The motor is provided with pulley and base. In a few instances on smaller dredges, motors of intermittent rating were furnished for operating the winch. These motors, however, have not been found suitable for this service, as the winch operates almost continuously.

All the pump motors are squirrel-cage motors, the high-pressure pump having a 150-hp., 600-r.p.m. motor, the low-pressure pump a 75-hp., 600-r.p.m. motor, the 6-in. 2-stage pump a 50-hp., 1200-r.p.m. motor, and the vertical pump a 10-hp. vertical motor. These motors are all direct connected to the pumps and, with the exception of the 10-hp. motor, are all provided with welded end-ring construction in the rotor.

Variable-Speed Motors

These motors are of the slip-ring, variable-speed type, provided with resistance for continuous operation at from 50% to full speed and with reversible controllers. They operate at 600 r.p.m., the screen motor being 75 hp. and the stacker motor 60 hp. In most of the former gold dredges these motors were of the constant-speed squirrel-cage type. However, in the more recent large dredges, due to difficulties sometimes experienced with squirrel-cage motors on account of the heavy starting conditions and the desirability at times of running for short periods at reduced speeds, slip-ring motors with resistances for two-minute starting duty were used. In heavy work, however, these were found too light, and for Yuba No. 14, resistances for continuous operation were installed and reversible controllers used.

There is provided a 2-hp., 1800-r.p.m., 3-phase motor with pulley and base for the repair shop on board the dredge. The operating time of a dredge is between 85 and 88% of the total time. The dredge operates night and day with three shifts. The load-factor varies from 62 to 80%, depending on the character of the ground, and as the dredge operates practically every day in the year throughout its life, except the Fourth of July and Christmas, it represents an excellent load for the power company.

Yuba No. 14 was built in four months and four days from the driving of the first rivet, a remarkable time considering the enormous total weight of the dredge. All material was transported 14 miles from the railroad over uncertain roads by means of power tractors and trailers, by no means a small job when it is noted that the completed dredge weighs very close to 1994 tons.

Classification at Miami

To obtain the best possible results in the concentration of ores, it is generally accepted as standard practice that classification is essential, that the different grades of feed thus separated may be treated on different tables and to the best advantage. The methods of classification are generally hydraulic, and the classifiers are either mechanical or stationary in operation. Of the latter type, baffle and hindered-settling classifiers are being favored by the operators. After considerable experimental work at Miami during which various types of classifiers were tested, the subject of tonnage, thickness of discharge, water required per ton of solids handled, proportion of coarse material

Classification does not result from the use of hydraulic water alone, but the pots act as baffles and the staggered path of the material allows the water to wash the fine particles from the downwardly flowing coarse material, carrying them above and beyond to the next classifier. A nipple and wooden plug is used in the bottom of the classifier spigot. The opening through the plug may vary from 1/4 to 3/4 in.



The results obtained at Miami by the use of this classifier may be seen from the following representative tests:

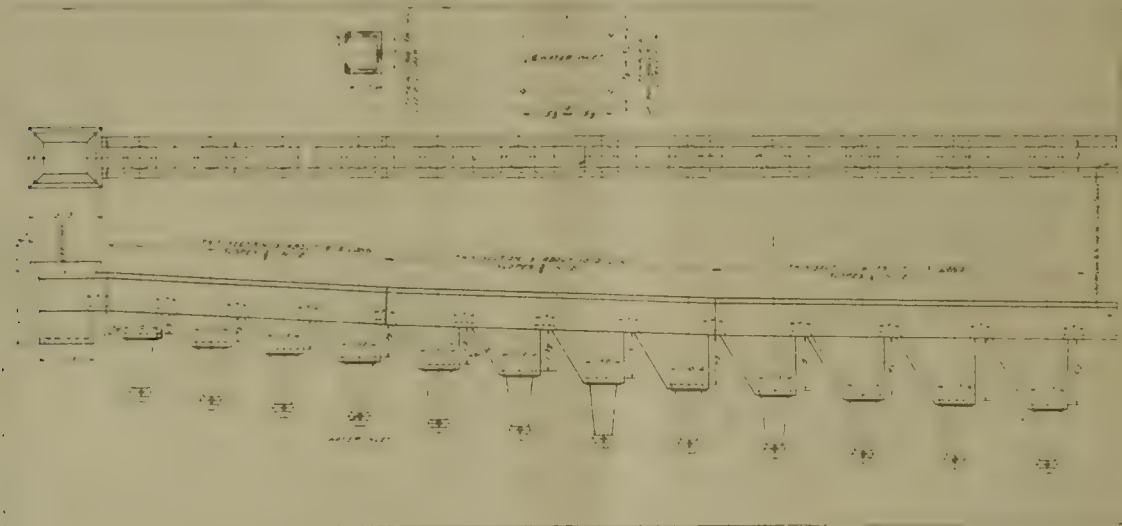


FIG. 2. ARRANGEMENT OF LAUNDERS AND CLASSIFIERS AT MIAMI.

in discharge, accessibility and ease in replacement of wearing parts were subjects of investigation. The Deister cone baffle classifier, a cross-section of which is shown in Fig. 1, was found adapted to conditions and has been installed. This classifier constitutes a cast iron barrel in which hollow cones or diaphragms with slots or openings sufficiently large to permit the free passage of the coarser material are placed in an inverted position. These pots or cones are staggered, the openings in one cone being out of line vertically with the adjacent cones, thus forming baffles. In operation, the crushed material which is mixed with sufficient water to insure its movement along the launder passes down into the barrel through the openings into the cones. At the same time sufficient water is admitted through one of the side inlets of the annular waterway, and of sufficient force to separate the fine from the coarse material passing through the cones, forcing these fines to the top and on to the next classifier, allowing the downward movement of the coarser particles. The arrangement of the launder and series of classifiers at Miami is as shown in Fig. 2.

Tons solids per 24 hours.....	33.60	37.90	23.90
Ratio solids to water in product....	1:1.77	1:2.38	1:2.64
Hydraulic water, gallons per minute	17.50	22.40	*
Screen analysis of product:			
+10 mesh	0.10	0.10	0.00
+20 "	4.70	6.10	12.70
+30 "	37.50	38.60	44.70
+40 "	24.30	19.80	19.20
+60 "	22.00	19.40	14.50
+80 "	5.00	5.70	3.70
+100 "	2.90	4.10	2.20
-100 "	3.50	6.20	3.00

*Not taken.

From the results tabulated, one cannot fail but be impressed with the tonnage and ratio of solids to water in the product. From the screen analyses of the 10-mesh material it is to be remarked that in each test from 78 to 83% of the product is between 30 and 60 mesh. If curves were plotted with mesh and percentage as coördinates, the sharp rise between the +20 and +30 and sharp fall between the +60 and +80 would indicate graphically the degree of classification which is being effected.

The Han-Yeh-Ping Iron & Coal Company

This Company, as many of our readers know, owns the only modern iron and steel works in China. It has had a very romantic history which may not be so generally known.

When Chang Chih-tung was viceroy of Canton a good many years ago, he was impressed with the strategic necessity for an iron and steel works in China so that the country might be able to manufacture materials for guns and ships in the event of a foreign war. He accordingly ordered from England the necessary equipment for a small steel works. So far as is known, no effort was made to determine whether the necessary raw materials were available in Canton. Before the material was delivered Chang Chih-tung had been promoted to be viceroy of the Hu-kuang provinces and he accordingly had the material shipped along with him to his headquarters at Wuchang. There a fairly convenient site was selected on the opposite side of the river in the town of Han Yang and a plant was erected. The next thing in order was to find raw material to work on. Fortunately a large deposit of iron ore of good quality was soon discovered at Tayeh in Hupei province, so situated that it could be cheaply mined and transported. Limestone of good quality occurs in close association with the iron ore.

Coke Supply

The problem of securing an adequate supply of coke was a much more difficult one. English, German, and American coke was tried, and although it gave good results the cost was so high as to prevent any possibility of operating at a profit. Coke from Tongshan and various other places in China was tried, but while the price was lower the quality was also so much lower that there was no advantage in its use. Finally it was discovered that coke of good quality was made by the natives in Western Kiangsi province and upon investigation it was found that there existed at that place coal seams which could be mined upon a large scale and coke of excellent quality made after washing the coal. The recital of all the difficulties through which the Company passed would take too much time. The technical work was performed under the direction of Gustave Leimung, while the management was largely in the hands of Sheng Hsuan-Huai. The plant was increased in size from time to time and various changes made, until finally there were three blast-furnaces and a full set of open hearth furnaces together with rail mills and the other accessories for a modern steel plant. The enterprise was at first semi-official but later it became more of a joint stock enterprise in which Sheng had the controlling interest.

From time to time it became necessary to raise more money and loans were secured from Japanese capitalists, the Japanese being willing to advance money to the plant in consideration for receiving a favorable contract for the supply of iron ore to the Japanese gov-

ernment iron works at Wakamatsu. It will thus be seen that while the enterprise was largely in private hands, it had rather vague connections with both the Chinese and Japanese governments. The business management of the plant seems to have been poor; at any rate, the financial position of the Company seems to have become worse rather than better, and the part destruction during the revolution was a final blow which placed it in a very serious position. Since that time the Chinese interests have made strenuous efforts to raise the necessary money to pay off old indebtedness and to rebuild and equip the plant so as to do good work along modern lines. The position of the Company is so unfavorable that there was no success in getting anyone to take any interest in the matter except the Japanese. The original loan of the Japanese was to be paid back by deliveries of ore to the government steel works. However, the amount of ore taken by the Japanese has not been enough to pay off the debt, and meanwhile something like \$2,500,000 additional has been borrowed from Chinese and foreigners at rates of interest which vary between 9½ and 13 per cent.

The Japanese Loan

The Company has finally entered into an agreement with the Yokohama Specie Bank, whereby the bank agrees to lend the Company \$7,500,000 at 7% interest. This will bring the total indebtedness of the Company to the Yokohama Specie Bank up to nearly \$15,000,000. Of the new money thus provided, \$3,000,000 will be spent for new equipment and reconstruction, while the remainder will be used to pay off old debts. The terms of the agreement give the control of the Company to the Japanese; and as the iron and steel company was, and still is, semi-official in character, its becoming a semi-official Japanese enterprise is naturally the cause of much commotion in China. There has been a good deal of discussion as to whether the Government at Peking will allow the Company to consummate this agreement, and it has been proposed to have the Chinese Government take over the enterprise itself. As this would involve the Chinese Government assuming an indebtedness of something like \$25,000,000 there is naturally a good deal of objection to this course of procedure. It is known that the Chinese interests concerned have made strong efforts to persuade the Bethlehem Steel Co. to come to their rescue, but that organization was naturally averse to becoming involved in such a complicated situation. At the last report the agreement with the Japanese bank had not yet been consummated, but unless the Chinese Government is willing to come to the rescue and furnish the funds required there seems no escape from the proposed arrangement.

With a membership of over 400,000, the United Mine Workers of America *Journal* was run at a loss of \$8596 in 1913. The revenue was \$15,435.

The Mogul Mill, South Dakota

By JESSE SIMMONS

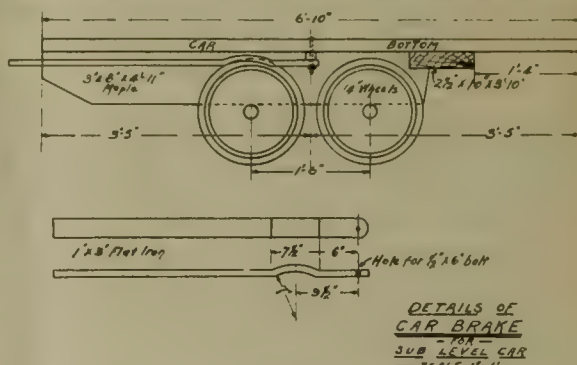
At the new plant of the Mogul Mining Co., on Nevada gulch, near Trojan, Black Hills district, a distinct departure from the customary practice of cyanidation is made. All of the ore is slined, and treated by agitation and continuous decantation. No filter is used. Furthermore, a De La Vergne oil-engine is used as a prime mover for the steadily running machinery; the crusher and rolls are operated by electric motors, using power which is purchased from the Consolidated Power & Light Co.

The Mogul mill is so situated that bottom-dump railroad cars discharge into the crusher bin. Entries to open-cut workings are directly in the rear of the mill, on the same level as the railroad track, and a portion of the mill supply comes in one-ton mine-cars. After passing through a No. 5D Gates crusher, the ore goes by shaking feeder to a 14 by 36-in. roll, delivering a product of about 1-in. cubes. Thence it is delivered by an 18-in. S.-A. conveyor, set at an incline of 22°, to two cylindrical steel bins, 16 by 14 ft., from either one of which it is possible to feed either one of two 6-ft. Trent Chilean mills. As this conveyor discharges into the bins a sample is automatically taken by cutting across the stream of pulp every 35 seconds, making it practicable to get a close sample on a small lot of ore. Of the two Chilean mills, but one is constantly used, and the other is held in readiness and kept in full repair. Cyanide solution is added at the Chilean mill, and the product elevated in a 16-in. bucket elevator to a Dorr duplex classifier, the overflow from which goes to a 35-ft. tank equipped with a Dorr thickener; the underflow goes to a 5 by 18-ft. tube-mill which is operated in closed circuit with the classifier. The result is that a product is treated of which about 1% is coarser than 60 mesh, and 40 to 50% finer than 200 mesh. From the 35-ft. thickener, which is installed in a tank 10 ft. deep, the clear overflow solution is transferred to the zinc-boxes, first passing through a clarifying filter, and the underflow of thickened slime runs by gravity to a 15-ft. 6-in. by 16-ft. Dorr agitator, thence by gravity to a second agitator, identical in size and equipment, thence by gravity to the continuous decantation installation of Dorr thickeners in 25 by 10-ft. tanks. At No. 3 thickener, barren solution is added, and at No. 4, the last in the series, wash water is used. Between the thickeners the pulp is handled with diaphragm pumps, which, I am told, are more efficient and require less attention and far less power than air-lifts. At this plant the moisture content of the slime drawn from the thickeners averages 40 to 44%, which is probably somewhat thicker than the average in mills equipped with air-lifts, and as the efficiency of the continuous decantation process rests upon thickening the slime to the last practicable point, this would appear to be an important factor in favor of the pumps.

The only solution precipitated is that drawn off the 35-ft. thickener, amounting to about 450 tons per day, and it is naturally the richest in the mill, a portion of it having been worked forward to this thickener from the No. 3, which is the fourth in the series, and the balance of it coming from the Chilean mill by way of the classifier and tube-mill. The capacity of the plant is 150 tons per day. The oil-engine is working satisfactorily, producing power at a lower cost than it can be purchased from the electric company. This engine is rated at 130 hp., and drives the Chilean mill, tube-mill, thickener, agitators, pumps, and two 10 by 10-in. single-stage compressors. As the plant has been in commission only three months, much data are not yet available. J. V. N. Dorr is general manager; L. D. Dougan, mill superintendent; and E. R. Graham, mine superintendent.

A Car Brake

The sketch shows details of a car brake for a sub-level car, especially needed where the track is well in-



clined for down grade when carrying loads. On a long down grade, a trammer or even two trammers may lose control of the heavily loaded car.

Present exports of gold to Europe are attracting considerable notice in financial circles. During the week ended June 13, gold worth \$19,000,000 was engaged for export, which is a record. This amount was made up of several shipments. The largest cargo of gold ever carried in one lot was on the *Lusitania*, which brought \$12,361,000 to New York from London on November 8, 1907, to help relieve the panic of that year.

Mineral production of South Australia in 1913 was as follows: copper, 7161 tons, worth £488,986; gold, £27,000; silver-lead, £1100; salt, £48,750; and ironstone and limestone fluxes, £50,000. The total was £642,626, against £595,670 in 1912, and £450,054 in 1911.

Pyrite production of the United States in 1913 was 341,338 long tons, valued at \$1,286,084, a decrease of 9590 tons and \$48,175 compared with 1912.

A Continuous Process?

By HUNLEY ST. JOHN BROOKS

Needless to remark, I was a visitor at the local branch of the Ananias Club, but my friend was not only a foundation member, but rumor even whispered that he had received his diploma from the founder of the first club of Ananias, of Oyster Bay. I had just returned from Nigeria, and had not seen him for years. The talk drifted to continuous milling processes as applied to gold ores. I had remarked that nowadays it was theoretically possible to set the machinery going and then recline in the shade, except when the occasion for a clean-up arose. I had said that it only needed the introduction of some form of continuous clean-up to make the formerly down-trodden millman's lot an ideal one. Bates looked carefully around to make sure that we were alone, and then remarked: "Mind, I am telling you this in strict confidence, as I don't want it to get about till the machinery is erected and turning out the goods. The absolutely continuous mill has been invented, and right here is the boy who has done the trick."

Bates Continuous Process

"I am leaving for South America tomorrow to supervise the installation of the 'Bates Continuous Precipitation and Smelting Process' at the Engaño mill of the Sueño de Pipa Mining & Milling Co. The company possesses in the south of Ecuador one of the richest gold mines in the world, but unfortunately the climate is so enervating that it is quite impossible to induce white men to exert themselves for any length of time. Many and many a young fellow has arrived there brimming over with quiet confidence and bursting with eagerness to jump right in and show them some. But after a few weeks the climate gets in its deadly work, and the erstwhile hustler, little by little, drifts into the habit of running around all day in pajamas when he isn't reclining thoughtfully in a hammock absorbing the cooling drinks obsequiously proffered him by the hospitable natives."

"At first the company tried training native talent for the work, but they are such inveterate socialists, and believed so thoroughly in the common ownership of gold, that the idea fell through. Then they attempted to bring over skilled Chinese from Johannesburg, but the government refused to permit their importation. The mill was closed for several years, till the introduction of the continuous processes of agitation and decantation induced them to start up again. It was then found possible to run the mill with only one white man per shift, who did little else but sit in a natty office and read the Sunday papers. The old manager suddenly making up his mind to pull out for 'God's country,' a new man full of life and vim was imported from North America. Though warned by the New York directors what to expect, he was profoundly moved by what he saw when he arrived. With a choking

voice he said to one of the mill shift-bosses: 'See here, Mister, I don't mind your sleeping on night shift; I don't even mind your bringing your bed into the mill; but I do object to your saying your prayers before you turn in.'

"However, on the principle that the less a man has to do the less he wants to do, the unhappy victims of the enervating effects of that atrocious climate grew more and more disinclined to make up the monthly clean-up. The company were quick to see what was required. What was needed was a system of automatic clean-up: something continuous, yet fool and thief-proof. They turned to the one man in America who could help them out, and you can take it from me, sir, that one man did not fail them."

"I discarded the zinc-boxes altogether, and introduced a rotary affair filled with zinc clippings. It revolves at slow speed and the friction of the clippings against each other rubs off the precipitate as fast as formed. The gold slime falls to the bottom of the box, where it encounters a sort of Dorr thickener mechanism which draws it off at under 40% moisture. From there it passes to a drier, and thence to the 'Bates Patent Continuous Bullion Furnace.' This is a kind of combination Erlenmeyer furnace and continuous classifier. It is a tubular affair set at a slight pitch from the feed to the discharge end. The precipitate, automatically mixed with the required flux, which is fed from a hopper, enters the furnace a little at a time. The layer of fluxed precipitate is so thin and the heat so regulated, that the gold is melted almost instantly and rolls in globules toward the discharge end. By reason of its greater specific gravity, it escapes from the furnace, but the furnace itself is made to revolve at such a rate that before the slag has time to escape it reaches the top of the furnace, where it is scraped back to the slag discharge outlet by means of rakes. From the furnace the bullion passes, always by gravity, to a simple continuous cupellation furnace of my own design. From this machine the refined bullion passes to the 'Bates Collector.' There, after being cooled to a pasty condition, it is forced through a narrow slot and issues in the form of a ribbon. It is wound on spools, each containing approximately a thousand dollars worth of output. Once a day (or less, according to climatic conditions) the manager manipulates the combination lock, takes out the output, and transfers it to the safe, where it remains until the day for shipment. When the mill is running you will see a 200-ton mill run by one white man, working one hour a day. Everything else is done by unskilled labor of the rawest description."

Pondering all this, I wonder was Bates pulling my leg or was he pulling the company's. I am still wondering.

Labor employed at Panama on March 25 totaled 33,201 persons, an increase of 1400 compared with that of February 25.

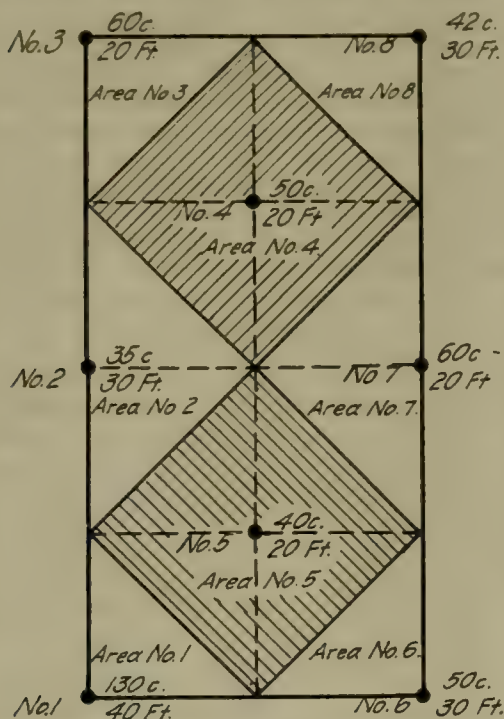
Discussion

Readers of the MINING AND SCIENTIFIC PRESS are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment. Insertion of any contribution is determined by its probable interest to the readers of this journal.

Valuing Dredging Ground

The Editor:

Sir—I venture to ask a question in connection with the article on the valuing of dredging ground, by Mr. Decoto, in your issue of May 9. In this article an example is given of the calculation of average value for an area, 'A', shown in the accompanying sketch, from six test holes on boundary lines and two in the



centre of the area, arriving at an average value of 72.42c. for the area, as per clipping herewith, or 62.90 as corrected below, to correspond with diagram of

Area A		
1.....	130 × 40 =	5,200
2.....	35 × 30 =	1,050
3.....	60 × 20 =	1,200
4.....	50 × 20 =	1,000
5.....	40 × 20 =	800
6.....	50 × 30 =	1,500
7.....	60 × 20 =	1,200
8.....	42 × 30 =	1,260
		210 13,210

Dividing 13,210 by 210 gives
an average value of 62.90+
for area 'A'.

Mr. Decoto. The reason for giving hole No. 1, of exceptionally large value and depth, and situated at a corner of the area, equal weight with holes No. 4 and 5 in the centre, is not made clear.

From inspection of the diagram it seems that holes No. 4 and 5 might be taken as representative of the squares shown hatched in the accompanying sketch.

and, the area of one of these squares being taken as unity, holes No. 2 and 7 should represent an area of 0.5, and holes No. 1, 3, 8, and 6, of 0.25. The average value for the whole area on this basis would then be calculated as follows:

1.....	130 × (40 × 0.25 = 10) =	1,300
2.....	35 × (30 × 0.50 = 15) =	525
3.....	60 × (20 × 0.25 = 5) =	300
4.....	50 × 20 =	1,000
5.....	40 × 20 =	800
6.....	50 × (30 × 0.25 = 7.5) =	375
7.....	60 × (20 × 0.50 = 10) =	600
8.....	42 × (30 × 0.25 = 7.5) =	315
Sums.....		95 5,215

$\frac{5215}{95} = 54.89c.$ average value for area 'A', or 8.01c.

less than corrected value, which is 17.53c. lower than the value given in the article referred to. What would be standard practice in this case?

H. N. HERRICK.

Berkeley, California, May 11.

[Mr. Herrick's point is well taken, and we trust may lead to further discussion of this timely subject.—EDITOR.]

Prospecting—Present and Future

The Editor:

Sir—I read with much interest the discussion in the columns of the *Mining and Scientific Press* under the heading 'What Is the Matter With Prospecting?' Coming from a number of the foremost engineers and mining men of the country, such an expression of opinion is of great value. However, owing to the necessity of brevity of each individual contribution, it seems that some phases of the question could hardly receive the attention they merit, and the writer has ventured to enlarge upon certain points suggested both by the discussion and by his own experience in the field.

The term 'prospecting' as used in this connection implicitly includes not only the search for new mining districts, but also the operations of individuals and corporations who are looking for promising properties in any stage of development. As to the men engaged in present-day prospecting, the old type of prospector is still in the field, and is still the pioneer in the business. He is usually a miner with a fondness for life in the open and a liking for the independence of working on his own initiative; added to this is the ever present hope that over the next range may lie the outcrop of the next big mine. It often happens that prospectors of this class are familiar only with certain types of ore deposits, and on going into new country they may overlook indications which are outside the field of their previous experience.

An instance of this kind occurred at Ray, Arizona, in the days of the earlier development of the camp. The old prospector looked dubiously at the reddish hills, which make a rather striking showing when viewed from the higher country to the east. He said: "Young man, do you reckon they really have a copper mine

yonder! If they have, I've walked over half a dozen or more and didn't know it. No, sir! I think this is just a stock-jobbing scheme."

It is probable that the lack of a broad experience has been a decided handicap to the work of many prospectors, and for this reason some of the districts which have been more or less thoroughly prospected by men from other districts which may have differed widely in type of ore deposits, will in the future yield important discoveries. In the earlier days when transportation was not easy, men moved only relatively short distances in the search for new mines, and it is sometimes possible to trace the advance of miners from a parent district by the methods used in the development of several camps in a more or less related series. Naturally, new things in the way of outcrops, or mode of occurrence of orebodies, or mineralogical characteristics of the ores were overlooked. A striking case of this kind was that of the Camp Bird mine, if the story is a true one: that one of the claims later forming part of the central holdings of the company was being worked as a lead-silver prospect, while the gold-bearing quartz was thrown over the waste dump.

After the 'old-timer' comes the 'practical mining man.' He has usually had extensive experience in the operation of mines, and, 'having worked himself out of a job,' has been sent to find a new mine. It is the men of this stamp who are responsible for the development of some of our largest mines. In fact, it seems that they have been more uniformly successful than anyone else. They are usually men of good judgment; they have the practical knowledge to back up their original decisions, and are ready to work on something that 'looks good.' Further, knowing by experience the necessity of taking chances in development work, they are usually willing to do so; while the purely technical man becomes scared because he cannot see the situation worked out by tape, assays, and slide rule. Finally, such a man has the confidence of the people for whom he has proved a successful manager or superintendent, and when in need of financial assistance has to waste no time in looking for it.

Finally come the men who are employed as 'field men' by the large companies. They have not had the extensive practical training of the type above mentioned, and in many cases their technical training has not been such as to fit them especially for the judgment of new properties. In the beginning they are often young graduates whose experience has been confined to work in minor positions on one or two properties. After spending several years in the field at the expense of the company, they have added considerably to their knowledge and may then begin to be useful. Men of this class, working for the most part on salaries, are deeply imbued with the idea that they must 'play safe.'

A few years ago I met an engineer on a property that had many of the indications of a big low-grade copper deposit. This man said: "Yes, it does look good, but it isn't a sure thing. If I turn it down,

my clients will not lose any money, and if it should turn out well, the chances are that they will never connect it with this examination." One of the reasons why more new mines are not discovered is that much of the money available for their development is in the hands of ultra-conservative technical men who are not disposed to jeopardize their salaries or fees by taking chances.

Another reason may be found in the methods of these men in office and field. A great many of the properties 'examined' are eliminated by the reading of reports in the city office. For the most part, reports submitted in this way are poor material upon which to base an opinion. They are often written by men untrained in that type of work, and in many cases are obviously based upon a very superficial study of conditions. In fact, it would seem that most of the people with properties to sell have little or no idea as to what is necessary in a good report.

The field methods of the average examining engineer are also open to criticism. He is usually sent to visit a certain mine in a district, and arrives after a more or less trying trip. He often has to put up with unpleasant living conditions which inevitably affect the thoroughness of his work and may bias his judgment, and in addition he may be in a great hurry to get to some other camp or back to the city office. Then there is the almost universal attitude, adopted by such men, of looking for reasons to reject the property. It is much easier to find these than to go over the ground in detail and pick out the points which may offer chances for success. These are not obvious in most cases, or the mine would not be on the market. Much time and money are wasted by engineers making hasty trips here and there over a wide field. They do not become familiar with the details of any one district, since they look only at the one property to which they have been sent. No matter how experienced a man may be in such work, his judgment must be superficial if he does not give the time necessary to familiarize himself with local conditions.

Turning from a criticism of present-day methods to a consideration of the possibilities of the future, there is such a wide field that only a few points can be presented here. In the first place, it must be admitted that the field is not so attractive as it was thirty years ago. Most of the striking outcrops in this country have been found and investigated; but even so, there are undoubtedly some absolutely new districts to be discovered.

There are types of deposits which are not so readily recognized which may have been overlooked by earlier prospectors. For instance, there are the 'disseminated coppers' and certain types of low-grade gold deposits, the superficial indications of which are very slight. There are also the ores of the rare metals which are only known to a comparatively slight extent. Nor does the argument that a country is full of people necessarily prove that its mineral resources are entirely developed. The ignorance of men con-

cerning things outside their education or daily occupation is remarkable, and scientific curiosity is strikingly rare. I, when a child in Michigan, found a piece of galena in a sand bank and, carrying it back to the village, spent a half day trying to find some one who knew what it was. Finally the specimen was shelved and its identity determined only by chance some weeks later.

Is it likely that a quartz outcrop in Maine or Michigan would be sampled and assayed for gold? It might have been seen by scores of lumber-jacks, timber cruisers, and hunters without one of them thinking of such a thing as a metal-bearing vein. The comparatively recent discoveries in the Cobalt and Porcupine districts are evidence that fur traders, lumbermen, and sportsmen may know a region thoroughly and still leave it unprospected. The Michigan iron and copper deposits which attracted attention in the early '60s were striking in their outcrops; but in the case of the iron ranges the scientific exploration of later years has developed more iron ore than was ever dreamed of in the early days. In one of these districts I have seen a chain of useless swamps develop into the most valuable iron land in the county; old, tumble-down wooden shaft-houses on abandoned mines have given place to steel head-frames at which are motors driven by electricity derived from the trout stream that "wasn't any good after it had been logged." Still the Upper Peninsula of Michigan is almost a *terra incognita* after leaving the iron and copper deposits.

In my opinion, the most promising field for prospecting in the broader sense is that offered by the older mining districts. One has only to procure a copy of 'Western Mining Districts,' a U. S. Geological Survey publication, to have the question of where to look greatly simplified. Most of the localities throughout the West in which the conditions favor the formation of ore deposits are noted in that bulletin.

Next is the question of what to look for. The answers to this may be tabulated as follows:

1. Deposits of types not generally known, including ores of the rare metals.
2. Deposits of types probably unfamiliar to the earlier miners of the district.
3. Conditions favoring the occurrence of orebodies of the kind best known in the district which may have been overlooked in earlier mining operations. Under this head are orebodies having no outcrop, those that have been lost by faulting, and those not discovered because of the control of development work by some erroneous hypothesis or 'hunch.'

Two cases may be cited briefly here. In one instance a very productive vein was cut off by a fault, and the management spent many thousands of dollars endeavoring to find the lost portion. It was assumed that the fault was a single definite plane, along which only one movement had taken place; on the contrary, it is a wide crushed zone, and there have probably been several periods of movement. As a consequence

of misunderstanding the real conditions, the work done by the old company was not so directed as to solve the problem.

In another instance a company spent a great deal of money hunting for a 'quartzite foot' because the orebodies in the big mine of the district occurred above a bed of quartzite. There was no such formation on the company's ground. The outcrops that led to the staking of the claims were on or near a shale-limestone boundary, and the shales have formed a barrier to the mineral-bearing solutions, with the result that this boundary is a locus of ore deposition, though not uniformly mineralized either along its strike or vertically. Most of the work in this mine was done on the 'hunch' that the ore *must* have quartzite beneath it; to furnish this necessary geological condition, a band of silicified limestone some 600 ft. from the shale bed has been taken as the objective for a series of cross-cuts all leaving the locality of the only orebodies that were ever worked on the property, the proceeds from which very nearly paid for "the extensive development work to locate the quartzite." There is no doubt that many of these old mines in almost forgotten districts will amply repay the expense of careful investigation and well planned development work. But it is very difficult to interest capital in such work.

"We have sufficient funds to buy anything good, up into the millions, but we must know that it is good; it must be big, and fully developed. No, we do not think favorably of that district; it has been dead a long time. If there were anything there it would have been found years ago. I have a report in my files by Mr. Soandso, who spent three days there in 1900, and there is nothing there."

That is about the attitude of the men with money to play the mining game, and who complain that they can find no place to put it. As a matter of fact, we are just passing beyond the 'boom' days of the mining industry in this country. The days of 'easy money' are gone, and the future calls for hard, careful work on the part of the men who would find new mines. The engineer cannot run into a camp in the morning and leave the next day with a 'sure thing' in his pocket. He must know the district thoroughly, must know its details, and must look for the facts that are not obvious; he must "see into the ground further than anybody else," even at the risk of achieving the impossible. The men associated with him must uphold his decisions by taking reasonable chances, and they must develop mines instead of expecting them to turn out ready-made.

If honest, exhaustive examination work and a reasonable expenditure of money for development fail to discover new mines, then one might as well admit that the days of the industry are numbered, and go to farming. But not until more real looking has been done, both in the estimation of the possibilities of old properties and new prospects, and by breaking ground to prove or disprove them.

J. H. FARRELL.

Los Angeles, California, April 19.

Concentrates

Most of these are in reply to questions received by mail. Our readers are invited to ask questions and give information dealing with the practice of mining, milling, and smelting.

Calcium carbide consumed at the Lonely Reef mine, Rhodesia, amounted to 3156 lb. in 1913.

Average cost of mining anthracite is about \$2.07 per ton, exclusive of charges for depreciation, amortization or interest. In 1913, the average price per gross ton was \$2.38.

Mine cave-ins have occurred from time to time in the town of Scranton, Pennsylvania, but have been exaggerated. To prevent further trouble, the coal mining companies are making an annual contribution for the permanent support of the surface.

High-frequency electric current, so-called 'diathermy,' is being used by Gustave Killian, of Berlin, in the treatment of cancer. The diathermy produces a coagulation of the tissues through which it is passed. In a lecture in London, he recently spoke on the palliative results of radium treatment of certain growths too advanced for radical surgical removal. During 1913, the Radium Institute of London treated 972 cases of cancer, including 490 cases of malignant disease of which 111 were of rodent ulcer. Of the malignant cases, none is stated to be actually cured, although 56 are described as 'apparently', and 183 as 'improved'. The medical superintendent, A. E. Hayward Pinch, said that the use of radium is not understood.

Death may occur from shock by the electric current either through temporarily paralyzing the nervous control of the muscles of respiration, or stopping the regular beat of the heart. When the heart is seriously affected it ceases to contract as a whole, but continues to contract in parts here and there, so that it appears to quiver. It is then said to 'fibrillate.' In this condition the heart fails to keep the blood circulating and death quickly results. At present no practical procedure has been discovered which will restore the regular beat of the heart in man after it begins fibrillating. Hope of resuscitation is now restricted to proper treatment of the cases of paralyzed respiration; and since deprivation of oxygen for about ten minutes injures irremediably some of the nerve centres of the brain, it is particularly important that measures for resuscitation be applied immediately and continued until natural breathing returns. In some instances, however, the heart may be merely weakened without being made to fibrillate; in such cases artificial respiration may be of vital importance, because a greatly weakened heart leads to impairment or total stoppage of respiration, which in turn destroys the last vestige of the heart-beat. In all cases, therefore, an attempt should

be made to restore natural breathing. Fortunately, artificial respiration can be applied by laymen without immediate need of complicated apparatus.

Alterations and additions to the Dome mill at Porepine, Ontario, will result in the following plant, it having been decided in 1913 to convert the existing process of all-slimes to one of leaching sand and filtration of slime, according to the general superintendent, H. C. Meek. The ore, after being delivered from the rock-crusher station, is to be crushed by 80 stamps (40 added) and 5 tube-mills, the product from the tube-mills being then distributed over 24 amalgamating plates, on which over 50% of the gold will be recovered. The product is then to be classified into sand and slime by means of hydraulic classifying and concentrating cones. The sand will be delivered to six vats, each 40 ft. diameter by 8 ft. 6 in. deep, for leaching by cyanide solution. The slime will be treated in the existing plant of four 8 by 40-ft. Pachuca tanks, and three 90 four-inch frame Merrill slime presses. The gold will be precipitated in 52-in. Merrill zinc-dust presses as during the past. In addition to the above, improvements to the rock-crusher station and belt-conveying system to the mill for the increased tonnage are in progress; and the water supply pumping scheme from Porepine Lake has been completed.

Dredge buckets have been increased in size, until the present largest of 16 cu. ft. capacity seems to be the economic limit. A bucket of this size weighs over two tons, and a digging ladder with 80 or 90 of these is



THREE SIZES OF DREDGE BUCKETS.

subjected to considerable strain, as is also the boat itself. The accompanying cut shows a comparison of sizes of the first dredge on the Yuba river, California; a 7-cu. ft. bucket of early boats; and a 15-cu. ft. bucket of Yuba No. 13.

Special Correspondence

LONDON

CONTROL OF PERSIAN OIL DEPOSITS ACQUIRED BY ENGLAND: AN INSTANCE OF FARSIGHTED BRITISH STATESMANSHIP.—DESCRIPTION OF THE DISTRICT.

Purchase of control of the Anglo-Persian Oil Co. by the British Government is an event of some importance in many ways. In the first place, it provides the first instance of the government obtaining for itself a source of supply of fuel of any kind for warships, having previously been at the mercy of the Welsh and English coal owners. Second, it proves to the 'man in the street' that oil is a much more important factor in the fuel problem than the average resident in the British Isles imagines. Third, that failing to obtain adequate supplies of oil within the British Empire, it has been necessary to go to a country within or near a hostile influence, that of Russia. It is opportune to say here that the oil required for British battleships is heavy oil suitable for combustion in steam-boiler furnaces, and not for internal-combustion engines. There are many advantages in burning oil fuel under steam boilers of warships, one being the absence of tell-tale smoke, and another the ease of equalizing the load in the ship, as the oil is consumed. As regards sources of supply, the attempts at securing a control of Mexican supplies were rendered futile by the revolutions, and a footing was not allowed in South America by representations relating to the Monroe Doctrine. The Persian deposits come very near the Russian horizon, and are also near the Turkish dominions where the Emperor Wilhelm of Germany likes to exercise a squeezing influence occasionally.

The history of the development of the Persian oil deposits is romantic. Fifteen years ago, W. K. D'Arcy, one of the men made rich by the Mount Morgan mine in Queensland, went in for oil, and obtained the sole prospector's license throughout Persia, with the exception of the northern provinces bordering on Russia. His first exploring parties met with modified success, and in the early years only one district, Kash-I-Shirin, in the northwest part, gave anything like promising results. But it was not until attention was turned to the bituminous seepages farther south, near Shushtar, that success was really attained. Here an oilfield of great potentialities has been developed, under the name of Maidan-I-Naphtun. The wells are about 1200 ft. deep, and the oil comes from a hard porous limestone of Miocene age. Other districts named White Springs and Ahwaz, nearby, are also being tested.

On the Maidan-I-Naphtun field, 30 wells have been drilled. Only 12, however, have been carried through to the oil horizon, and these have all produced oil; but some are wholly or partly shut-down as their production is not at present required. There is storage available for 60,000 tons of crude oil, either in steel tanks or open reservoirs. The oil is conveyed by pipe-line to the refinery at Abadan near the Persian Gulf, distant about 145 miles, and about 800 ft. below the level of Maidan-I-Naphtun. The pumping station is situated at Tembi, $2\frac{1}{2}$ miles from the wells, where powerful modern pumping machinery has been installed. The pipe-line is 6 in. diameter as far as Wais (53 miles), and 8 in. thence to Abadan, and has an estimated capacity of about 1000 tons per day, though this figure has been appreciably exceeded for short periods. The greater size of the pipe-line from Wais will enable considerable quantities of oil to be carried from the White Springs and Ahwaz, if the borings there are successful, without reducing the quantity being carried from Maidan-I-Naphtun. The pipe-line is provided

with gate-valves 10 miles apart, and stations have been placed at intervals of 20 miles for the purpose of keeping an hourly record of the pressure, so as to detect and avoid any loss by leakage.

The refinery is of modern construction, and laid out with a view to future extensions. It contains four benches, consisting in all of 34 stills, and petrol, kerosene of two qualities, and oil-fuel are produced. To prepare an oil-fuel suitable for admiralty requirements, it is only necessary to remove about 30% of the light products, allowing 5% for loss in refining a quantity of oil-fuel is obtainable equivalent to 65% of the original crude. A bench of four stills is capable of treating 7500 tons of crude oil, giving an output of about 4800 tons of admiralty fuel per month; and as the refinery is at present constructed, 20 stills could be turned on for this purpose which would produce about 24,000 tons per month, or say about 280,000 tons per year. The total capacity of the pipe-line is not sufficient, however, at present to deliver the necessary amount of crude oil, and the maximum possible output of oil-fuel at the present time cannot be estimated at more than 20,000 pounds per month. The total storage at the refinery, completed or under construction, will have a capacity of nearly 110,000 tons, of which 60,000 tons will be for crude oil. A steel pier has been built on the river bank near the refinery, having a depth of 25 ft. of water alongside at low-water spring-tide, but tank steamers load to only 18 ft. 6 in. at the pier, and take the remainder of their cargo from lighters below the bar. It is expected that it will eventually be possible for vessels to load to a greater depth at the refinery.

NEW YORK

EXPERIMENTS ON KEYSTONE, ARIZONA, COPPER ORE.—EAST BUTTE MINE.—BRADEN MINE AND PLANT.—MOND NICKEL CO.—GUANAJUATO REDUCTION & MINES CO.—COMPANIA HUANCHACA DES BOLIVIA.—DEVELOPMENT COMPANY OF AMERICA.

The new Keystone Copper Co. has made its report for the year ended December 31, 1913. The assets of the Company were valued at \$1,455,000, and the report shows cash on hand of \$3641. An interesting feature of the report is the account by J. P. Channing of the results of experiments made by R. C. Canby on the treatment of the ore. The first plan was to crush the ore fine, leach the oxidized copper minerals, and recover the sulphides by concentration. Experiments showed, however, that much of the chalcocite was in coarse form, while much of the oxidized material consisted of cuprite which is almost insoluble in sulphuric acid. Experiments are now being made along lines of giving the ore a light roast to make the cuprite soluble, at the same time oxidizing the sulphides. Flotation is also being considered. As the Company has blocked out 2,500,000 tons of ore which averages about 21% copper, the treatment of the ore is of great importance. An experimental mill has been built near Miami, and experiments are still under way. The Company is in litigation with the Inspiration Consolidated, which is seeking to obtain an underground right-of-way through Keystone ground. The preliminary injunction granted last year to the Keystone has been made permanent, and the Inspiration has started condemnation proceedings against the Keystone to secure the desired right-of-way. The case is now before the Supreme Court of Arizona, and it is not known when the decision will be handed down.

The East Butte company is doing well under the capable management of Oscar Rohn, and will probably turn out over 1,250,000 lb. of copper monthly during this year, most of it from its own ores. The East Butte has been smelting Davis-Daly ores, which are decreasing in amount. The East Butte is a most interesting example of how a mine can 'come back,' as after having been a failure it has developed into a suc-

cess, although the tendency in copper mining of recent years has been toward the development of big low-grade properties, rather than the success of smaller enterprises with richer ore.

The Braden improved its recovery last month, making a 75.36% extraction of copper in its ore, the best results so far this year. The grade of ore treated was 2.11% copper, a decrease as compared to last month. Reports from Chile are to the effect that the Company is having a good deal of trouble with its smelter, which is somewhat puzzling, because it has not been many months since S. S. Sorensen, one of the most capable smelting men in the country, was sent down to take the general management of the Company. There are also reports of difficulties in the underground mining, and at any rate the operating costs, which Pope Yeatman estimated at 7.4c. per pound on a mill extraction of 65% of the copper in 1911, have never been reduced below 9½c. per pound, and are up again. The experience of Cerro de Pasco, Kennecott, Bonanza, and the Braden, all go to show that the development of a big mine in a remote place involves a great many difficulties which it is hard to foresee.

The reorganization of the Mond Nickel Co. should be of a good deal of interest to everybody, because that organization, the International Nickel Co., and the Société Minière Caledonienne among them control the nickel production of the world. The Mond company is of special interest, as it extracts nickel from the ore in the form of nickel carbonyl gas, which on further heating decomposes, yielding a deposit of pure nickel. The property and process of the Company

The unrest in Mexico has caused the shut-down of its plants, making it impossible for the Company to realize cash on all the production of the past six months, although earnings during the half-year are said to be more than sufficient to meet the interest payment.

The Compañía Huanchaca des Bolivia is having internal difficulties. The Company owns large silver mines in Potosi, Bolivia, and has smelters at Pulacayo and Playa Blanca, though the latter is now idle. It will be remembered that C. R. Corning went down to Bolivia about a year ago to take charge of operations of the Company. The secretary of a committee of disgruntled stockholders is now circularizing the other stockholders, charging that the expenditure of \$2,000,000 for the building of a hydro-electric plant is only represented by equipment of half that sum, and that the Company is being operated for the benefit of the American Smelting & Refining Co. The latter Company is drawn into the matter through the fact that it formerly leased the Playa Blanca smelter, and more recently considerable amounts of ore have been shipped to the Tacoma smelter. As a matter of fact, the American Smelting & Refining Co. has no direct connection with the Huanchaca, and the chief difficulty seems to be that a company which used to pay about 25% per year, twenty-five years ago, has steadily decreased its dividends, and since 1908 has paid none at all. However, the best of mines has to be worked out some time.

The Southern Arizona Mining & Smelting Co. has been incorporated in Virginia, with a capitalization of \$6,000,000

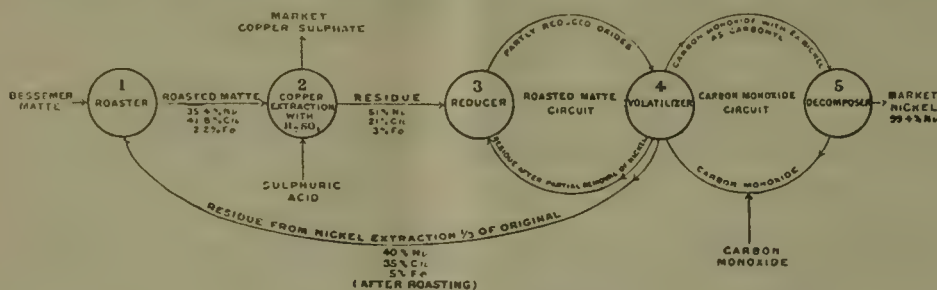


DIAGRAM OF OPERATIONS INVOLVED IN THE MOND PROCESS.

were described at some length in the *Mining and Scientific Press* of September 13, 1913. Not long ago a new smelting plant was built at Conaston, and operations of the organization have been so profitable that it has been decided to double the capitalization of the Company. The new Company will have a capitalization of £1,700,000, divided into 500,000 7% cumulative preferred shares, 300,000 7% non-cumulative preferred, and 900,000 common shares of £1 each. The present Company has £50,000 in deferred shares, which will be abolished. The present holders of the preferred shares of £5 each will be allowed to exchange them for five similar shares in the new Company. Of the common shares of the new Company, 450,000 will be allotted to the holders of the deferred shares of the old Company. In order to carry out this scheme, the old Company will be dissolved and its holdings turned over to the Mond Nickel Co., Ltd., as the new Company is to be called. Nothing more is heard of the rival company which was reported to be about to be launched a year ago.

At the annual meeting of the Greene Cananea Copper Co., the retiring directors, J. W. Harriman, M. M. Parker, and Phillip Foster, were re-elected. It is reported that the flotation process developed by J. M. Callow, which is giving good results at the National Copper mill at Mullan, Idaho, will be used by the Morning mill.

The Guanajuato Reduction & Mines Co. has announced that it will pay its semi-annual bond interest due on July 1.

and \$1,500,000 in debentures for the purpose of taking over the following subsidiaries of the defunct Development Company of America: Imperial Copper Co., Arizona Smelting Co., Arizona Southern Railroad, and the Gila Copper Sulphide Co. The history of these ventures was discussed in this journal of June 13, 1914.

BOSTON

REORGANIZATION OF UTAH METALS CO.—UNITED VERDE EXTENSION.—FARMING NEAR THE WASHOE SMELTER.—OLD DOMINION AFFAIRS.—STOCKS.

It appears that the reorganization of the Utah Metals Co. is to be effected upon a strong basis, with some of the leading financiers of Boston behind it. Former governor Eugene N. Foss and Messrs. Clark and Coolidge, who are on the board of the Alaska Gold Mines Co., are said to have become largely identified with the new Company, which will be known as the Utah Metal & Tunnel Co. This is a Maine corporation, with 500,000 shares of \$1 each. The old Company had a capitalization of \$7,500,000, being one of the largest mining corporations founded in Boston. The Company has a tunnel over two miles long extending from Bingham to Tooele, and also represents a consolidation of the Bingham Central Mining Co., the Bingham Standard Copper Co., and the Bingham Metal Mining Co., embracing 34 acres in the Bingham district,

Utah. Under the former Company the mineralized area was estimated at about half the value of the total property holdings. The tunnel furnished water and transportation to several Bingham companies. One of the main objects was to haul waste from Bingham, where there is a lack of dumping room to Tooele, where the waste can be used to advantage. E. P. Jennings succeeded Walter B. Farning as president, director and executive officer of the old Company.

Contrary to tradition, there seems to be a chance of an other copper mine being developed at Jerome, Arizona, outside of the holdings of the United Verde of W. A. Clark. Interests closely affiliated with Phelps, Dodge & Co. are conducting comprehensive exploration and development at the United Verde Extension, and results have lately been reported as encouraging, indicating that profitable ore will be exposed in the near future. United Verde Extension has never done much in a market way. The Company's mineralized holdings in area exceed those of the United Verde.

The Anaconda Copper company, through a subsidiary company called the Deer Lodge Valley Farms Co., is offering, on easy terms, 10-acre farms in the town of Opportunity, lying between Anaconda and Butte. These lots are situated in the Deer Lodge valley, where the farmers several years ago fought the Anaconda interests on the ground that fume from the Washoe smelter was destroying their crops and vegetation. Your correspondent traveled last July through the area which was under contest between the smelting and farming interests, and was surprised to note the strength of the crop and forest growth. It is claimed that the sulphur which escapes from the smelter stacks, in time as it settles down becomes an enriching element to the soil, and farmers are benefited rather than injured by it. At any rate, the Anaconda company has been experimenting, and proposes to encourage intensive truck farming right under the shadow of the Washoe smelter. The Company will also become a large manufacturer of sulphuric acid for use in its own leaching processes and for sale in Butte, which has in the past year become a large consumer of acid, and which it buys in Denver at \$22 per ton.

A recrudescence of the Old Dominion suit against A. S. Bigelow has resulted in another decision favoring the Company. At first it was thought that this would lead to a distribution of the bulk of the assets awarded the holders of Old Dominion 'trust receipts' as made by the Supreme Court two years ago. A dividend of \$10 per share was looked for. But hope is to be deferred again. G. F. Hyams, an associate of Mr. Bigelow, succeeded in tying up the matter for two years by securing an injunction restraining the distribution of the assets placed with a trust company by Mr. Bigelow to secure payment in the event of judgment against him, and it seems that Mr. Hyams has one or two more 'tricks' up his sleeve. The liquidating value of the 'trust receipts' will be about \$12 or \$13 per share, but they are selling at about half that price on the Curb here, and are inactive at that. This shows clearly that the average trader in the stock market is willing to gamble on nothing less than the forthcoming decision of a court.

Thanks to the efforts of one Boston banking house, the Boston mining list has been 'liberalized,' and when the 'coppers' get becalmed as at present, attention is somewhat diverted to zinc, gold, and coal issues. Alaska Gold, Butte & Superior, and the 'coal-dust twins,' Island Creek and Pond Creek, have recently by their activity or price strength contributed no little to taking investors' minds off of the heaviness of the red-metal issues. Copper stocks in Boston since the first of June have been exceedingly quiet. The extreme variation of 20 active coppers has been less than a point, showing a deadlocked market.

The demand for copper has been slight of late and but few sales are reported. The foreign demand has declined considerably and is again about normal. European consumption continues heavy.

WASHINGTON, D. C.

SMELTER FUME INVESTIGATIONS OF THE BUREAU OF MINES.
APPROPRIATIONS ASKED. EXPLOSIVES INVESTIGATIONS. USE OF PHOTODUPLICATION IN EDUCATIONAL WORK.

The U. S. Bureau of Mines is to have an appropriation of \$100,000 this year for scientific investigations concerning the mining, preparation, treatment, and utilization of ores and other mineral substances, with a view to improving health conditions, increasing safety, efficiency, and economic development, and conserving resources through the prevention of waste in the mining, quarrying, metallurgical, and other mineral industries. More particularly the money is to be used in connection with the study of the waste and deleterious products from smelters, especially copper smelters, and the general damage to the community arising from smelter fume. In asking for the appropriation, the director, J. A. Holmes, told the House Committee on Appropriations that the gases contained chiefly sulphur and arsenic, other substances being given off in much smaller quantities. An idea as to the amount of gases given off, he said, might be gained from the fact that one smelter in Montana gives off 1000 tons of sulphur per day. "The damage here extends for miles beyond," added Mr. Holmes. "In the case of another smelter, in California, the damage can be traced 25 miles where the drift of the wind is constant for a considerable period, and the area is extending. It has been learned how to take care of arsenic and the metalliferous materials given off in small quantities such as lead fumes, and that part of the sulphur given off in the form of sulphuric acid, the SO₂ combination which goes into sulphuric acid and which in that form is decidedly injurious. About the smelter itself, where the employees of the company operate, most of the damage done has been from the lead and arsenic. The policy that we have followed is that, wherever feasible, investigations which are local in their character must be paid for by the companies themselves rather than by the Government. In connection with the smelter investigations, however, there were certain problems which the smelter companies have practically declared to be unsolvable, and they did not think they ought to be called upon to spend money to solve, because they did not think they could be solved, and the results would apply to other smelters as well as themselves. Of the appropriation last year for this general work, \$15,000 was expended for smelter work. Wherever the problem was at all a local one, we have required the smelting company to do the investigation. We selected the men and we mapped out the line of examination, but every dollar of expenditure and the employment of the men and the handling of the moneys has been entirely within the hands of the smelting companies. With the expenditure of \$15,000, we have this year conducted the more abstract of the investigations, which could not be considered local in their character. Three of the smelters, under our general advice, are conducting investigations, each one of which costs practically as much as the amount we are spending. It seems our duty to get other people to bear these burdens just as far as feasible. We handle none of the money of these smelting companies; we plan the investigations and select the men to do the work, and watch the results."

Mr. Holmes was asked by members of the committee about the waste of sulphuric acid. "Unless there is a market for the sulphuric acid, there would be the question of storage, and it would be leaking into the streams, which would be just as vigorously opposed as turning the gas loose in the atmosphere. What we are trying to do is to find some means of collecting the sulphur in the form of a solid, so that it can be compressed into cakes; then it can be stored without any difficulty or loss in storage. Sulphuric acid is used in a good many manufacturing operations in the East, but the supply comes from Louisiana or abroad because the cost of

transportation from the West is prohibitive. Nevertheless, we are trying to get some of the larger smelting companies to go into not only the manufacture of sulphuric acid, but also of the phosphates."

Mr. Holmes mentioned other lines of investigation, such as safety and waste investigations in certain metallurgical plants, like those for the extraction of silver and gold. He asked for an additional appropriation of \$20,000 for the next year. It is especially desired to use this money, he explained, with reference to investigating the explosives used in metal mining and quarrying. "In metal mining," he said, "they want quick action, because they want to shatter the rock, but they do not care anything about low temperature. What they want is an explosive that will produce the minimum of poisonous gases, because in metal mining there is no such extensive ventilation system as in coal mines." To instruct the men in the use of explosives, pictures were being used, he told the committee, because most of the men did not understand English. With each picture is a line or two in four different languages. "By that means we get them to understand the meaning of these lectures," he said, "and we have been quite successful in bringing out the entire attendance of the miners. They will come to see the pictures and then try to learn all about safety projects. We would be still more effective if we could afford to use moving pictures."

ROCHESTER, NEVADA

THE FEDERAL DREDGE.—BONANZA KING TO BE REOPENED.—4J LEASE DEVELOPMENT.—ROCK, SHEA AND COLLIGAN, AND FERRY-SAMPSON LEASES.—ROCHESTER MINES COMPANY.

The dredge of the Federal Dredging Co., operating a few miles northeast from Rochester in Spring valley, was sunk during the past week, a small hole having been punched in the bottom by a 'reef' or point of bedrock at a time when the water was low in the pond. This dredge has had a rather checkered career. It was built in the upper portion of the basin, where it was found after the starting of operations that the bedrock was very close to the surface, and 'reefs' of the same, over which it was impossible to float the dredge, were numerous. The dredge was then moved, after several attempts, overland, to the lower portion of the area, where conditions more suitable to successful dredging were found. It has been running a number of months with good returns. The pond has been drained, and examination has shown that the damage to the dredge is slight, and it will be in operation again within a week.

The Bonanza King mine was visited last week by one of the officials, and it was stated that this property would be unwatered and examined with a view to a resumption of operations.

On the Rochester Mines Co.'s property the 4J lease has cut 30 in. of ore assaying \$30 per ton, in a raise from the main level. It is thought that this ore is a continuation of the shoot exposed in the north end of the Codd lease. The 4J lease has driven 250 ft. in a cross-cut, easterly from the main drift, and has cut several small stringers. This work is being continued with the expectation of cutting the main east vein at this depth. Little work has been done on this vein, and only on the surface, but this was sufficient to show its milling value. It is possible that the main lessees, three in number, and those adjoining, will combine and operate under one management.

The Rock lease, on the Nenzel Crown Point property, has added another shift, and is driving a cross-cut to meet the drift from the bottom of the shaft. This will save hoisting, which has been necessary heretofore. A small shipment is being made from this lease.

On the Rochester Weaver Co.'s claims, the Shea and Colligan leases are extracting ore for shipment. The Ferry-

Sampson lease is also making a shipment. The main leases have continued to make shipments totaling nearly 100 tons per day.

A meeting of the board of directors of the Rochester Mines Co. is scheduled for Monday, June 15, and it is expected that Joseph F. Nenzel will resign as president of the Company, and that John Cowan, of Salt Lake City, will be elected to the place. Several directors are also expected to resign, and their places will be filled from the new management. J. F. Nenzel and Rudolph Nenzel are to remain on the board of directors. This follows the recent settlement of the litigation involving the controlling stock in this Company. It is rumored that various properties will be consolidated and that a mill will be built to treat the ores of this camp.

PLATTEVILLE, WISCONSIN

CONDITION OF ZINC-MINING INDUSTRY.—PRODUCTION OF DISTRICTS.—SMELTER BUYING.—AMERICAN METALS CO. AS A BUYER.—NEW PLANTS.—IDLE MINES, ETC.

The general depression affecting the zinc-mining industry seems to have had no deterrent effect, as far as zinc-ore production in southwest Wisconsin is concerned. The month of May shows the southern districts of the field to have been unusually active, and both production and shipments reached the highest point known for the field in the past two years, while a careful survey of reserve tonnage in bin at the close of the month shows over 6000 tons of concentrate held in bin in anticipation of better markets. Producers claim that zinc ore must be on a basis of \$40 per ton assay of 60% zinc to afford any profit to them, and yet the creditable showing made was accomplished on a market that held most of the month under this point. The higher grade separator zinc ore and high-grade wet concentrate were in fair demand, while the inferior grades suffered by comparison. Buyers showed no anxiety to circulate through the field and submit bids, and therefore the bulk of the output, both contract and open market offerings, was secured by the Mineral Point Zinc Co. Average prices prevailing for the month were reported by one of the leading ore buyers as follows: 30%, \$14; 35%, \$16.50; 40%, \$19; 45%, \$22.50; 50%, \$26; 55%, \$30 to \$32; and 60%, \$36 to \$39 per ton. Producers of carbonate zinc ore were afforded no market at all, although market quotations showed substantial improvement. Production was maintained in the face of this rather discouraging situation, and a large tonnage is ready for immediate delivery should the opportunity present itself. Lead ore was in poor demand, and the few sales reported cleared on bids of \$45 to \$46 per ton of 80% lead. The market on pyrite was off all the month, and the deliveries were less than half usually reported.

Deliveries were made during the month by districts as shown in this following table:

District	Zinc, pounds.	Lead, pounds.	Pyrite, pounds.
Benton	7,306,000	167,040	3,349,600
Galena	5,560,000		
Hazel Green	3,514,000		
Livingston	3,292,000		
Cuba	1,922,000		
Linden	1,152,000	194,370	60,000
Harker	1,080,000		
Platteville	860,000	65,300	
Shullsburg	434,000		
Montfort	242,000	50,000	
Mineral Point	172,000		
Highland	132,000		
Dodgeville	86,000		
Mineral Point Zinc Co.	4,020,700		
Total	29,772,700	476,730	3,409,600

Sales were distributed among the smelters as follows: to Mineral Point Zinc Co., 7054 tons; National Separating Co., Cuba, 1280 tons; Empire Roasters, Platteville, 1042 tons; Illinois Zinc Co., 820 tons; Grasselli Chemical Co., 739 tons; M & H Zinc Co., 515 tons; Wisconsin Zinc Co., Cuba works, 197 tons; Linden Zinc Co., 388 tons; American Metals Co., 346 tons; and Wisconsin Separating Co., 186 tons, a total of 329 cars, equal to 12,867 tons.

The American Metals Co. started buying for the first time as a competitive element. The Wisconsin Zinc Co. purchased the Campbell Magnetic Ore Separating Works, at Cuba, originally owned by J. B. Worthington and other Boston interests. The plant was overhauled and re-rigged, and began operating for the Wisconsin Zinc Co. on June 1. A decided increase in deliveries of high-grade ore out of the field will follow as a consequence of this transaction. The Galena Iron Works Co., founders and mill builders, was taken over by a new corporation capitalized at \$60,000. Prospect work with drilling machines received such impetus during the month that small operating concerns were unable to secure service. The vast holdings of the New Jersey Zinc Co., in this field, were personally inspected by 50 of the leading officials of the corporation during the month, and it developed later that a most elaborate mining program is to be started as a result of this inspection. New modern power and concentrating plants were completed during the month for the West Hill Mining Co., Platteville; Lawrence Mining Co., Hazel Green; and Unity Mining Co., Galena. New plants are in process of construction for the New Jersey Zinc Co., Benton; Wisconsin Zinc Co., New Diggings; and Frontier Mining Co., Benton. Agents of Boston and Philadelphia capitalists were quietly engaged in securing options and leaseholds in the Benton, Hazel Green, and Galena districts.

The Empire Roasters, at Platteville, after several years steady treatment of high-grade zinc ore, will be removed to the Wisconsin Zinc Co.'s new properties in the New Diggings district. Thirty-five mines, fully equipped with power and concentrating plants, were idle at the close of the month. Two particularly heavy zinc ore producers, the Vinegar Hill mine, in the Galena district, and the Ellsworth mine, in the Mifflin district, are exhausted, and will be abandoned and the equipment removed to more desirable points. The Mineral Point Public Service Co., furnishing electric power, is extending its line northward to include all of the northern mining districts. Exceedingly rich strikes of zinc ore were made during the month in the Benton, Linden and New Diggings camps. A boycott directed against the Northwestern Railway Co. has been put into effect by the leading mining companies in the Benton, New Diggings and Shullsburg districts, and the traffic diverted to the Illinois Central Railway. Three camps for years steady ore producers are flat at the present time, Highland, Platteville, and Shullsburg.

MELBOURNE, AUSTRALIA

MINING LEGISLATION.—A CURT REQUEST.—THE TASMANIA MINE.

—A CONDEMNATORY REPORT.—GOLD AND SILVER IN 1913.

Attention is drawn by the *Australian Mining Standard* to examples of poor legislation by Australian governments. In Tasmania, a machinery act was rushed through parliament toward the close of last year. A clause in this measure made it obligatory for every motor in use below ground to have some one in attendance upon it continually. Not only so, but he must be a man properly qualified. The only mine to which the clause applies is the Mt. Lyell, and its underground pumps are electrically driven, and are started and stopped automatically. All that they require is occasional lubrication, so that all the attendant (who has, by law, to receive the wage given skilled labor) has to do is to sit and read or do anything else he can find to do to pass away

the time. The plants, it may be mentioned, are housed in chambers of iron and concrete, which are absolutely fire-proof.

Another instance given by this contemporary has reference to the Holman hoist. The mining laws of more than one of the states require the working of these little winches by certificated engine drivers, though the skill required for their manipulation is no greater than that necessary for the working of a machine drill. What is the result? The practical abolition of the Holman hoist, because its use for the ordinary purpose of hoisting material from winzes becomes too expensive, as a man cannot be kept fully employed driving one, and the certificated driver will not (and indeed dare not) take on miner's work between hoists. So, instead of being benefited, the miner is handicapped by having to haul out his dirt by the slower and more laborious windlass. This is only one of many instances in Australian mining legislation of the authorities interfering to make the industry unremunerative.

Surely the funniest thing that has yet happened in any strike in any part of the world has occurred at Lithgow, New South Wales. The 'fillers' at the Invincible colliery struck for an increase of wages. In the ordinary course of things this meant their earning nothing during the progress of the strike and being dependent upon payment from the union to which they belonged; but this was something not at all to their taste, so they hit upon the happy idea of asking the manager to find them other work during the continuance of the strike. For sheer impudence, this is hard to beat.

As was only to be expected, the report of the independent engineers, W. H. Cundy and J. Fawcett, appointed by the late Tasmanian government to make an inspection of the Tasmanian gold mine, Beaconsfield, has entirely confirmed the reports on which the directors were acting when they resolved to close down the mine. The summary and conclusion of the report are sufficient indication of the position taken by the engineers. It is as follows: "The mine is practically worked out down to 1500 ft. There have been blocks of good grade ore down to the 1500-ft. level, but as stoped in bulk and sent to the mill has been unprofitable. The lode is going down strong, but there is no evidence on which to found any expectation of increased gold content at the next or lower levels, though there is always a possibility of that happening. On that possibility, and if we were reporting for shareholders, we would not recommend the expenditure of £50,000 to £60,000 to sink the shaft and develop another level."

The gold output of Australasia in 1913 was as follows:

	Fine oz.
New South Wales	149,657
Victoria	434,932
Queensland	265,735
South Australia	6,545
Western Australia	1,314,048
Tasmania	33,400
Northern Territory	3,119

Total Australia	2,307,436
New Zealand	343,627
Papua (New Guinea)	15,094

Total Australasia

2,566,157

The silver output of Australasia in 1913 was as follows: New South Wales, 5,908,638 oz., and 8,596,251 oz. in concentrate, a total of 14,504,889 oz. fine, valued at £1,757,963; Queensland, 604,979 oz., valued at £68,438; Tasmania, value of silver-lead production, £319,997; South Australia, value of silver-lead production, £1100; Western Australia, value of silver exported, £20,376, and value of silver-lead exported, £53,524; and New Zealand silver export, 975,591 oz., valued at £103,863.

General Mining News

ALASKA

FAIRBANKS

Careful estimates of the gold production of this district for the current season show a total of \$3,791,000, or about the same as last year. The various creeks should yield \$2,941,000, Hot Springs about \$700,000, and the Tenderfoot, Kantishna, Bonfield, and outlying districts about \$150,000. Dumps on the creeks contain about \$665,500. The order of output from creeks is estimated as \$503,000 from Chatanika, \$438,000 from Ester, \$329,000 from Cleary, and \$312,000 from Goldstream. No estimate of the yield from the quartz mines has been made.

JUNEAU

May returns of the mines on Douglas Island were as follows:

	Alaska Mexican.	Alaska Treadwell.	Alaska United.
Development done, feet	30	339	1,161
Stock of broken ore, tons	-1,418	-66,973	-8,651
Stamps working	120	540	240
Ore crushed, tons	20,811	83,706	40,796
Concentrate saved, tons	335	1,566	900
Gold by amalgamation	\$20,062	\$101,517	\$44,493
Gold by cyanidation	20,269	89,660	40,447
Average per ton	1.94	2.28	2.10
Net profit	\$16,363	\$100,866	\$28,655

Of the development done in the Alaska United company's 700-Ft. Claim mine, 345 ft. was performed on the 1570 and 1750-ft. levels by the Alaska Treadwell company. No steam power was necessary during the month, water being plentiful.

A bonus dividend, No. 107, of 75c. per share, will be paid by the Alaska Treadwell Gold Mining Co. on June 29.

RUBY

A gold nugget worth over \$2600 was found on ground worked by W. Redwood and associates on the Hammond river in the Koyukuk district. They also got smaller nuggets worth a total of \$1000. The largest nugget found in Alaska, on Anvil creek, Nome district, was worth \$3200.

ARIZONA

GILA COUNTY

At the Barney Copper Co.'s mine, 25 men are employed. The shaft is down 125 ft., and over 100 ft. per month is to be sunk. At a depth of 312 ft. in the Inspiration Extension, adjoining the Keystone, Inspiration, and Live Oak properties, copper ore similar to that from the Scorpion shaft of the Inspiration has been cut. The shaft is to be sunk to 500 ft. The Gibson mine is employing 20 men and shipping about 100 tons of 30% and 200 tons of 14% copper ore per month to the Old Dominion smelter. Tests on the ore are being made in San Francisco.

PINAL COUNTY

(Special Correspondence.)—Electric power transmission lines are now connected with the Magma mine at Superior. The new mill probably will be ready by July 1. The Silver King mine has been bonded to an English syndicate. The Ajax claims, near the Reymert mine, has been taken over by George N. Bience, who represents Seeley W. Mudd. The price was \$50,000.

Superior, June 18.

YAVAPAI COUNTY

(Special Correspondence.)—The Emporia camp, on Groom creek, is quite busy. More men are to be employed at the Emporia mine, and ore is to be sent to Douglas in July.

Emporia, June 18.

CALIFORNIA

NEVADA COUNTY

The sum of \$35,000 is to be spent at the Golden Center of Grass Valley mine in erecting a 60-ft. head-frame, sinking a vertical shaft, and installing an electric hoist. The 10-stamp mill is working continuously. C. A. Brockington is superintendent.

PLACER COUNTY

The old Mayflower mine, on the Blue lead, is being reopened in charge of Charles Akers, formerly of the Hidden Treasure. The Gray Eagle, another old mine, is being pumped out. A number of claims in the Forest Hill district are being prospected.

Twenty men are working for the Excelsior Consolidated Gold Mining Co. at Cisco.

PLUMAS COUNTY

Keiselguhr, used in the manufacture of explosives and other materials, has been identified in the Golden Eagle and Goodenough mines, near La Porte. The mineral has been mined here since operations started, but, its value not being known, was discarded as waste.

SIERRA COUNTY

A good deal of prospecting is being done in the American Hill district, where a number of claims show promising results. An electric pump is now working in the Kate Hardy mine, near Forest, and sinking has been resumed. A. D. Grant is in charge. The interior shaft of the North Fork mine is down 75 ft., and is to be continued to 200 ft. before cross-cutting. The Miners' Home gravel mine has changed hands and 25 men are being employed by W. Spencer. The deposit is really stiff pipe-clay mixed with boulders. In washing, it is dumped into a hopper filled with water, and when the clay gets soft the pulp is run through a sluice-box in the usual way. Average returns are \$10 per carload. Good gravel has been opened in the Motor claim at Port Wine.

SISKIYOU COUNTY

Charles T. Harbeck, a New York capitalist and president of the Siskiyou Mines Co., operating a large hydraulic mine



MAP OF TRINITY COUNTY.

6 miles above Happy Camp, has just completed his annual 10-day inspection of the property. Mr. Harbeck was satisfied with the progress being made and the general condition of the extensive property.

TRINITY COUNTY

The option held by John Hays Hammond and associates

on over seven miles of placer ground along the Trinity river has been extended, and further prospecting is being done. Sufficient ground has been already proved to warrant the building of dredges.

TRUMBULL COUNTY

The Rawhide mine, three miles north of Jamestown, is being unwatered prior to examination. The App-Heslep claims at Quartz may also be mined.

COLORADO

GILPIN COUNTY

A lease and bond has been taken on the Keystone claims, in Quartz valley, by T. R. Cudahy. Past production is over \$200,000. Ore-shoots at 900 and 1000 ft. in the Pittsburg mine, in lower Russell gulch, are developing well. The mine produces 30,000 gal. of water per day. Recent shipments are as follows:

	No. 1.	No. 2.	No. 3.
Tons	17	17	16
Gold, ounces	4.17	4.66	6.21
Silver, ounces	5.26	6.20	6.40
Copper, per cent	5.85	6.20	6.14

Kramer Bros., H. Wherry, Holmes & Co., and the Bates Leasing Co. are all doing well with their leases.

TELLER COUNTY (CRIPPLE CREEK)

Four distinct shoots have been partly developed at 1600 ft. in the Vindicator mine. There are 125 miners employed on No. 11, 12, 13, 14, and 16 levels. Lessees are working on levels above and on shafts No. 2, 5, 6, and 11, and the Hull City shaft. Good progress is being made with the new concentrating plant. H. P. Nagle, Jr., is superintendent. Unworked ground on Battle mountain, owned by the United Gold Mines Co., is to be worked by lessees.

IDAHO

BLAINE COUNTY

The mill of the Wilbert mine, 40 miles from Arco, is to be restarted in a few days, according to the manager, Harry S. Knight. Steady development was carried on while the plant was stopped, and 75 tons of lead ore per day can be supplied.

CUSTER COUNTY

Rich gold ore is reported to have been discovered by W. Oster and the Wells brothers at the old Montana mine on Estes mountain. Little has been done on this property for many years. A few men are now working at the old Ramshorn mine at Bayhorse, which has been practically idle for about 20 years. Past work consisted in driving 15 adits and connections a total of about seven or eight miles, and a production of copper-silver ore worth \$3,000,000.

SHOSHONE COUNTY

Work has been resumed at the Morning mine by the Federal company, which was shut down several weeks ago. Good lead-copper-silver ore was opened in the Great Western mine some time ago, and sinking on the shoot is to be started. The claim is above Burke. Rich silver ore has been opened in the Hughes lease of the Yankee Boy mine near Wardner. During the quarter ended May 30, the Federal Mining & Smelting Co.'s net earnings were \$218,456, of which \$180,000 was paid in dividends. The surplus on June 1 was \$1,540,187.

F. Augustus Heinze and his associates have lost their suit to oust McKinnon & Carrington of the Assets Realization Co. from the directorate of the Stewart Mining Company.

MICHIGAN

HOUGHTON COUNTY

The worst air-blast in the history of the Quincy mine occurred last week. Work at No. 2 shaft can be resumed in about three weeks.

MISSOURI

JASPER COUNTY

Just above water level, at 216 ft., the M. & N. Mining Co. is mining 25% 'jack' ore south of Cartersville. The operators state that good ore is opened to 230 ft., and again at 245 ft. Heavy timbering is necessary in the soft ground. A 4-in. motor-driven centrifugal pump is draining 12 acres of Connor land, south of Cartersville, leased by F. Wallower. Previous work was done from 190 to 215 ft. depth. At 60 ft., in a lease of G. L. Childress and B. Messenger, lead and calamine ore yielding nearly 75% is being mined.

MONTANA

JEFFERSON COUNTY

The Whitehall Mining, Milling & Development Co. has been organized at Whitehall, with a capital of 500,000 \$1 shares. Of these, 50,000 were subscribed for, 200,000 are in the treasury, and 250,000 were given for the Burlington group of mining claims. These claims are three miles northeast of the town. Over 200 ft. has been driven on a 36-ft. ore-body. Ore shipped has assayed up to \$32 per ton, but average assays are \$16.50 per ton. Officers of the Company are: T. T. Gates, president; N. D. Root, vice-president; and C. W. Hatch, secretary. These are directors with Edward Ryan, Jess Johnson, L. B. Knight, Ross Edwards, J. M. Borden, and James Ryan.

SILVERBOW COUNTY

The report of the Anaconda Copper Mining Co. to the assessor of this county for purposes of taxation for the twelve months ended June 1, 1914, shows net earnings of \$8,613,564, against \$11,446,901 last year. Net earnings for the calendar year 1913, as shown by the annual report to stockholders and review in this journal of May 23, were \$11,323,498. The latest statement is as follows:

	1913-14.	1912-13.
Ore mined, tons	4,714,653	4,531,640
Gross revenue	\$39,464,004	\$43,130,733
Yield, per ton	8.37	9.51
Total mining cost	17,816,505	18,285,445
Cost per ton	3.78	4.03
Cost of transportation	1,405,558	1,369,843
Cost of treatment	8,057,896	8,496,850
Cost per ton	1.71	1.87
Cost of marketing	3,570,478	3,531,602
Total costs	30,850,439	31,683,842
Net proceeds	8,613,564	11,446,901

The lower price received for copper partly explains the reduced profits for the period just ended. As the Company has 4,332,500 shares outstanding, exclusive of 330,000 shares to issue for the International Smelting & Refining Co., the net profits for the year ended June 1 were equal to \$1.99 per share, against \$3 paid in dividends. In other words, the Company fell \$4,350,000 short of earning dividend requirements for this period.

Suit has been started at Helena by minority stockholders of the Alice Gold & Silver Mining Co. against the Anaconda Copper Mining Co. and majority stockholders of the Alice Gold & Silver company, involving property alleged to be worth several million dollars, and in which the Sherman anti-trust law is invoked. The plaintiffs allege that on May 27, 1910, the majority stockholders of the Alice company voted to transfer the stock of that Company to the Anaconda company, and that the stock so voted was worth \$15,000,000, while the 30,000 shares of stock received from the Anaconda company were worth only \$1,020,000. The plaintiffs allege that this really amounts to restraint of trade, and in support of that contention they recite the history of the Amalgamated Copper Co. since 1899, tending to show that that Company, which controls the Anaconda, continuously has been buying up min-

ing properties in Silverbow county and paying them with their own stock.

An independent miners' union was formed at Butte on June 21 in spite of overtures from Charles H. Moyer and other Western Federation officials. W. McDonald is temporary president, and most of the executive committee are I. W. W. men. A mass-meeting of 5000 men was held, voting being done by acclamation. An assessment of 50c. per month is to be levied.

Further trouble arose at Butte on June 23, when a meeting was to be held at the Miners' Union hall to hear a 'peace' plan by Charles H. Moyer. A crowd threatened to break up the meeting and sheriff's deputies opened fire on the men, killing one and wounding several others at the same time. Three charges of dynamite wrecked the front of the hall. Moyer has promised a full investigation into the old union's affairs, but in the meantime has fled.

NEVADA

During the ten months that the Nevada Industrial Insurance Commission has been in existence, a total of \$203,211 has been paid in as premiums by the various industries allied with the Commission. Of this total, \$167,627, or 82%, was contributed by the mines of the state. In the mining,

ber. 691 accidents incapacitated injured persons for less than two weeks, and 469 accidents for more than two weeks. Twenty-nine accidents resulting fatally were reported to May 31. The number of claims filed to May 31 reached 464, while cases involving 391 disabilities and 13 fatalities have been disposed of. Fifty-four claims have been rejected and eight claims withdrawn. During the life of the Commission the compensation paid totals \$37,125, and the compensation awarded and payable in monthly installments from the pension reserve fund reaches \$34,390. The expense of conducting the Commission totals \$23,372, and for furniture and fixtures \$3848 has been paid. The organization expenses were \$2084. In the asset column of the report the cash in the general fund is given as \$81,437; cash in the pension reserve fund, \$34,390; and cash in the insurance reserve fund, \$20,321. The total cash is given as \$136,148.

ESMERALDA COUNTY

Drifts have been driven 60 ft. north and south from the Goldfield Ore shaft at 810 ft. In the north end the quartz is more solid with better gold content, and in the south it is broken, but improving. Ore averaging \$100 per ton is being extracted from a winze below the Vernal 100-ft. level. W. S. Norris is superintendent. The 500-ft. level of the Silver Pick shows, at 150 ft. from the cross-cut, 12 in. of ore assaying \$58 gold, 2 oz. silver, and 5% copper; and 36 in. assaying \$22 gold, with similar silver and copper content. The Jumbo Extension is shipping about 90 tons of ore per day to the Goldfield Consolidated mill. The portion of the plant in use consists of the following, according to J. K. Turner, consulting engineer to the Jumbo Extension company: The ore is elevated from the main crusher to the ore-bins and thence falls through the gates to two 5-stamp batteries, an 8-mesh screen being used. All the product from the stamps passes over two sand roughing tables, the concentrate from these tables going to an iron tank outside the mill building. Tailing then passes to the Chilean mill, using a 24-mesh screen. The oversize goes to the finishing sand table, making a concentrate, which passes to the rectangular boxes in the drying-room, while the tailing is diverted to a discharge tank. The undersize from the Bunker Hill screen passes to two roughing slime tables. Concentrate goes to the rectangular boxes in the drying-room and the tailing to six finishing slime-tables on the main floor. The concentrate is carried to the rectangular boxes, and all tailing goes to a tank in the mill to be flushed out to the tailing pond. The deepest level of the mine, where drifts are being extended northeast and southwest from the raise above the 1017 ft. level, has continued to show 7 ft. of good mill ore. The higher-grade product, which contains silver and copper in addition to gold, is shipped to the Millers' sampler of the Western Ore Purchasing Co. Experiments are being conducted with a view to equipping the part of the mill that is treating Jumbo Extension ore with the flotation process.

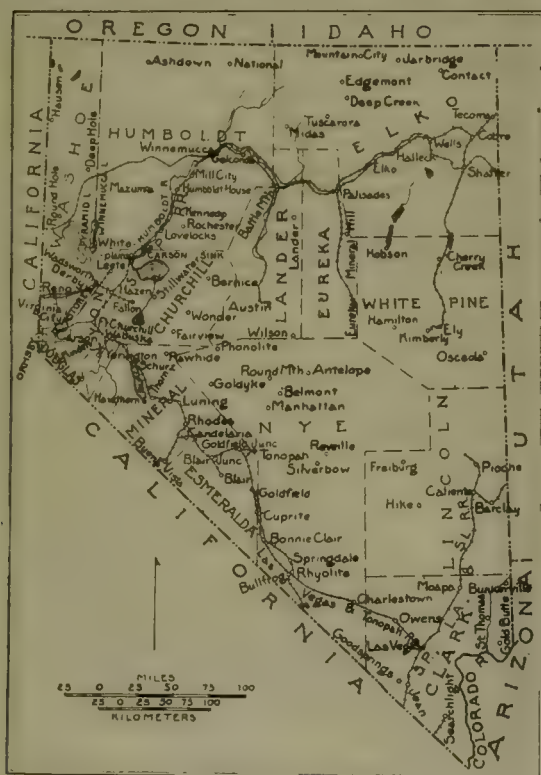
The Goldfield Consolidated Mines Co. has come to an agreement with the Moore Filter Co. regarding royalty payable on the latter's process.

HUMBOLDT COUNTY

The Kromer-Hampton lease on the Nevada Packard mine is now producing about 30 tons of ore per month. A fourth shipment has been made which averages about \$60 per ton. The company is driving three adits to get under the rich shoots. In No. 6 and 7 levels of the National Mines Co. rich gold and silver ore has been opened. P. G. Harrison is in charge. Good headway is being made in the White Rock adit of the Charleston National company. In the Hatch lease of the Buckskin National company, the vein has been cut 30 ft. from the surface. Other lessees in the district are busy.

LYON COUNTY

A large number of bees have died in the Yerington valley of late, and some apiarists blame fume from the Mason Val-



MAP OF NEVADA.

milling, and smelting industries, 257 firms, corporations, and individuals are contributors to the fund and employ 7710 men. Some of these are as follows: Nevada Consolidated, over 2500 men, \$40,756; Goldfield Consolidated, over 750 men, \$17,327; Tonopah Belmont, 400 men, \$9928; Mason Valley, \$4722; Pittsburg Silver Peak, \$3659; Round Mountain, \$2438; Nevada Hills, \$2610; Ophir Silver, \$1088; National Mines \$1428; Buckhorn Mines, \$3950; Yellow Pine, \$1288; and Prince Consolidated, \$1141. The balance was made up by railroads, lumber, power, and miscellaneous industries. A total of 1203 accidents were reported during the period. Of this num-

lev smelter, but a number of causes have been suggested which would probably kill these insects. The plant treated 4942 tons of ore during the week ended June 17. An experimental leaching plant of 10-ton capacity is being erected at the smelter by E. R. Weidlein, of Pittsburgh.

The Casting Copper portion of the Nevada-Douglas property is now producing 120 tons of ore per day, averaging 6.75% copper. No. 5 raise is up 50 ft. from the 200-ft. level. The ore is all chalcopryite in schist formation, and assays 2.5% copper. Work at 300, 400, 600, and 700 ft. in the Ludwig is yielding fairly satisfactory results.

MINERAL COUNTY

At Rawhide, the Nevada New Mines Co. is employing 36 miners and 10 millmen, who are producing 900 tons of ore per month. A winze is down 35 ft. below the 500-ft. level, and the ore contains gold and ruby silver. The second bullion shipment for June amounted to 3100 oz. The Black Eagle company is milling 50 tons of ore per day. Lessees in the district are doing fairly well. The Goldfield Consolidated has acquired the Aurora property at a cost of over \$900,000.

NYE COUNTY

The Round Mountain company, R. H. Ernest, superintendent, is about to lay a pipe to sluice the hill of Round Mountain and other portions of its property. Water from Jett creek is to be used, and the pipe-line will be from 6 to 8 miles long. The Company's mine and mill are in continuous operation. Litigation between the Round Mountain Mining Co. and the Round Mountain Sphinx Mining Co. was concluded on June 16, the former Company absorbing the latter, while the capital of the Company will be increased from \$1,000,000 to \$1,500,000. James Robertson, of Tonopah, has been instrumental in making the agreement, ending five years' trouble in the courts. At Manhattan, installation of the surface equipment has taken longer than anticipated, due to the large amount of excavation necessary. The collar of the new shaft being on a hillside, the whole hill for 150 ft. in length and 50 ft. in width had to be leveled, necessitating the removal of over 2500 tons of rock. A shipment of five tons of concentrate caught by riffles below the tube-mill plates of the War Eagle mill, has been made. The product averages 20 oz. gold per ton. The local chalcedony rock is showing much greater efficiency than the imported Danish tube-mill pebbles at this mill.

Ten mines at Tonopah produced 49,008 tons of ore, worth \$832,130, in May. The West End treated 6250 tons at a profit of \$32,007. A pump with a capacity of 200 gal. per minute at a depth of 2000 ft. is being installed on No. 15 level of the Belmont mine.

George W. Abel, of Battle Mountain, has given the Denver Quartz Mill & Crusher Co. an order for a 25-ton Denver quartz mill, and the Denver Engineering Works an order for an Isbell concentrator.

STOREY COUNTY

Owing to the Mexican and Union companies, on the Comstock lode, refusing to help in operating the Union shaft and the joint Union-Sierra Nevada winze to prospect below 2500 ft., the Sierra Nevada has been temporarily shut down. The Ophir company is to stop work above 2500 ft. and ventilate this level; by this the Sierra Nevada will be able to operate through the C. & C. shaft. The winze below 2500 ft. is down 90 ft., and shows 8 ft. of \$7 ore. Connection was to be made at 2600 ft. and driving north done on the vein.

UTAH

BEAVER COUNTY

The Croft mine has been sold to G. W. Morgan and associates of Salt Lake City. A large vein, containing chiefly lead and silver, with some gold and zinc, has been opened for 3000 ft. along the strike, the deepest working being 100 ft. Copper ore has also been found in the south part of the property.

JUAB COUNTY

A jigging plant is being used to treat old dumps at the Bullion Beck mine at Tintic. Two machines are treating 26 tons of ore per day, producing three tons of 40% lead and 18 to 22 oz. silver concentrate. The lessees have to pay a royalty of 25%. Jigs are also working at the Uncle Sam mine.

In the Dragon mine, at Silver City, is a large tonnage of iron ore averaging 50 to 60% metal, and it is stated that Jesse Knight will probably erect a blast-furnace in the district.

SUMMIT COUNTY

The Snake Creek tunnel was advanced 371 ft. in May, which distance is a record. The work is now in about 8000 ft., and a depth of 700 ft. The flow of water is 5200 gal. per minute. J. A. McIlwee & Co. are contractors.

A Holt-Dern mechanical roasting furnace will probably be installed in place of the present hand-rabbed furnaces at the Mines Operating Co.'s plant. A better roast, 10% better leaching, and a general saving of \$1 per ton is expected from the new furnace, based on results from a 10-ton machine which has been tried for several months.

The U. S. District Court has granted title to the Silver King Consolidated company to all ores vertically beneath the surface of the Electric Light, Cumberland, Ural, and Croesus claims at Park City. Shipments of products from Park City mines last week were as follows: Daly-Judge, 653; Silver King Coalition, 465; Silver King Consolidated, 310; and Daly West, 74; a total of 1502 tons.

WASHINGTON

STEVENS COUNTY

Trial runs have been made on the Copper King oil-burning smelter at Chewelah. The matte produced assayed 34% copper. The furnace was devised by J. J. Anderson, of Spokane. C. S. Batchelder is metallurgist.

CANADA

ALBERTA

An explosion in the Hillcrest colliery, near Frank, on the Crow's Nest line, is reported to have killed 200 men on June 18. Rescue cars and apparatus were rushed to the mine.

BRITISH COLUMBIA

Three blast-furnaces are now in commission at the Granby plant at Hidden Creek. There has been a shortage of silicious ore lately. A total of 1,250,000 lb. of copper has been produced since the new smelter started.

ONTARIO

An adjourned meeting of the Chambers-Ferland Mining Co. was held in Cobalt on June 10, and there was considerable discussion on the proposal to transfer the stock and assets for 115,000 £5 shares in the Aladdin Mining Co., which has few valuable assets. The meeting was adjourned to London, on July 1.

Eighty stamps are now working at the Dome mill, but the extra tube-mill is not quite ready. A continuous decantation plant is to be added to the McIntyre mill, and so increase the capacity from 150 to 300 tons per day. The last four weeks' report of the Hollinger company shows that mine development was satisfactory. The mill treated 15,200 tons of ore, including 831 from the Acme mine, averaging \$13.10 per ton, with 95.7% recovery. All costs amounted to \$4.219 per ton, and the gross profit was \$123,088. The net surplus is \$820,058.

YUKON

Thirty tons of rich silver ore, to be followed by 30 tons more, is being shipped from McWhorter's claim on Galena creek near Mayo. Forty-five claims have been recorded on Galena creek, and a total of about 60 in the district. Daily shipments of copper ore from the Pueblo mine to Tacoma are now about 240 tons.

Personal

CARR B. NEEL is in California.

F. B. VAN HORN is at Portland, Oregon.

J. A. HOLMES is at Fort Bayard, Arizona.

E. GYBSON SPILSBURY has returned from Belgium.

F. LYNWOOD GARRISON is on his way to Nome, Alaska.

MAN J. WELCH will be in Vantrent, California, for a few weeks.

BRADLEY STOUGHTON has returned from a brief trip to France and Spain.

C. F. RAND expects to reach New York, returning from Cuba, about July 1.

A. A. HASSAN has been examining the Big Injun property in Mineral county, Nevada.

H. C. MEER has resigned as manager for the Dome Mines company of Porcupine, Ontario.

HORACE V. WINCHELL was in New York last week, returning from Europe, and has gone to Washington.

BERNARD MACDONALD has moved his office from 1005 Fair Oaks avenue, South Pasadena, to 533-4 I. W. Hellman building, Los Angeles.

F. YAMADA, mining engineer with the Tokio Copper Mining company of Tokio, Japan, was in Ontario recently and is visiting Western mines.

J. P. IDIRINGS, who has been lecturing in London, is visiting various European countries and will go to the Dutch East Indies for some months.

N. O. LAWTON, formerly superintendent of mines for the Miami Copper Co., is visiting some of the copper and iron mines of the Lake Superior district.

WILHELM ROSENFELT, of St. Petersburg, and A. SIMON, of London, are examining a copper property in the Altai mountains, Siberia. Later on the former will go to Turkestan.

T. E. MITCHELL, formerly assistant general superintendent for the Anaconda Copper Mining Co., has accepted the position of assistant general manager for the Burma Corporation, of Burma, East India.

E. S. MOORE passed through San Francisco this week on his way to the Australian meeting of the British Association for the Advancement of Science. He plans to spend next winter at the University of Berlin.

L. D. RICKETTS, general manager for the Greene Cananea Copper Co., THOMAS F. COLE, WILLIAM B. THOMPSON, and a number of others will shortly visit the property of the Consolidated Coppermines Co., at Ely, Nevada.

OSCAR LACHMUND, general manager for the British Columbia Copper Co., of Greenwood, British Columbia, was in Republic, Washington, last week, conferring with the Ben Hur Leasing Co. and other mining concerns in relation to ore shipments.

K. M. SIMPSON, formerly general manager for the Atlanta mines of Goldfield, is assistant general manager for the Goldfield Consolidated Mines Co., relieving J. W. HUTCHINSON, who is leaving to undergo treatment for injuries sustained last winter.

The U. S. Civil Service Commission calls attention to the fact that for the non-assembled open competitive examination for assistant mining engineer, scheduled for July 13, 1914, the maximum age limit will be 45 years on the date of the examination instead of 35 years as stated in the original announcement.

With the close of the present term at the Massachusetts Institute of Technology, ROBERT H. RICHARDS will be made professor emeritus, after forty-six years of teaching. In addition to the invaluable service he has given the Institute in the department of Mining Engineering and Metallurgy and as secretary of the Institute, he is well known in the mining profession as consulting engineer and expert in mining matters and for many technical books.

Society Meetings

JUNE

American Society of Mechanical Engineers.....end of June
Franklin Institute, Philadelphiaend of June
Society for the Promotion of Engineering Education29 to July 2

JULY

Northern California and Southern Oregon Mining Congress, Ashland, Oregon 9-10

AUGUST

American Institute of Mining Engineers, Salt Lake City 10-14
British Association, Adelaide, South Australia..... 8
Canadian Mining Institute, Rocky Mountain branch, Banff.
Lake Superior Mining Institute, Marquette, Michigan.. 17

SEPTEMBER

American Chemical Society, Montreal 15-18
American Institute of Electrical Engineers.....not fixed
Colorado Scientific Society, Denver..... 3

OCTOBER

American Institute of Electrical Engineers..... 9
American Iron and Steel Institute..... 23-24
Colorado Scientific Society, Denver 3

NOVEMBER

American Institute of Electrical Engineers..... 13
Colorado Scientific Society, Denver 7

DECEMBER

American Institute of Electrical Engineers..... 11
American Museum of Safety 11-20
American Society of Mechanical Engineers..... 7-8

Schools and Societies

THE Montana section of the American Institute of Mining Engineers leaves Butte on August 9 for the Salt Lake City meeting. So far, 25 engineers have promised to attend from Montana.

CLARENCE L. CORY, professor of electrical engineering and dean of the college of mechanics of the University of California, was recently given the degree of Doctor of Engineering by Purdue University.

THE ninth International Congress of Applied Chemistry will be held at St. Petersburg, Russia, from August 8 to 14, 1915, according to the preliminary announcement, which contains all details of the meeting. The secretary is W. N. Ipatiew.

THE British Association for the Advancement of Science meets in Adelaide, South Australia, on August 8. A week at each state capital is planned, with excursions, one of which is to Broken Hill, New South Wales. About 400 members will attend from England.

THE University of California started its summer school with about 3000 students on June 22. There are only five permanent buildings on the Berkeley campus, and the Alumni Association of the University is to ask the people of California to vote bonds for \$1,800,000 to erect more substantial buildings to house students and valuable apparatus.

THE Mount Lyell School of Mines and Industries, affiliated with the University of Tasmania, is in full swing at Queens-town. It is right at the centre of operations of the Mt. Lyell copper mines and smelters, and offers good opportunities for study in mining, treatment, power, and railways. Robert C. Sticht is president, and B. Whittington, registrar.

The Metal Markets

LOCAL METAL PRICES

San Francisco, June 27.

Antimony	9 - 3 1/2c
Electrolytic copper	15 - 15 1/2c
Pig Lead	4.15 - 5.10
Quicksilver (flask)	\$38.50
Tin	39 - 40 1/2c
Spelter	6 1/2 - 6 3/4c
Zinc dust, 100 kg. zinc-lined cases, 7 1/2 to 8c. per pound	

EASTERN METAL MARKET

(By wire from New York.)

NEW YORK, June 25.—The past week's metal prices show little change from the previous week, copper being lower, and lead and spelter remaining as before. All markets are quiet and weak. Transactions on the Stock Exchange are very small, and copper shares are falling. The St. Louis lead and spelter markets are dull at 3.80 and 4.90c, respectively. Bar silver in London is quiet at 25 1/2d. (\$1.75c) per ounce.

SILVER

Below are given the average New York quotations in cents per ounce, of fine silver.

Date	Average week ending
June 18.....	56.37
" 19.....	55.87
" 20.....	56.12
" 21 Sunday.....	
" 22.....	56.50
" 23.....	56.37
" 24.....	56.25
May 13.....	58.73
" 20.....	58.31
" 27.....	57.12
June 3.....	56.52
" 10.....	56.48
" 17.....	56.56
" 24.....	56.24

1913.	1914.	1913.	1914.
Jan.....	63.01	57.58	
Feb.....	61.25	57.53	
Mch.....	57.87	58.01	
Apr.....	59.26	58.52	
May.....	60.21	58.21	
June.....	59.03		
July.....		58.70	
Aug.....		59.32	
Sept.....		60.53	
Oct.....		60.88	
Nov.....		58.76	
Dec.....		57.73	

Monthly averages.

COPPER

Quotations on copper as published in this column represent average wholesale transactions on the New York market and refer to electrolytic copper. Lake copper commands normally 1-5 to 1-4c. per lb. more. Prices are in cents per pound.

Date	Average week ending
June 18.....	13.60
" 19.....	13.60
" 20.....	13.60
" 21 Sunday.....	
" 22.....	13.50
" 23.....	13.50
" 24.....	13.50
May 13.....	13.93
" 20.....	14.00
" 27.....	13.98
June 3.....	13.86
" 10.....	13.75
" 17.....	13.65
" 24.....	13.55

1913.	1914.	1913.	1914.
Jan.....	16.54	14.21	
Feb.....	14.93	15.42	
Mch.....	14.72	16.23	
Apr.....	15.22	16.31	
May.....	15.42	15.08	
June.....	14.71	14.25	
July.....		14.21	
Aug.....		15.42	
Sept.....		16.23	
Oct.....		16.31	
Nov.....		15.08	
Dec.....		14.25	

The cost of producing copper per pound in the United States, Canada, and Mexico last year showed a marked increase over that of 1912, according to Thompson, Towle & Co., of New York, who have computed this figure from the operating results of fifty of the largest producers in these countries. The properties in question include all the large porphyry mines of the West, the Michigan coppers, the mines of Butte, Bisbee, Globe, Clifton, and other large camps throughout the country, two British Columbia properties, and three of the largest Mexican mines, which yielded a total of 1,200,000,000 lb. of copper, about 85% of the total output of North America. The cost was 9.9c. per pound, against 9c. in 1912. Indications point to the current year's cost being lower than 1912.

Reports from 29 copper companies operating in the United States in 1912, and 30 companies in 1913, show the following totals, according to Hayden, Stone & Company:

	1913.	1912.
Total production, pounds.....	1,094,554,692	1,099,198,493
Av. price received, cents per lb.....	15.33	16.05
Av. cost, cents per lb.....	11.51	9.86
Total profit.....	\$57,741,471	\$82,430,445
Average profit per share.....	\$3.90	\$6.80

The output of these mines is nearly two-thirds of the entire American production. In spite of the Lake Superior strike, which greatly hampered the mines in that district, the 1913

and 1912 figures are practically the same, the loss from the lack of mining being made up chiefly by the gain from the porphyries. The higher cost of production and lower prices obtained for the metal in 1913 made a considerable difference in the net profits, which were \$25,000,000, or nearly \$7 per share, smaller in 1913 than in the preceding period. Nevertheless, that the properties which turn out two-thirds of the total American output of copper can, under such unfavorable circumstances as prevailed during the greater part of the past year, earn approximately \$1 per share on the capital stock outstanding, is good evidence of the profitability of good mining investments. Especially is this true when we consider the comparatively small amount of cash paid in, usually not over \$25 per share, and frequently nearer \$10 per share.

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending	June 11.....	38.50
May 28.....	39.00	38.50
June 4.....	39.00	38.50

1913.	1914.	1913.	1914.
Jan.....	39.37	39.25	41.00
Feb.....	41.00	39.00	40.50
Mch.....	40.20	39.00	39.70
Apr.....	41.00	38.90	39.37
May.....	40.25	39.00	39.40
June.....	41.00		40.00
July.....		41.00	
Aug.....		40.50	
Sept.....		39.70	
Oct.....		39.37	
Nov.....		39.40	
Dec.....		40.00	

Monthly averages.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date	Average week ending
June 18.....	3.90
" 19.....	3.90
" 20.....	3.90
" 21 Sunday.....	
" 22.....	3.90
" 23.....	3.90
" 24.....	3.90
May 13.....	3.90
" 20.....	3.90
" 27.....	3.90
June 3.....	3.90
" 10.....	3.90
" 17.....	3.90
" 24.....	3.90

1913.	1914.	1913.	1914.
Jan.....	4.28	4.11	
Feb.....	4.23	4.02	
Mch.....	4.32	3.94	
Apr.....	4.36	3.86	
May.....	4.34	3.90	
June.....	4.33		
July.....		4.35	
Aug.....		4.60	
Sept.....		4.70	
Oct.....		4.37	
Nov.....		4.16	
Dec.....		4.02	

Monthly averages.

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date	Average week ending
June 18.....	1.85
" 19.....	1.85
" 20.....	1.85
" 21 Sunday.....	
" 22.....	1.85
" 23.....	1.85
" 24.....	1.85
May 13.....	1.85
" 20.....	1.85
" 27.....	1.85
June 3.....	1.85
" 10.....	1.85
" 17.....	1.85
" 24.....	1.85

1913.	1914.	1913.	1914.
Jan.....	6.88	5.14	
Feb.....	6.13	5.22	
Mch.....	5.94	5.12	
Apr.....	5.52	4.98	
May.....	5.23	4.91	
June.....	5.00		
July.....		5.11	
Aug.....		5.51	
Sept.....		5.55	
Oct.....		5.22	
Nov.....		5.09	
Dec.....		5.07	

Monthly averages.

TIN

New York prices control in the American market for tin, since the metal is almost entirely imported. San Francisco quotations average about 5c. per lb. higher. Below are given average monthly New York quotations, in cents per pound:

Monthly averages.	1913.	1914.
Jan.....	50.45	37.85
Feb.....	49.07	37.76
Mch.....	46.95	38.10
Apr.....	49.00	26.10
May.....	49.10	33.29
June.....	45.10	
July.....		40.70
Aug.....		41.75
Sept.....		42.45
Oct.....		40.61
Nov.....		39.77
Dec.....		37.57

Gold and silver received at the San Francisco mint during May amounted to 170,543 and 46,597 fine oz., respectively, with a total value of \$3,565,746. Coinage executed in the period was worth \$2,123,500. Coin, bullion, etc., on hand at the close of business was \$241,278,334.

Coal-mine fatalities in the United States in April totaled 338.

The Stock Markets

SAN FRANCISCO STOCKS AND BONDS

(San Francisco Stock and Bond Exchange.)

June 26.

BONDS

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Associated Oil 5s.....	\$ 97½	98½	Natomas Consol. 6s.....	—	20
Natomas Con.....	27½	30	Pac. Port. Cement 6s.....	100	—
Unlisted.			Santa Cruz Cement 6s.....	85	—
General Petroleum 6s.....	38½	39½	Union Oil.....	86½	87½

STOCKS

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Amalgamated Oil.....	78	—	West Coast. pfd.....	—	112½
Associated Oil.....	38½	39½	Unlisted.		
San Pont. pfd.....	80	84	General Petroleum.....	4	8
Grant.....	78	81	Noble Electric Steel.....	50c	60c
Pac. Ost. Borax, com.....	—	57½	Pac. Port. Cement.....	60	94
Sterling O. & D.....	—	11	Riverside Cement.....	—	63
Union Oil.....	69	—	Santa Cruz Cement.....	40	—
			Stand. Port. Cement.....	—	20

NEVADA STOCKS

(By courtesy of San Francisco Stock Exchange.)

June 25.

Atlanta.....	\$.15	Montana-Tonopah.....	\$.72
Becher.....	.30	Nevada Hills.....	.34
Belmont.....	6.75	North Star.....	.27
Con. Virginia.....	.13	Ophir.....	.15
Florence.....	.42	Pittsburg Silver Peak.....	.27
Goldfield Oro.....	1.37	Round Mountain.....	.35
Goldfield Con.....	.10	Sierra Nevada.....	.09
Hallfax.....	.65	Tonopah Extension.....	2.37
Jim Butler.....	.37	Tonopah Merger.....	.41
Jumbo Extension.....	.21	Tonopah of Nevada.....	6.75
MaeNamara.....	.01	Union.....	.43
Mexican.....	.35	Victor.....	.40
Midway.....	.22	West End.....	.71
Mizpah Extension.....	.24	Yellow Jacket.....	.31

CALIFORNIA STOCKS

(Latest Quotations.)

Bid.	Ask.	Bid.	Ask.
Argonaut.....	\$3.00	Kennedy.....	\$7.50
Brunswick Con.....	1.50	Mountain King.....	0.50
Bunker Hill.....	1.90	South Eureka.....	1.25
Central Eureka.....	0.14		1.50

COPPER SHARES—BOSTON

(By courtesy of J. C. Wilson, Mills Building.)

June 25.

	Bid	Ask		Bid	Ask
Altoque.....	\$ 37	38	Nevada Con.....	\$ 13½	15
Ariz. Commercial.....	4½	4½	North Butte.....	2½	25
Butte & Superior.....	36	36½	Old Dominion.....	44	44½
Calumet & Arizona.....	63½	63½	Oscoda.....	75	76
Calumet & Hecla.....	400	405	Quincy.....	55½	56
Copper Range.....	36	36½	Shannon.....	6	5½
East Butte.....	9½	10	Superior & Boston.....	1½	2
Franklin.....	42	44	Tamarack.....	34½	35
Granby.....	78½	79½	United Verde.....	70	75
Greene Cananea.....	39½	40	U. S. Smelting, com.....	34	34½
Isle Royale.....	19	20	Utah Con.....	1½	1½
Mass Copper.....	4½	4½	Winona.....	2½	2½
Mohawk.....	43½	44	Wolverine.....	39½	40

NEW YORK CURB QUOTATIONS

(By courtesy of E. F. Hutton & Co., Kohl Building.)

June 25.

	Bid.	Ask.		Bid.	Ask.
Braden Copper...	7½	7¾	McKinley-Dar. ...	65c.	70c.
B. C. Copper.....	1½	1¾	Mines Co. Am.....	2½	3
Can. Cop. Mines.....	1¼	1½	Nipissing	6¼	6½
Davis-Daly	¾	¾	Ohio Copper	¾	¾
First National.....	1½	2¼	Stand. Oil of Cal.304		306
Hollinger	18	19	Tri Bullion	1½	1½
Iron Blossom.....	1¼	1½	Tuolumne	1½	1½
Kerr Lake	4½	5½	United Cop. com.	¾	¾
Lt. Rose	1¾	1½	Yukon Gold	2½	2½
Mason Valley	2¾	3			

NEW YORK STOCK EXCHANGE

(By courtesy of J. C. Wilson, Mills Building.)

June 25.

	Bid	Ask		Bid	Ask
Amalgamated.....	\$ 67	67½	Miami.....	\$ 21½	22
Anaconda.....	30½	30½	Nevada Con.....	13½	13½
A. S. & R., com.....	61½	61½	Quicksilver, com.....	1	2
Calif. Pet., com.....	19	19½	Ray Con.....	20½	20½
Chino.....	38½	38½	Tenn. Copper.....	32½	32½
Guggenheim Ex.....	51½	52	U. S. Steel, pfd.....	108½	109
Inspiration.....	16½	17	U. S. Steel, com.....	58½	58½
Mexican Pet., com.....	57½	58	Utah Copper.....	56	56½

Gold Production in New Zealand

During May, the Hauraki peninsula, which contains all of the gold-silver mines of the North Island of the Dominion, produced the following returns:

Mine and District.	Tons.	Value.	Dividend.
Mt. Welcome, Coromandel.....	4	\$ 520	.....
New Waitaia, Coromandel.....	124	6,500	.....
Talisman, Ohinemuri.....	3,950	105,000	.....
Waihi, Ohinemuri.....	14,602	120,000	\$115,000
Waihi Grand Junction, Ohinemuri.....	8,610	88,000	.....
Waihi-Paeroa, Ohinemuri.....	12,400	19,500	.....
New Sylvia Thames.....	860	4,900	.....
Occidental, Thames.....	0.05	1,400	.....
Watchman, Thames.....	868	4,400	.....

The Waihi-Paeroa tonnage represents tailing recovered from the Ohinemuri river. During 1913 the Waihi company treated 184,768 tons of ore, yielding gold and silver bullion worth \$1,530,000, of which \$670,000 was profit and \$476,070 was paid in dividends. Ore reserves total 764,732 tons. The Waihi Grand Junction treated 98,383 tons in 1913, yielding \$870,000. The profit was \$190,000, and \$92,000 was paid in dividends. Gas is still troublesome in the main cross-cut, at 1000 ft., which is to drain and prospect the deeper areas of the Thames field.

GOLD PRODUCTION of the Kolar, India, group of mines in May was as follows:

Mine.	Tons.	Ounces.
Balaghat.....	3,200	1,412
Champion Reef.....	18,031	11,444
Mysore.....	25,155	19,540
Nundydroog.....	7,500	6,638
Ooregum.....	12,914	7,606

OPERATIONS of the Lenskoie mine, controlled by the Lena Goldfields company, Siberia, from October 1, 1913, to April 30, 1914, were as follows: Men employed, 7574; gravel mined, 487,161 cu. yd.; gravel washed, 71,274 cu. yd.; and average gold content, \$6.90 per yard. The washing season is now in full swing.

MANGANESE-ORE PRODUCTION of the Caucasus districts of Russia in 1913 totaled 1,051,559 tons. Imports into America and Europe from all sources were 2,172,684 tons.

METAL PRODUCTION of the Aramayo Francke mines, Bolivia in May was as follows: tin, 290 tons; copper matte, 5 tons; and silver ore, 58 tons.

GOLD PRODUCTION of the Mt. Boppy mine, New South Wales, in May was valued at \$48,000, from the treatment of 6069 tons of ore.

COAL OUTPUT of the Chinese Engineering & Mining Co. during the last week of May was 39,000 tons. Sales totaled 43,000 tons.

GOLD OUTPUT of the Kolar goldfield, and two outside mines in India, was 49,495 oz. in May, against 48,860 oz. in May of 1913.

GOLD OUTPUT of the St. John del Rey mine, Brazil, in May was \$177,600, from 16,000 tons of ore.

Company Reports

INDIANA MINING COMPANY

This is a Lake copper company in which the United States Smelting Refining & Mining Co. has a substantial interest. The shaft has been sunk to a depth of 1415 ft., and prospecting is in progress. The following are details of cost: Shaft-sinking, mining 211 ft., \$4454; timbering, \$3560; and power, \$2792, a total of \$10,806, less \$206 for machinery sold, equals \$10,600 or \$50.24 per foot. Cutting station at 1400 ft., \$432; driving and cross-cutting 270 ft. at \$17.52 per foot, \$4737; and diamond-drilling, \$4190. The shaft is cylindrical, 17 ft. outer diameter, 8 by 12 ft. inner, lined with steel concrete.

FRANKLIN MINING COMPANY

This is a Lake copper company in which the United States Smelting, Refining & Mining Co. has a substantial interest. About 1,000,000 lb. copper was produced in 1913, chiefly from prospecting work, which amounted to 2000 ft. during 1913 up to July, when work was stopped by the strike. The following statement of costs and expenditures during 1913 is of interest: Mining expense—Sinking 117 ft. at \$10.057 per foot, \$1177; raising 397 ft. at \$5.86 per foot, \$2327; driving 1299 ft. at \$5.181 per foot, \$6730; cross-cutting 134 ft. at \$4.903 per foot, \$657; stoping 8897.9 fathoms at \$6.1516 per fathom, \$57,985; compressor and drills, \$20,076; and labor and other expenses, \$41,779; also hoisting expense, 127,033 tons, \$18,645; rock-house expense, \$3128; transportation, \$12,806; surface and incidental expense, \$15,520; stamp-mill expense, \$38,648; prospecting, \$4384; and taxes for 1913, \$11,202; a total of \$235,064.

RHODESIA GOLD MINING & INVESTMENT CO., LTD.

The capital of this Company is £300,000 in £1 shares, and it has share interests in the following Rhodesian companies: Lonely Reef Gold Mining Co., 34,296 out of 271,007 £1 shares; Sabi Gold Mining Co., 49,896 out of 50,000 £1 shares; Cam & Motor Gold Mining Co., 43,000 out of 517,500 £1 shares; Hay Gold Mining Co., 13,471 out of 140,700 £1 shares; United Rhodesia Goldfields, 4500 7s. 6d. shares; and Rhodesia Native Labor Bureau, £500 5% debentures. The shares costing £99,177 had a market value of £135,210 at the end of 1913. The Company also has mining interests in the Bernheim mines, Pretty Polly mine, and Felixburg claims.

Ore reserves in the Lonely Reef mine are 172,557 tons assaying \$17.14 per ton. The mill in 1913 treated 58,903 tons yielding £218,520, of which £126,392 was profit. A dividend of 30% was paid. Francis Drake is general manager of this property. The Cam & Motor mill started work in January, 1914, and alterations have since been made to permit of the estimated capacity being attained. Ore reserves are estimated at 1,016,240 tons worth £2,262,150. Reserves in the Bernheim mines are 25,000 tons of \$8.75 ore. A separate company was formed to work the Sabi mine, and development in the Bernheim group is sufficiently advanced for a similar proceeding. Ore developed in the Sabi property amounts to 49,000 tons of \$10.36, and 3300 tons of \$8.85 ore. A few thousand tons of ore has been opened in the Felixburg claims. At the Pretty Polly, 1292 tons was milled and some sand treated, the total averaging 34.82s. per ton.

The year's profit was £6954, and £25,173 was brought forward from 1912. Receipts totaled £11,239.

PACIFIC GAS & ELECTRIC COMPANY

This is primarily an industrial concern operating in California, and is one of the four or five largest similar corporations in the United States, and the significance of its report to readers of a mining journal is on account of the im-

portance of the Company as a supplier of electric power, also water, for mines, mills, and dredges in many counties. This power is supplied at about an average of 1 cent per kilowatt-hour. Out of a total revenue from sales of electricity during the past year, amounting to \$8,230,782, the mining industry contributed \$557,462, or about 7%. The Company's operations may be summarized as follows.

Number of consumers of gas, electricity, water, and steam	349,417
Gas sold, cubic feet	7,430,000,000
Revenue from gas	\$6,547,595
Capacity of all electric generating plants, water and steam, horse-power	290,928
Revenue from electricity	\$8,230,782
Water pumped, gallons	1,510,417,976
Revenue from water, etc.	\$ 851,047
Revenue from Sacramento street railway	572,913
Total revenue for 1913 (\$14,744,651 in 1912)	16,202,337
Maintenance, operation, distribution, and administration expenses	9,331,207
Interest on notes, debt, bonds, etc.	4,148,086
Net income	2,723,044
Dividends on preferred (6%) and common (11 1/2%) stock	998,848
Salaries and wages paid	\$6,955,817
Employees	6,778

GOLDEN HORSE-SHOE ESTATES COMPANY, LTD.

Financial results of this Kalgoorlie company were discussed in the 'Special Correspondence' pages of this journal of June 20. During 1913 the mills, sand, slime, and concentrate plants crushed 280,512 long tons of ore at a cost of \$1.17 per ton; leached 91,935 tons of sand at a cost of 70c. per ton; filter-pressed 165,591 tons of slime at a cost of \$1.49 per ton, in-



TWO 500-KW. A. E. G. TURBO-GENERATORS AT THE HORSE-SHOE. LOW-PRESSURE CYLINDER OF INGERSOLL-RAND COMPRESSOR SHOWING ON UPPER LEFT.

cluding settling, agitating, cyaniding, and filtering; and roasted and cyanided 22,986 tons of concentrate at a cost of \$2.75 per ton. There was also treated 16,930 tons of old residue yielding 2259 oz. fine gold. The total yield was 97,423 oz. gold, the recovery being 83.2%, and total cost \$5.40 per ton. The total revenue in 1913 was £415,571, out of which there was a net balance of £42,698. From 1912 the sum of £35,603 was brought forward, making a total of £78,300. Debenture interest absorbed £12,500, and dividend No. 36, £60,000, leaving £5800 for the current year. The plant, which cost £571,829, stands in the Company's books at £45,000. Stores worth £22,745 are on hand at the mine.

In his report the general manager, J. W. Sutherland, states that development totaled 9485 ft., including 634 ft. of shaft:

sinking, at a cost of \$22.65 per foot. Of this, 3308 ft. was in barren rock, the balance in ore. The total to date is 137,104 ft., including 3961 ft. of diamond-drilling. Development in this mine has attracted considerable attention of recent years, especially on No. 4 lode, near the Great Boulder boundary. A geological report was made by C. O. G. Larcombe, of the local school of mines. The main shaft was sunk to 2836 ft., and No. 2 to 1879 ft. Both shafts are still being deepened. No. 2 lode produced 121,076 tons of \$8.17 ore, and continues to open well south on the lower levels. No. 3 lode yielded 150,897 tons of \$8.19 ore, and is also showing well at the south. A fault disturbed it at 2630 ft. No. 4 lode produced 8539 tons of \$19.43 ore. This lode came into Horse-Shoe ground from the Great Boulder at about 2550 ft. depth, and is still dipping farther in. It was cut by the east cross-cut from the main shaft at 2780 ft. On this level a new shoot of ore was opened, being 4 ft. wide, worth \$10 per ton. Ore reserves are estimated as 715,496 tons averaging \$8.15 per ton.

The output of this great mine to date is 2,992,615 long tons, yielding 2,128,210 oz. fine gold, and £3,135,000 in dividends.

SEOUL MINING COMPANY

Monthly yields of this Company, operating in Whang Hai province, Korea, are published regularly in this journal, and the report under review covers the year ended December 31, 1913.

The general manager, A. H. Collbran, reported as follows: Development in the Suan mine totaled 5505 ft., making 28,563 ft. to date. Most of the stoping was done by machines, a larger compressor having been installed. Ore reserves in the three ore-bodies, and including broken ore in stopes, amount to 315,538 tons averaging gold, \$9.08; copper, 1.04%; and bismuth, 1.7 lb. per ton, an average gross value of \$13.22 per ton. In the Tul Mi Chung mine, of which E. W. Mills is superintendent, the sum of \$129,191 has been spent in development to date. In 1913, work amounted to 7179 ft., and 10,214 ft. to date. Ore reserves total 276,880 tons averaging gold, \$6.08; silver, 0.8 oz.; and copper, 1.37%, worth \$10.63 per ton. A complete sorting system was started on July 1, and to the end of the year 1480 tons of waste was discarded at a cost of 3.8c. per ton. The gold content of the ore was thereby increased by 34c. per ton.

Owing to a shortage of water the 40-stamp mill worked 327.6 days, and crushed 71,535 tons of ore, an average of 5.46 tons per stamp day. The ore averaged \$9.51 gold and 1.019% copper, also some bismuth. Gold recovered by amalgamation was 76.79%. Concentrate production was as follows:

	Regular.	Canvas.	Black.
Tons	555	65	149
Gold, per ton	\$68.75	\$111.99	\$140.09
Copper, per cent	18.34	16.36	24.31
Bismuth, per cent	1.71	3.72	3.36

The total gold recovery was 86.54%, and copper 20.50%. Value of all products extracted was \$671,537. Operating costs were \$4.13, and profits \$5.26 per ton. Dividends equal to 50% on the capital of \$500,000 were paid. The sum of \$55,411 was carried forward to 1914.

Tests were made on ore from the Tul Mi Chung mine by W. G. Perkins, and 90% extraction can be made by crushing, amalgamation and concentration of the gold-silver-copper ore. A mill with an initial capacity of 300 tons per day is to be erected. On account of the diminishing supply and increasing cost of firewood, an electric power-plant of two 1000-kw. steam turbo-generators is being constructed at Pyeng Yang, 47 miles from Holkol and Tul Mi Chung. H. Maki is engineer of this department, and he hopes to finish the plant by September, 1914. Motors are to be installed in the Soctaire mill.

The general report contains a good deal of interesting information on prospecting other areas, roads, telephones, rainfall (23.35 in.), hospital treatment, and new equipment. There were 5486 natives employed by the Company.

CALUMET & HECLA MINING COMPANY

Like all the other Michigan copper companies in 1913, this one suffered considerably through the miners' strike which started last July. Results of the past three years show the decreased output and profits, as follows:

Development on—	1913.	1912.	1911.
Conglomerate lode, ft..	6,101	11,185	9,360
Osceola lode, ft.....	7,533	18,504	19,889
Kearsarge lode, ft.....	428	2,140	2,008
'Rock' stamped from all			
lodes, tons	2,035,625	2,806,610	2,909,972
Old tailing treated, tons..	388,164	481,320	477,794
Refined copper from all			
sources, lb.	45,016,890	67,856,429	74,130,077
Copper per ton of rock, lb.	22.11	24.18	25.47
Copper per ton of tailing			
treated, lb.	11.92	12.86	12.66
Price received for copper,			
cents per pound.....	15.77	16.65	12.82
Total cost, cents per pound	14.25	9.86	8.52
Dividends from subsidiary			
companies	\$ 915,439	\$ 892,775	\$ 295,225
Dividends paid in 1913...	3,200,000	4,200,000	2,400,000
Dividends paid to date...	.....	\$123,250,000	.....
Cash at mine, New York,			
and Boston at end of re-			
spective years	\$ 3,840,162	\$ 6,818,093	\$ 7,245,437
Supplies on hand.....	1,772,324	1,329,810	1,189,690
Sinking fund	446,466	1,166,999	1,446,116
Total assets	7,280,229	11,560,426	11,720,449
Total liabilities	726,265	844,012	457,342
Profit and loss surplus...	6,553,964	10,716,414	11,263,107

The Company holds a large interest, controlling in some, in the following companies: Ahmeek, Allouez, Centennial, Cliff, Gratiot, Isle Royale, La Salle, Laurium, Jaceola, Seneca, Superior, Tamarack, and White Pine.

In the Conglomerate lode 20 drills are at work removing shaft pillars and cleaning-up arches and backs of old stopes.



LINE OF SHAFTS AT HOUGHTON, MICHIGAN.

A special one-man drill has been devised to meet conditions of working this lode, and it is gradually being introduced.

At the new regrinding mill, half of the machinery is erected, and the dredge to recover old tailing from Torch lake should be finished this summer. With a daily capacity of 3000 tons, and recovery of 5 lb. of copper per ton at a cost of 6c. per ton, the profit in 30 years will be \$10,000,000. With leaching applied to most of the residue from this plant, another \$10,000,000 profit will be made. It will also be applicable to conglomerate rock unmined, and Tamarack sand, and White Pine rock. A second mechanical furnace is finished at the smelter, and part of the new electrolytic refining plant is in commission. Expenditure of the aid fund last year was \$51,592.

Recent Publications

ANALES DE LA DIRECCION FOMENTO, 1913. No. 1 to 6. Monthly Journals of about 90 pages. Lima, Peru.

ROCKY MOUNTAIN MINE TIMBERS. By Norman de W. Better. Professional paper from the Forest Service, Bulletin 77. P. 34. Illustrated. U. S. Department of Agriculture, Washington, 1914. This is an interesting discussion for mining men.

GOVERNMENT OWNERSHIP OF RAILWAYS. List of publications pertaining to Bulletin 62. P. 74. Index of authors. Bureau of Railway Economics, Washington, 1914. The live discussion of this subject of late makes this list of abstracts of publications especially timely.

TESTS OF BOND BETWEEN CONCRETE AND STEEL. By Duff A. Abrams. Bulletin 71. P. 228. Illustrated. University of Illinois Engineering Experiment Station, Urbana, 1914. In these days of the great use of reinforced concrete structures, this publication is of special value to constructing engineers.

THE COMMERCIAL ASPECT OF ELECTRIC ZINC-LEAD SMELTING. By Woolsey McAlpine Johnson. Paper presented at annual meeting of the Canadian Mining Institute, Montreal, May 4-6, 1914. P. 21. Increasing attention is being directed to this form of reduction of zinc-lead ores, which has been described in this journal recently.

TWELFTH ANNUAL REPORT OF THE BUREAU OF SCIENCE, Philippine Islands. By Alvin J. Cox. P. 131. Ill., index. Manila, 1913. The Bureau of Science conducts investigations into a great variety of subjects, coming under its jurisdiction in this tropical area, such as pneumonic plague, cholera, tobacco beetles, silk culture, stone industry, plant life, hat making, fruit, coconuts, sugar growing, portland cement, pottery, brick, coal, oil prospecting, mineral veins of the Baguio district, and gold nuggets from the Paracale placer deposit.

COAL IN ALASKA. Report on its possible use in United States Navy. A letter from the Secretary of the Navy dealing with surveys, and experimental tests on the coal on warships. P. 123. Maps and 12 plates. Washington, 1914. The conclusion is arrived at, that the failure on test of the excellent Bering River sample at the Engineering Experiment Station from severe and unusual clinking, a sample better in all respects than the Pocahontas used in comparative test, obliges the department to regard and so report the Bering River field to be unavailable as a source of coal for the Navy, until extensive general development definitely locates coal not possessing the serious objection found in the sample tested by the department.

United States Geological Survey publications, Washington, 1914:

Advance chapters from 'Mineral Resources of the United States, 1913':

PRODUCTION OF MINERAL PAINTS. By James M. Hill. P. 24.

PRODUCTION OF SLATE. By A. T. Coons. P. 16.

SULPHUR, PYRITE, AND SULPHURIC ACID. By W. C. Phalen. P. 29.

RESULTS OF TRIANGULATION AND PRIMARY TRAVERSE IN OHIO, 1898 to 1911 inclusive. R. B. Marshall, chief geographer. Bulletin 552. P. 232. Map.

EROSION AND SEDIMENTATION IN CHESAPEAKE BAY AROUND THE MOUTH OF CHOPTANK RIVER. By J. Fred Hunter. Professional paper 90-B, shorter contributions to *General Geology*, 1914-B. P. 15. Maps.

Recent Patents

1,097,708—Machine for washing precipitates. Harry E. Elton, Mountaintown, Pennsylvania.

A filter tunnel holding stand, means for rotating the stand, and means for supplying a wash liquid to a filter supported in the stand.

1,098,443—Process for separating copper from nickel and cobalt. Victor Hybinette, Fredericktown, Missouri.

The process of separating copper from nickel and cobalt in sulphide ores and products from concentration, consisting in roasting the material, thereafter subjecting it to magnetic separation, making concentrate; when necessary partly removing the sulphur from the concentrate by roasting said matte, leaching said roasted matte with diluted sulphuric acid, thereby obtaining a solution containing principally copper.

1,098,611—Device for treating smelter fume. Olof V. Blom, Fresno, California.

A conduit for use in treating smelter fume, the same comprising an inclined conduit arranged in steps, a receptacle opening into said conduit just below the junction of adjacent steps and disposed at substantially right angles to said conduit, whereby the bottom of each receptacle inclines toward its lower corner, a door in the lower corner of each receptacle, another receptacle disposed below each of said first-named receptacles, and a pipe leading from the upper side of one end of each of said first-named receptacles to the corresponding receptacle below the same, as described.

1,097,113—Concentrator. Arthur L. Wilfley, Denver, Colorado.

The combination of a tiltable concentrating table closed at its rear side and open at its opposite side for discharge purposes and means for automatically tilting the table for two positions of successively greater inclination in a forward direction for the purpose of discharging the gangue and concentrate, respectively, and in the order named, and then reversing the table's movement, and finally tilting it rearwardly to permit the accumulation thereon of a charge of pulp and means for supplying pulp to the table during the period of rearward inclination, substantially as described.

1,097,139—Concentrator. John Malcolm Nicol, Mill Valley, California.

An apparatus for separating materials of different specific gravity, comprising a substantially smooth flat belt transversely inclined and having longitudinal riffles, each of said riffles having a flat smooth plane inclined side joining the substantially flat plane of the belt at an obtuse angle and adapted to serve as a dam at the feed portion, and means beyond the feed portion and toward the concentrate discharge end for gradually reducing the inclination of said riffle planes to a horizontal in advance of the concentrate discharge end.

1,097,592—Sintering machines. Eugene Hiram Laws, Salida, Colorado, assignor to the Ohio & Colorado Smelting & Refining Co., Denver, Colorado, a corporation of Colorado.

The combination with a traveling grate made up of articulated ore-bearing pallets having air passages therethrough and provided with rollers on both sides, and a suction box having its mouth opening up to the pallets and terminating in dead plates at both ends, of vertically adjustable means for supporting the pallets on their rollers with their bottoms in close proximity to but out of wearing engagement with the edges of the suction box and with the dead plates during their passage thereover, substantially as described.

Industrial Progress

The CHICAGO PNEUMATIC TOOL Co. has issued Bulletin 185, illustrating the varied uses of the portable gasoline-driven compressor manufactured by that firm.

THE LUNKENHEIMER Co. is distributing an attractive little booklet descriptive of the 'Renewo' valve made by that firm. In this valve all parts are renewable, particularly the seat and disc.

AMERICAN CONCENTRATOR Co., of Springfield, Ohio, in 'Bulletin No. 2' describes the equipment of its coal and ore testing laboratory. Special attention is given the testing of iron ores and design of concentration plants.

SULLIVAN MACHINERY Co. announces appointment of J. C. West as general sales engineer, with headquarters at Chicago. Mr. West will be succeeded at San Francisco by Ray P. McGrath, heretofore stationed at Boston.

THE DENVER QUARTZ MILL & CRUSHER Co. published recently a leaflet contrasting by means of pictures the first mill built by the Company in 1908 with the 100-ton mills now being built. The 1908 mill had seven 300-lb. rolls and a total weight of 4500 lb. The modern mill has four 3200-lb. rolls and a total weight of 32,000 pounds.

THE JOSHUA HENDY IRON WORKS' Bulletin 124 is descriptive of the Hendy quartz stamp mills, with single and triple discharge mortars. Over 1000 of these unit mills have been sold since 1895. The small size and large capacity suits them especially to pioneer conditions, and from Nome to South America they are found on the skirmish line.

H. S. RENSHAW Co., Ltd., 207-208 Metropolitan Bank Bldg., New Orleans, Louisiana, asks us to say that owing to accidental destruction of current files, the sending of complete catalogs by manufacturers of mining machinery and supply houses will be appreciated. This firm is purchasing agency for the Canadian Agency, Ltd., and other large operators in Latin America.

The Duluth office of the H. W. Johns-Manville Co. has moved to larger quarters at No. 327 West First street, in order to take care of its increased business. The new office is on the ground floor, with windows for the display of J-M asbestos roofing, pipe coverings, packings, sanitary specialties, auto accessories and other products of this Company's well known and varied lines.

H. N. ELMER, North American agent for Siebe, Gorman & Co., Ltd., announces that the MINE SAFETY APPLIANCE Co., of Pittsburgh, has been appointed agents for 'Proto' mine-rescue apparatus in Eastern territory. The MINE SAFETY APPLIANCE Co. is a new concern formed by G. H. Deike and J. T. Ryan, engineers, who have resigned from service with the U. S. Bureau of Mines to enter commercial life.

A number of the employees of the WESTINGHOUSE ELECTRIC & MANUFACTURING Co. and the WESTINGHOUSE MACHINE Co. went on a strike during the first week of June, because the management refused to recognize the demands of the newly formed labor union, the Allegheny Congenial Industrial Union, and as a result the works of these Companies at East Pittsburgh are partly shut down. The management of the Company does not believe that the trouble will be of long duration.

THE LUFKIN RULE Co. announces the issuing of a new catalog, No. 9. Its 110 pages are devoted exclusively to measuring tapes and rules, and it is unusually complete. Special attention is invited to the fact that in addition to measuring tapes and steel rules, within lines the Company has manufactured for the last 25 years it now has ready for the market

a complete line of folding boxwood and flexible spring joint wood rules. Requests for copies of the new catalog will receive prompt attention.

THE TRAYLOR ENGINEERING & MANUFACTURING Co. announces that arrangements have been completed with Charles A. Jacobson for the manufacture and sale of the 'Jacobson' gas-engines. Mr. Jacobson was the pioneer in the introduction of large gas-engines in the United States and has plants in operation in every part of the country. The 'Jacobson' gas-engine is of the scavenging type, and can be used on natural, producer, and illuminating gases of all kinds and characters. The starting device is the 'Jacobson' air starter. The engines are built in all sizes with single and multiple cylinders and particularly adapted for direct connecting to alternators running in parallel.

MESTA MACHINE Co., of Pittsburgh, Pennsylvania, has for distribution Bulletin N, which is descriptive of the air-compressors and vacuum pumps manufactured by this Company. A distinguishing feature of the Mesta compressor is the automatic plate valve, which it is claimed, makes possible the economic use of much higher piston or rotative speed, which speed is limited only by the speed of the driving engine, or by general wear and tear on the compressor, if the latter be driven by electric power. Some of the advantages claimed for this type of valve, which is known as the Iversen patent, are the simplicity of the air end, high volumetric and mechanical efficiency, lack of wear on valve and seats, no lubrication of valves required, noiseless at high speed, and no adjustment valves necessary.

THE BUSCH-SUTZER BROS.-DIESEL ENGINE Co. has closed a contract with the Lake Torpedo Boat Co. for six 600-hp., reversible, ten-cycle, marine Diesel engines to be placed on three new twin-screw submarine torpedo-boats for the U. S. government. These engines, which are being built at St. Louis, will be similar to two sold to the Lake company some time ago for the same purpose. The control is so arranged that a single operator has complete control over both engines. Each is provided with two separate scavenging pumps arranged in line with the working cylinders, also two 3-stage injection air-pumps; all are operated from the crank-shaft, and each engine has its own water and oil circulating pumps. Excepting air-storage bottles, these engines are complete units with all parts integral. These marine engines are totally different, in every way, from the non-reversible 2 and 4-cycle massive engines which the Company is building for stationary purposes, or from the light-weight marine type Diesel-generator sets supplied to the Argentine for the first-class warships *Rivadavia* and *Moreno* which were recently completed in this country.

THE INGERSOLL-RAND Co. has ready for distribution a limited number of books, 'Photographs in Color of the Panama Canal.' This book illustrates the dams and locks in natural color, and in addition is supplemented with a very concise article on 'What the Canal Will Accomplish' by Emory R. Johnson. Copy will be sent free on request. 'Form 4020,' also issued by the Ingersoll-Rand Co., is a 32-page catalog on Leyner-Ingersoll water drills. Among the several unique features of construction may be mentioned the 'Hand Hammer Blow,' the 'Water Feature,' the 'Oiling System,' the 'Butterfly Valve,' 'Sergeant Rotation,' 'Irco Metal,' etc. 'Little David Riveting Hammers,' Form 8011; and 'Rivet Set Retainer for Little David Hammers,' Form 8011-1, are the subjects of two other bulletins just issued. All those interested in 'safety first' as applied to the operation of pneumatic riveting hammers will be interested in these booklets. All 'Little David' riveting hammers can be furnished with a rivet set retainer, which meets the requirements of the safety laws being drafted by the various states. These bulletins are illustrated to show application of the tools, and also give sectional views to show the details.



